EPA United States Environmental Protection Agency

Energy and Environment Guide to Action

State Policies and Best Practices for Advancing Energy Efficiency, Renewable Energy, and Combined Heat and Power

2015 Edition

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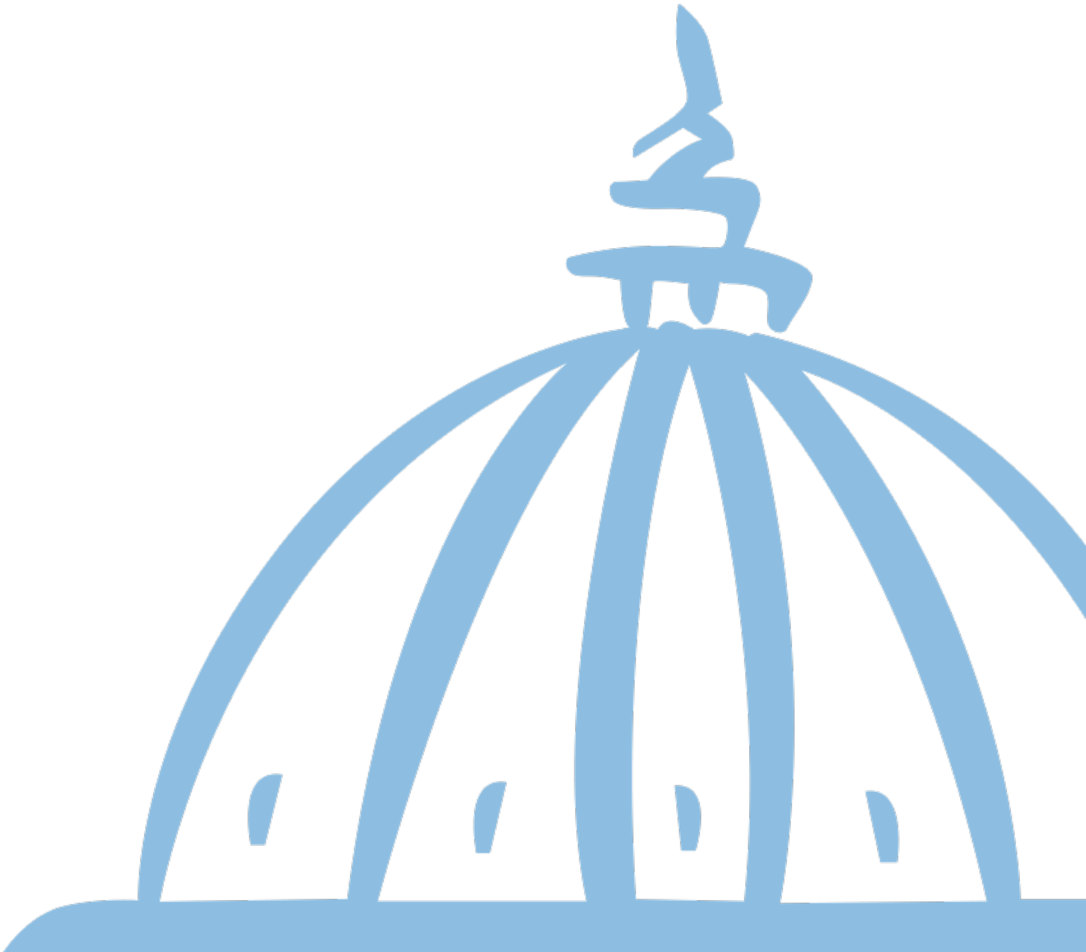

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Preface

EPA's State Climate and Energy Program is pleased to release the 2015 *Energy and Environment Guide to Action: State Policies and Best Practices for Advancing Energy Efficiency, Renewable Energy, and Combined Heat and Power*. The *Guide to Action*, which EPA first released in 2006, is a cornerstone resource of EPA's State Climate and Energy Program, a voluntary program that helps states develop policies and programs that can reduce greenhouse gas emissions, lower energy costs, improve air quality and public health, and achieve economic development goals. The *Guide to Action* provides in-depth information about over a dozen policies and programs that states are using to meet their energy, environmental, and economic objectives with energy efficiency, renewable energy, and combined heat and power. Each policy description is based on states' experiences in designing and implementing policies, as documented in existing literature and shared through peer-exchange opportunities provided to states by EPA's State Climate and Energy Program.

The *Guide to Action* is intended for use by state energy, environment, and economic policy-makers and regulators. States are encouraged to use the *Guide to Action* to help design and implement energy efficiency, renewable energy, and combined heat and power, which may help meet the state's own energy, environment, and economic policy objectives. Any comments, questions, and corrections related to the *Energy and Environment Guide to Action* and EPA's State Climate and Energy Program can be directed to the contacts provided on page ES-17.

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Chapter 7. Electric Utility Policies

Key Acronyms and Abbreviations

A

AC	alternating current
ACC	Arizona Corporation Commission
ACEEE	American Council for an Energy-Efficient Economy
ADAGE	Applied Dynamic Analysis of the Global Economy
AEPS	alternative energy portfolio standard
AERLP	Alternate Energy Revolving Loan Program
AESP	Association of Energy Service Professionals
AMI	advanced metering infrastructure
APPA	American Public Power Association
APSC	Arkansas Public Service Commission
ARRA	American Recovery and Reinvestment Act
ASAP	Appliance Standards Awareness Project
AVERT	AVoided Emissions and geneRation Tool

B

BCAP	Building Codes Assistance Project
BPA	Bonneville Power Administration
BTO	Building Technologies Office
Btu	British thermal units

C

CAEATFA	California Alternative Energy and Advanced Transportation Financing Authority
CALMAC	California Measurement Advisory Council
CARB	California Air Resources Board
CCEF	Connecticut Clean Energy Fund
CEC	California Energy Commission
CEE	Consortium for Energy Efficiency
CEFIA	Clean Energy Finance and Investment Authority (Connecticut)
CEO	Colorado Energy Office
CES	clean energy standard
CGB	Connecticut Green Bank
CHP	combined heat and power
CHP TAP	Combined Heat and Power Technical Assistance Partnership
CHPA	Combined Heat and Power Association
CHPP	Combined Heat and Power Partnership
CL&P	Connecticut Light & Power
CO_2	carbon dioxide
COBRA	Co-Benefits Risk Assessment
ComEd	Commonwealth Edison Company
Con Edison	Consolidated Edison Company
C-PACE	Commercial Property Assessed Clean Energy (Connecticut)
CPCN	Certificate of Public Convenience and Necessity
CPUC	California Public Utilities Commission
CSC	Climate Showcase Communities
CT DEEP	Connecticut Department of Energy and Environmental Protection
CVR	conservation voltage reduction

D

DC	direct current
DCEO	Department of Commerce and Economic Opportunity (Illinois)
dCHPP	CHP Policies and Incentives Database
DEED	Demonstration of Energy and Efficiency Developments
DG	distributed generation

DGA	Department of General Administration (Washington)
DGS	Department of General Services (Maryland)
DOE	U.S. Department of Energy
DOER	Department of Energy Resources (Massachusetts)
DPU	Department of Public Utilities (Massachusetts)
DSIRE	Database of State Incentives for Renewables and Efficiency
DSM	demand-side management
DWR	Department of Water Resources

E

ECPA	Energy Conservation and Production Act
EDA	Economic Development Administration
EEAC	Energy Efficiency Advisory Council (Massachusetts)
EEI	Edison Electric Institute
EEM	energy-efficient mortgage
EEPS	Energy Efficiency Program Sponsors
EERS	energy efficiency resource standard
EEU	energy efficiency utility
eGRID	Emissions and Generation Resource Integrated Database
EGU	electric generating unit
EIA	U.S. Energy Information Administration
EIM	energy improvement mortgage
EISA	Energy Independence and Security Act
EISPC	Eastern Interconnection States' Planning Council
EM&V	evaluation, measurement, and verification
EMP	Energy Master Plan
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act
EPC	energy performance contracting
ERAM	Electric Rate Adjustment Mechanism
ERB	Energy Resilience Bank (New Jersey)
ESC	Energy Services Coalition
ESCO	energy service company
ESP	electric service provider
ESPC	energy savings performance contract

F

FCE	fuel conversion efficiency
FCM	forward capacity market
FEMP	Federal Energy Management Program
FERC	Federal Energy Regulatory Commission
FIT	feed-in tariff

G

GEMS	Green Energy Market Securitization program (Hawaii)
GHG	greenhouse gas
GW	gigawatt
GWh	gigawatt-hour

H

HCRC	Hawaii Community Reinvestment Corporation
HECO	Hawaiian Electric Company
HERO	Home Energy Renovation Opportunity (California)
HERS	Home Energy Rating System
HUD	U.S. Department of Housing and Urban Development
HVAC	heating, ventilating, and air conditioning

I

ICC	Interstate Commerce Clause
ICC	International Code Council

ICC	Illinois Commerce Commission
ICE	internal combustion engine
IEA	International Energy Agency
IECC	International Energy Conservation Code
IEEE	Institute of Electrical and Electronic Engineers
IEI	Edison Foundation Institute for Electric Innovation
IEPEC	International Energy Program Evaluation Conference
IGCC	integrated gasification combined cycle
IMPEAQ	Integrated, Multi-pollutant Planning for Energy and Air Quality
IMT	Institute for Market Transformation
IOU	investor-owned utility
IPMVP	International Performance Measurement and Verification Protocol
IREC	Interstate Renewable Energy Council
IRP	integrated resource plan/planning
ISO	independent system operator
ISO-NE	Independent System Operator New England
ITC	investment tax credit

J

JEDI	Jobs and Economic Development Impact

K

kW	kilowatt
kWh	kilowatt-hour

L

LDC	load distribution company
LEED	Leadership in Energy and Environmental Design
LIEF	Long-Term Industrial Energy Forecasting
LIHEAP	Low-Income Home Energy Assistance Program
LoanSTAR	Saving Taxes and Resources
LRAM	lost revenue adjustment mechanism
LTPP	long-term procurement planning

M

M&V	measurement and verification
MACRS	Modified Accelerated Cost Recovery System
MADRI	Mid-Atlantic Distributed Resources Initiative
MEEA	Midwest Energy Efficiency Alliance
MEEIA	Missouri Energy Efficiency Investment Act
MISO	Midcontinent Independent System Operator
MPSC	Missouri Public Service Commission
MSW	municipal solid waste
MW	megawatt
MWh	megawatt-hour

N

NAECA	National Appliance Energy Conservation Act
NAESCO	National Association of Energy Service Companies
NASEO	National Association of State Energy Officials
NBI	New Buildings Institute
NEEA	Northwest Energy Efficiency Alliance
NEEP	Northeast Energy Efficiency Partnerships
NEG	net excess generation
NEPOOL	New England Power Pool
NERC	North American Electric Reliability Council

NFPA	National Fire Protection Association
NGA	National Governors Association
NGO	nongovernmental organization
NJBPU	New Jersey Board of Public Utilities
NJCEP	New Jersey's Clean Energy Program
NO_x	nitrogen oxides
NRDC	Natural Resources Defense Council
NREL	National Renewable Energy Laboratory
NWPCC	Northwest Power and Conservation Council
NYSERDA	New York State Energy Research and Development Authority

O

OBF	on-bill financing
OBR	on-bill repayment
OBR	output-based regulations

P

PACE	property assessed clean energy
PBF	public benefits fund
PBR	performance-based ratemaking
RI GHG	Rhode Island Greenhouse Gas Process
PG&E	Pacific Gas and Electric
PGE	Portland General Electric
PMA	Power Marketing Administration
PPA	power purchase agreement
PSB	Public Service Board
PSC	Public Service Commission
PTC	production tax credit
PUC	public utility commission
PUCN	Public Utilities Commission of Nevada
PURPA	Public Utility Regulatory Policies Act
PV	photovoltaic
PVE	Petroleum Violation Escrow

Q

QECB	Qualified Energy Conservation Bond

R

RAP	Regulatory Assistance Project
REAL	Regional Economics Applications Laboratory
REAP	Rural Energy for America Program
REC	renewable energy certificate
REED	Regional Energy Efficiency Database
REEO	Regional Energy Efficiency Organization
RES	renewable energy standard
RESNET	Residential Energy Services Network
REV	Reforming the Energy Vision
RGGI	Regional Greenhouse Gas Initiative
RIM	Ratepayer Impact Measure
RIMS II	Regional Input-Output Modeling System
RPS	renewable portfolio standard
RTO	regional transmission organization
RTP	real-time pricing

S

SAM	System Advisor Model
SBC	system benefits charge
SCT	Societal Cost Test
SECO	State Energy Conservation Office (Texas)
SEE Action	State and Local Energy Efficiency Action Network
SEP	supplemental environmental project
SFV	straight fixed variable
SGIA	Small Generator Interconnection Agreement
SGIG	Smart Grid Investment Grants
SGIP	Small Generator Interconnection Procedures

SIP	State Implementation Plan
SIR	Standard Interconnection Requirements (New York)
SIT	State Inventory Tool
SOS	Standard Offer Service
SPEER	South-central Partnership for Energy Efficiency as a Resource
SREC	solar renewable energy certificate
SWEEP	Southwest Energy Efficiency Project

T

Tbtu	trillion British thermal units
TEP	Tucson Electric Power Company
TERP	Texas Emissions Reduction Plan
TIF	tax increment financing
TOU	time-of-use
TRC	Total Resource Cost
TRM	technical reference manual
TVA	Tennessee Valley Authority
TWh	terawatt-hour

U

UCSD	University of California, San Diego
UCT	utility cost test
UL	Underwriters Laboratories
UMP	Uniform Methods Project
USDA	U.S. Department of Agriculture
USGBC	U.S. Green Building Council

V

VOST	value-of-solar tariff

W

WGA	Western Governors Association
WHP	waste heat to power

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Executive Summary

Introduction and Background

In 2006, the U.S. Environmental Protection Agency (EPA) issued the *Clean Energy-Environment Guide to Action* to help state policy-makers learn about what other states were doing to bring clean, cost-effective, reliable energy to the marketplace. States have long served as policy pioneers, particularly when it comes to energy efficiency, renewable energy, and combined heat and power (CHP). The original *Clean Energy-Environment Guide to Action's* intent was to gather and share information about proven state best practices, successful strategies, and lessons learned.

> **Who Should Use the *Guide to Action*?**
>
> The *Guide to Action* is written for state air, energy, environmental, and economic policy-makers who want to learn about proven state clean energy policies and implementation best practices so they can:
>
> - Develop a clean energy strategy appropriate for their state.
> - Boost existing efforts to achieve a cleaner, more efficient energy system.
> - Identify the roles and responsibilities of key decision-makers.
> - Access technical assistance, resources, and tools available for state-specific analyses and program implementation.

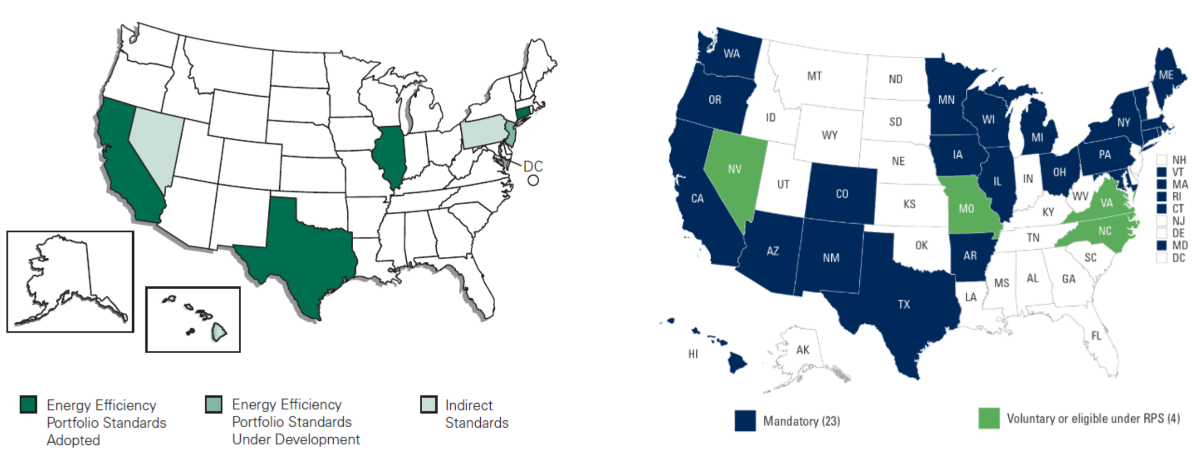
Since the original *Guide to Action* was issued, states have continued to break new ground in these policy areas as they adjust to market needs, take advantage of technology breakthroughs, and achieve their energy and environmental goals. For example, as of March 2015:

- Twenty-seven states have adopted energy efficiency resource standards (EERSs), up from seven in 2005. Mandatory EERSs have increased from two to 23 states. See Figure ES.1.
- Thirty-seven states and Washington, D.C. have adopted renewable portfolio standards (RPSs) that increase the amount of wind, solar, biomass, and other renewable resources in their energy portfolios. Twenty-nine states and Washington, D.C. have mandatory RPSs (DSIRE 2015). This is an increase from 23 states with some form of RPS in 2005 (EPA 2006).

Still, many states can implement new policies and do more to strengthen their existing energy efficiency, renewable energy, and CHP efforts.

Figure ES.1: States with EERSs: 2005 and 2015

2005 **2015**



Sources: 2005 map from EPA 2006; 2015 map from ACEEE 2014b and DSIRE 2015.

EPA is publishing this update, the *Energy and Environment Guide to Action: State Policies and Best Practices for Advancing Energy Efficiency, Renewable Energy, and Combined Heat and Power* (*Guide to Action*), to gather the latest best practices and opportunities that states are using to invest in energy efficiency, renewable energy, and CHP in service of their environmental, energy, and economic goals. The 2015 *Guide to Action* describes over a dozen state policies, details the best practices and attributes when designing and overseeing effective state policies and programs, identifies key stakeholders to engage during policy development and implementation, and provides resources for more information. Each policy description is based on state experiences in designing and implementing policies, as documented in existing literature and shared through peer-exchange opportunities provided to states by EPA's State Climate and Energy Program.

What's New in the Updated *Guide to Action*?

Over the last 10 years, states have made great progress with their clean energy policies. The new *Guide to Action* includes the following updates:

- All case studies and examples have been updated to reflect new or refined state approaches.
- Best practices have been updated to reflect current thinking.
- Discussions of evaluation approaches have been strengthened to reflect improved state practices.
- New resources have been added to help states design and implement policies.

Why Energy Efficiency, Renewable Energy, and CHP?

States have found that investing in energy efficiency, renewable energy, and CHP is a cost-effective way to meet their energy needs while reducing harmful greenhouse gas (GHG) emissions and other air pollutants, lowering energy costs, and potentially improving the reliability and security of the nation's energy system. Fossil-fueled electricity generation is a major source of air pollutants that form ground-level ozone and fine particulate matter, as well as over 30 percent of GHGs in the United States (EPA 2014a). Using energy efficiency, renewable energy, and CHP helps reduce or avoid environmental and related public health problems.

What Are Energy Efficiency, Renewable Energy, and CHP?

The policies discussed in the *Guide to Action* include demand- and supply-side strategies to meet energy demand and reduce peak electricity system loads in a clean, reliable, and cost-effective manner. These strategies generally fall within the following categories:

Energy efficiency reduces the amount of energy needed to provide the same or improved level of service. Common energy efficiency measures include hundreds of technologies and practices for practically all end-uses across all sectors of the economy.

Renewable energy comes from sources that replenish themselves over time. Renewable energy definitions vary by state, but usually include solar, wind, geothermal, biomass, biogas, and low-impact hydroelectric power.

CHP, also known as cogeneration, is a clean, efficient approach to generating both electric and thermal energy from a single fuel source.

States are finding that investing in energy efficiency, renewable energy, and CHP also creates jobs. The U.S. energy efficiency and renewable energy sectors employed over 566,000 people in 2010, with job growth rates exceeding 2.5 percent annually from 2003 to 2010 (Brookings 2011; EPA 2014b). States and the U.S. energy industry face many challenges in providing affordable, clean, and reliable energy in today's complex energy markets. States have found that reducing electricity demand through energy efficiency and introducing new, cleaner forms of electricity generation can save money for all customer classes, reduce GHG emissions, and help ensure that the grid continues to meet our energy needs.

Opportunities for State Action

Many states have already implemented policies and programs to increase energy efficiency, renewable energy, and CHP. States can learn from each other to adopt new policies and improve their existing policies and programs. This *Guide to Action* discusses ways that states can capitalize on additional, cost-effective clean energy potential and reap multiple benefits in the following areas:

- *Developing a clean energy strategy.* State energy efficiency, renewable energy, and CHP policies are typically developed and implemented across multiple agencies and regulatory jurisdictions. States are finding that developing these policies in conjunction with broad planning processes, such as comprehensive energy and air quality planning or statewide sustainability planning, can help ensure that relevant stakeholders are involved and that the policies are recognized as possible strategies to meet multiple policy goals; they may also provide an opportunity for regional collaboration.
- *Energy efficiency*. States have found that cost-effective energy efficiency can make a significant dent in future energy demand while also benefitting the environment, economy, and energy system. There is still a lot of potential: study estimates vary, but most show that achievable potential on the order of 15 to 20 percent of U.S. electricity demand could be met through energy efficiency over the next 10 to 15 years (ACEEE 2008; ACEEE 2014a; Sreedharan 2013). A little more than half of all states have enacted EERSs, which require that retail electricity distributors meet a specific portion of their electricity demand through energy efficiency; this is an option that could be explored by other states.

  To maximize energy efficiency deployment, states use programs funded by electricity customer fees, federal grants, capacity markets, or emissions allowance auctions. State energy efficiency programs can also coordinate with weatherization assistance programs to leverage an additional funding source while also ensuring complementary energy efficiency program design and implementation for low-income residential customers. They also take advantage of technical assistance and tools available from federal programs such as ENERGY STAR®.
- *Renewable energy*. States have found that the cost of renewable energy technologies has fallen significantly in recent years, creating new policy opportunities. States that do not already have RPSs are considering developing them. An RPS provides a clear and long-term target for renewable energy generation that can increase investors' and developers' confidence in the prospects for renewable energy and therefore encourage investment. States with existing RPS requirements can actively adjust their investments and policy approaches to take advantage of cost-competitive, new, renewable energy technology.
- *CHP*. Most existing CHP capacity (over 80 percent) is located at industrial manufacturing facilities; however, states have found that this trend is changing. States are increasingly focusing on the potential for adding CHP in a variety of ways, including district energy systems at universities and downtown areas, industrial-scale CHP in many industry sectors (e.g., chemicals, paper, and food manufacturing), and in commercial buildings such as hotels and casinos.
- *Leading by example*. For years, many states have been leading by example by establishing policies that reduce emissions and achieve substantial energy cost savings within state facilities, fleets, and operations. In doing so, they have demonstrated environmental leadership and raised public awareness of the benefits of energy efficiency, renewable energy, and CHP. Since leading by example can involve a wide range of policies that potentially cover all state agencies, local governments, schools, and other public sector organizations, there are likely additional ways states can redouble their efforts to lead. The *Guide to Action* describes the full suite of state lead by example options.

The *Guide to Action*: Overview

This *Guide to Action* covers state energy efficiency, renewable energy, and CHP policies and is organized in the following chapters:

Chapter 2: *"Developing a State Strategy*." Describes processes states have used to engage stakeholders; assess their resource potential and policy opportunities; and develop a comprehensive, statewide strategy that provides clean, low-cost, reliable energy while achieving state energy, environmental, and/or economic goals.

Chapter 3: *"Funding and Financial Incentive Policies."* Describes how states are using targeted funding and incentive programs to increase investment in clean energy technologies and services by residents, industries, and businesses.

Chapter 4: *"Energy Efficiency Policies."* Describes how states are encouraging energy efficiency improvements through programs, standards, and codes.

Chapter 5: *"Renewable Portfolio Standards."* Offers a range of strategies and approaches that states are using to promote renewable energy.

Chapter 6: *"Policy Considerations for Combined Heat and Power."* Describes options states have used to capture CHP's environmental, energy, economic, and reliability benefits, either by providing CHP-specific incentives or incentivizing CHP with other similar technologies or fuel types.

Chapter 7: *"Electric Utility Policies."* Offers details on a variety of strategies that states have used to further promote energy efficiency, renewable energy, and CHP. These strategies include electricity resource planning and procurement, policies that sustain utility financial health, interconnection and net metering standards, customer rates and data access, and maximizing grid investments to achieve energy efficiency and improve renewable energy integration.

States Are Developing Strategies for Implementing Energy Efficiency, Renewable Energy, and CHP

States across the nation are setting environmental and energy targets and identifying the best ways to reach those targets.

As of September 2014, 20 states and Washington, D.C., have set targets for GHG reductions. States have found that energy efficiency and renewable energy policies are often key to achieving these goals. For example, Oregon's 10-Year Energy Action Plan sets GHG reduction targets and aims to meet 100 percent of new electric load growth through energy efficiency.

Pennsylvania recently commissioned a study, *Electric Energy Efficiency Potential for Pennsylvania*, which provides detailed information on the energy efficiency measures that are the most cost-effective and have the greatest potential energy savings.

New York commissioned the *Energy Efficiency and Renewable Energy Potential Study of New York State*, which identified energy efficiency policies that would yield about $30 billion in net economic benefits, as well as solar and wind energy technology with the highest potential for in-state renewable energy sources.

Table ES.1 provides an overview of the policies described in the *Guide to Action*, as well as the energy resources targeted by each policy. These policies were selected because of their proven effectiveness; their ability to help overcome the barriers states face as they promote energy efficiency, renewable energy, and CHP; and their successful implementation by a number of states. The information presented about each policy is based on proven models, state experiences, and lessons learned.

Table ES.1: Summary of Policies by Type of Energy Resource

Policy	*Guide to Action* Section	Energy Efficiency	Renewable Energy	CHP
Funding and Financial Incentives Policies	3	•	•	•
Energy Efficiency Policies	4	•	•	•
Energy Efficiency Resource Standards	4.1	•		•
Energy Efficiency Programs	4.2	•		
Building Codes for Energy Efficiency	4.3	•		
State Appliance Efficiency Standards	4.4	•		
Lead by Example	4.5	•	•	•
Renewable Portfolio Standards	5		•	•
Combined Heat and Power	6	•	•	•
Electric Utility Policies	7	•	•	•
Electricity Resource Planning and Procurement	7.1	•	•	•
Policies that Sustain Utility Financial Health	7.2	•	•	•
Interconnection and Net Metering Standards	7.3		•	•
Customer Rates and Data Access	7.4	•	•	•
Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration	7.5	•	•	•

Table ES.2 (at the end of this section) presents additional details about each of the policies, including specific approaches states can use to implement each policy, key design issues and resources, and states that serve as examples of each policy. (Note that many other states have also implemented these policies; for more information, see the policy sections in the *Guide to Action*.) A brief description of each of the 14 policies follows, including highlights of state experiences with each policy.

Developing a State Strategy

Rather than evaluating individual policies in isolation, states have found that an overarching strategy for developing energy efficiency, renewable energy, and CHP can help articulate goals and identify the best ways to meet them. Goals include reducing energy consumption by a certain amount; achieving a certain percentage of renewable energy in the energy mix; or lowering GHG emissions to a certain level with energy efficiency, renewable energy, and CHP. States have found that goals can be performance-based, with a focus on reliability, or cost-based, with a focus on reducing energy costs. There are many ways to meet most goals; developing a comprehensive strategy for meeting them ensures that efforts are focused appropriately.

States have found that the main steps in developing a comprehensive energy efficiency, renewable energy, and CHP strategy generally include:

- Engaging with key state agency officials and stakeholders (because decisions related to the electricity system cut across multiple jurisdictions).
- Clarifying state priorities and goals for energy.

- Developing a baseline and forecast to understand current conditions and future trends relevant to the state's energy and/or environmental goals.
- Assessing energy efficiency, renewable energy, and CHP potential.
- Identifying policy and program options, including enhancing existing policies as well as implementing new ones.
- Estimating potential policy and program impacts.
- Prioritizing policies and programs relative to the state's goals.
- Developing an implementation strategy that defines responsibilities, actions, a schedule, and a mechanism for monitoring and reporting.

The order of these steps varies from state to state. For example, some states first develop broad goals for energy efficiency, renewable energy, and CHP, which may be based on regional goals or agreements, other state activities, or political considerations; they then determine the most effective ways to achieve their goals. Alternatively, some states first conduct thorough analyses of their clean energy potential, then evaluate policy options and assess related opportunities before determining a goal. This range of approaches to goal-setting allows each state to proceed in a manner suited to local circumstances.

Funding and Financial Incentives

States that are promoting energy efficiency, renewable energy, and CHP provide different degrees of funding opportunities and financial incentives. Revolving loan funds, property assessed clean energy (PACE) financing, energy savings performance contracting, credit enhancement, and energy efficiency mortgages are all state funding strategies that help lower the upfront costs of investing in new technology, reducing one of the major barriers to wider adoption. Financial incentives that lower this cost barrier include grant programs, rebate programs, performance-based incentives, and tax incentives.

When designing effective funding and financial incentive programs, states typically keep four general principles in mind:

- Focus on specific markets and technologies and select them based on technical and economic analyses of those markets and technologies.
- Use financing and incentives *as part of* a broader package of policies to encourage investments to maximize the success of all of the policies.
- Establish specific technical and financial criteria to define the types of eligible projects.
- Track details of program costs and energy savings/production to ensure that the programs can be evaluated for cost-effectiveness and improved.

States Are Supporting Energy Efficiency, Renewable Energy, and CHP with Funding and Financial Incentives

- The Home Energy Rebate Program, administered by the Alaska Housing Finance Corporation, provides up to $10,000 in rebates to homeowners who make energy efficiency improvements to an existing home, and up to $10,000 for the construction of a qualified energy-efficient new home.
- North Carolina offers a renewable energy tax credit equal to 35 percent of the cost of eligible renewable energy property that is constructed, purchased, or leased by a taxpayer.
- The Connecticut Commercial Property Assessed Clean Energy program allows commercial, industrial, and multifamily property owners to finance energy efficiency and clean energy improvements through a special assessment on their property tax bill, which is repaid over a period of up to 20 years.
- The New Jersey Energy Resilience Bank provides funding to support energy infrastructure projects that will address energy vulnerabilities and maximize energy resilience by supporting projects such as fuel cells, CHP, solar with storage, and dynamic microgrids.

Promoting Energy Efficiency

States have found that saving energy through energy efficiency improvements can cost less than generating, transmitting, and distributing energy from power plants. These improvements also provide many other benefits, including reduced peak loads, lower electricity bills, reliable grid support, reduced air emissions, and improved public health. States have adopted many policies that support cost-effective energy efficiency programs by removing key market, regulatory, and institutional barriers that hinder investment in energy efficiency by consumers, businesses, utilities, and public agencies. The *Guide to Action* describes four energy efficiency policies that states have successfully implemented to support greater investment in, and adoption of, energy efficiency.

Energy Efficiency Resource Standards

EERSs are set by state legislatures and require that energy providers meet a certain portion of their electricity demand through energy efficiency. EERSs usually take the form of multi-year targets that utilities or other retail distributors must meet, such as a requirement to meet 10 percent of annual energy demand or a certain percentage of retail sales through energy efficiency.

While EERSs set a specific target for energy savings, state policy-makers and utilities usually have some flexibility to explore the best strategies for meeting those targets. Utilities and other program administrators often meet these targets through customer energy efficiency programs, such as offering rebates for energy-efficient appliances or light bulbs. Some states also achieve EERS targets using other approaches, such as peak demand reductions, building codes, and CHP. EERSs have been a major force behind the adoption of energy efficiency programs, such as those described below.

States have found that effectively designed and explicit EERSs, based on sound analyses of technical, economic, and achievable potential, can help ensure that energy efficiency opportunities are pursued to meet electricity demand at least cost.

States Are Establishing EERSs

As of March 2015, at least **27 states** have set some sort of energy efficiency requirement or goal. Most of these EERSs have been highly successful: states generally exceeded their savings targets in 2012, with overall savings of 20 million megawatt-hours (MWh)—surpassing combined targets of 18 million MWh (ACEEE 2015).

- In Arizona, the state's largest utility reported a net benefit to consumers of more than $200 million in 2012 alone as a result of the state's EERS. In total, Arizona's electric utilities saved 693 gigawatt-hours in 2012, equivalent to 1.66 percent of retail sales.
- Following the passage of Assembly Bill 2021 in 2006, the California Energy Commission (CEC), CPUC, and other stakeholders were required to develop a statewide estimate of all cost-effective electricity and gas savings and to develop annual energy savings and demand reduction goals for the state's four largest IOUs. This study must be updated every 3 years. From 2006 to 2014, accounting for program and customer costs, California's EERS program has resulted in overall savings of $1.8 billion.
- The Illinois Power Agency Act of 2007 sets incremental electric and gas savings, ramping up from 0.2 percent electricity savings in 2008 to 2 percent in 2015 and thereafter. Illinois electric utilities ComEd and Ameren both exceeded their electricity savings goals for each of the first 5 years of the EERS.
- In Pennsylvania, all utilities met or exceeded the EERS goal of achieving 10 percent energy savings from government buildings, nonprofits, and schools by 2013.

Energy Efficiency Programs

States develop energy efficiency programs to lower customers' energy costs, reduce the need for new power system capacity, meet energy savings goals, stimulate local economic development and new jobs, and reduce the environmental and health impacts of meeting electricity service needs. Energy efficiency programs help educate consumers about the benefits of energy-efficient purchases or actions, and help overcome costs and other barriers that prevent households and businesses from investing in energy efficiency improvements. State agencies that deliver Low-Income Home Energy Assistance Program assistance also help implement energy efficiency programs to improve energy affordability.

States rely on a combination of authorities and funding sources to administer and oversee successful energy efficiency programs. In most states, energy efficiency programs are funded through modest electricity surcharges on customer bills. This funding is used to cover the costs of designing and implementing the programs, as well as incentives paid to customers.

States are finding that energy efficiency programs significantly reduce electricity demand at a relatively low cost. In 2012, energy efficiency programs in 48 states reported energy savings. Well-designed and administered energy efficiency programs have reduced demand at a lower cost than generating electricity, and have also helped create local jobs by lowering energy costs and stimulating new public and private sector investments.

States Are Establishing Energy Efficiency Programs

As of 2013, **48 states and Washington, D.C.,** have energy efficiency programs. State funding for electricity energy efficiency programs increased from $1.6 billion in 2006 to $6.3 billion in 2013 (ACEEE 2014c).

- Massachusetts first required electric utilities to provide energy efficiency programs through public benefits funds during its restructuring of the industry in 1997. In January 2013, the Department of Public Utilities approved the second 3-year (2013–2015) electric and gas energy efficiency plans under the Green Communities Act, calling for savings to increase to 2.6 percent in 2015.
- In 2009, Missouri enacted Senate Bill 376, the Missouri Energy Efficiency Investment Act (MEEIA). MEEIA requires Missouri's investor-owned electric utilities to capture all cost-effective energy efficiency opportunities. The Missouri Public Service Commission's rule to implement the MEEIA sets out voluntary goals for electric utilities to achieve 0.3 percent annual savings in 2012, ramping up annually to 1.7 percent in 2019, for cumulative annual savings of 9.9 percent by 2020. In 2011, Missouri's energy efficiency programs resulted in savings of 369,000 MWh.
- In 1999, Vermont authorized the Vermont Public Service Board to collect a volumetric (per kilowatt-hour [kWh]) charge on all electric utility customers' bills to support energy efficiency programs. In 2012, Vermont's budget for electricity efficiency programs was almost $40 million, making up 5.2 percent of statewide utility revenues; its budget for natural gas efficiency programs was $2 million.

Building Energy Codes

Building energy codes require new building construction, as well as major renovations to existing buildings, to meet minimum energy efficiency requirements. These codes are intended to reduce the building's energy needs throughout its lifetime. With these codes, states require certain construction practices that can achieve significant energy and cost savings for building owners and occupants with little to no increase in total construction costs.

The U.S. Department of Energy (DOE) estimates that building codes will result in more than 14 quadrillion British thermal units of energy savings from 2009 to 2030. These energy savings will translate to significant economic benefits for consumers and businesses. DOE estimates that building energy codes will result in a financial benefit of nearly $2 billion annually by 2015 and more than $15 billion annually by 2030. The projected savings from energy codes also translates to an estimated cumulative savings of 800 million metric tons of carbon dioxide by 2030–equivalent to removing 145 million vehicles from our nation's roadways (DOE 2014).

State and local governments have already made progress with codes. However, states have found opportunities to realize further energy savings by adopting new and more efficient codes and by improving code compliance. DOE estimates that upgrading from the 2006 to the 2012 International Energy Conservation Code (IECC) would reduce energy costs to homeowners by an average of 32.1 percent (DOE 2012).

States Save Energy with Building Codes

As of March 1 2015, **41 states** (including Washington, D.C.) have a state-level *residential* building energy code equal-or-better than the 2006 IECC; **42 states** (including Washington, D.C.) have a state-level *commercial* building energy code equal-or-better than ASHRAE Standard 90.1-2004 (BCAP 2015).

- California's Title 24 standard for residential and commercial buildings is a mandatory, statewide building energy code that is more efficient than the 2012 IECC and ASHRAE 90.1-2010. California's building energy code differs from other state codes in that it affects the process of building design and construction verification more thoroughly.
- Massachusetts was the first state to adopt an above-code appendix to its state building energy code in 2009. One hundred twenty-two communities in Massachusetts adopted this voluntary code. The state government adopted new codes in 2014, which are expected to save $144 million annually by 2030.
- Illinois adopted the 2012 IECC on January 1, 2013, and has set up an aggressive system for implementing future updates to energy building codes. DOE expects Illinois' energy cost savings to reach $270 million annually by 2030.

State Appliance Standards

State appliance efficiency standards establish minimum energy efficiency levels for appliances and other energy-consuming products. These standards typically prohibit the sale of less efficient models within a state. Many states are implementing appliance and equipment efficiency standards for products that are not already covered by the federal government, and are finding that they offer a cost-effective strategy for improving energy efficiency and lowering energy costs for businesses and consumers.

Appliance standards help overcome barriers such as “split incentives,” whereby the individual purchasing the appliance (such as a builder or landlord) is not the individual who benefits from the energy savings. The purchaser therefore has little incentive to spend the time identifying or incurring the additional cost of the most efficient model. Standards also help overcome the barrier of “panic purchases,” whereby homeowners purchase appliances on an emergency basis (when the previous model breaks down) and do not have time to research the most efficient options.

Efficiency standards can play a significant role in helping states meet energy savings goals. In California, for example, draft regulations for 15 new appliance standards are expected to save 50 billion gallons of water, 1,400 megawatts (MW) of peak electricity, 9,800 gigawatt-hours (GWh) of electricity, and 162 million therms of natural gas per year, all while providing $2 billion in energy cost savings annually (CEC 2014).

States Are Setting Efficiency Standards for Appliances

As of February 2014, **12 states** and Washington, D.C., have passed legislation to adopt appliance efficiency standards for 16 types of appliances not covered by federal standards.

- California’s energy efficiency standards cover more than 50 products. Since California’s appliance standards program was first established, it has saved consumers over $75 billion on electricity bills alone.
- Connecticut has adopted or plans to adopt nine appliance standards that are not currently covered by federal standards. These appliances include bottle-type water dispensers, commercial hot food holding cabinets, hot tubs, swimming pool pumps, compact audio equipment, DVD players and recorders, and televisions.
- Oregon’s standards cover bottle-type water dispensers, hot food holding cabinets, compact audio devices, DVD players and recorders, and portable electric spas. In 2013, Oregon passed Senate Bill 692, which added standards for televisions and battery chargers effective in 2014, as well as double-ended quartz halogen lamps effective in 2016. These new standards are expected to save 244 GWh and $22 million annually in energy costs by 2020.

Lead by Example

Lead by example initiatives include a range of programs and policies that states and municipalities can pursue to increase energy efficiency, renewable energy, and CHP in their facilities, fleets, and operations. For example, many local governments require their agencies to purchase a certain amount of renewable energy, install solar panels, adopt certain energy efficiency measures, or achieve specific levels of energy savings.

States have found that lead by example initiatives are important because they are uniquely positioned to use their purchasing power, significant scope of operations, and visibility to demonstrate the value and benefits of energy efficiency, renewable energy, and CHP. State and local governments are also positioned to support similar actions among other local governments, schools, colleges and universities, parks and recreation facilities, and other public sector organizations. Public agencies collectively oversee a large amount of building space, vehicle fleets, and energy use, meaning that changes implemented for public agencies can have significant impacts.

In this way, state lead by example initiatives help demonstrate to home and business owners that energy efficiency, renewable energy, and CHP measures are feasible and can result in real savings. They also offer opportunities to achieve substantial energy cost savings, demonstrate environmental leadership, and raise public awareness of the benefits of clean energy technologies.

States Are Leading by Example

Many states and local governments have lead by example initiatives. For example:

- New Hampshire's Executive Order 2011-1 establishes a target to reduce statewide fossil fuel use by 25 percent from 2005 levels by 2025, with interim goals for 2015 and 2020. Staff must also purchase ENERGY STAR rated equipment and implement a "clean fleets" program to reduce transportation fuel use.
- Montgomery County, Maryland, led a regional partnership to purchase wind energy. Participating entities include six Montgomery County agencies and 12 other local government entities. As of 2012, green power was supplying about 25 percent of the aggregate demand in county facilities.
- The Texas legislature passed Senate Bill 700 in June 2014, which requires state agencies and institutions of higher education to set percentage goals for reducing their use of water, electricity, gasoline, and natural gas, and to include those goals in their comprehensive energy plans.

Promoting Renewable Energy: RPSs

An RPS requires electric utilities and other retail electric providers to meet a certain amount of customer demand with eligible sources of renewable electricity. States have found that an RPS is a useful tool to increase the amount of renewable energy using a cost-effective, market-based approach. RPSs can be used in both regulated and restructured electricity markets.

States create RPS programs because renewable energy provides significant energy, environmental, and economic benefits. These include reduced emissions of GHGs and other air pollutants, reduced waste, increased energy supply diversity and security, reduced power price volatility, and local economic development. Many states have also adopted RPS programs to stimulate market and technology development, with the ultimate goal of making renewable energy competitive with conventional forms of electric power.

States have found that RPS policies are a key driver for developing new renewable electric generation facilities, such as wind and solar, in the United States. They have also helped increase how much electricity is directly generated by homes and businesses. RPSs are attractive to many states because they are an administratively efficient, cost-effective, market-based approach to achieving renewable electricity policy objectives.

States Are Setting RPSs

As of July 2014, **29 states** and Washington, D.C., as well as the Northern Mariana Islands and Puerto Rico, have established RPS requirements. An additional nine states, as well as Guam and the U.S. Virgin Islands, have adopted non-binding renewable portfolio goals. In 2012, state RPS policies applied to 55 percent of all U.S retail electricity sales.

- California's RPS requirements are among the most aggressive in the country, requiring retail sellers of electricity to purchase 33 percent renewable electricity by 2020.
- Massachusetts has set a state RPS target of 22.1% by 2020. By assigning separate tiers for new and existing resources, Massachusetts' RPS encourages development of new renewables while also acknowledging and providing support to existing renewables.
- Wisconsin's RPS lists a few non-electrical technologies as eligible resources, specifically solar water heaters; solar light pipes; ground source heat pumps; and installations that generate output from biomass, biogas, synthetic gas, densified fuel pellets, or fuel produced by pyrolysis. The state also has regulations that direct how eligible RECs can be issued from these resources that do not produce electricity.

Promoting Combined Heat and Power

CHP is a system that simultaneously generates heat and electricity from a single fuel source. States have found that CHP is a highly efficient way to produce energy because it uses heat that is produced as a byproduct of electricity generation or industrial sources and would normally be wasted. Thus, CHP systems are substantially more efficient than traditional electricity generation purchased from the grid. CHP is used in every state, and is found primarily in areas with high industrial and commercial activity concentrations, high electricity prices, and policies favorable to CHP.

CHP offers a low-cost approach to adding new electricity generation capacity. Onsite electric generation reduces grid congestion and improves the electricity distribution system's reliability. CHP defers the need for investments in new central generating plants and transmission and distribution infrastructure, helping to minimize electricity cost increases. It also provides all of the environmental benefits of improved energy efficiency (e.g., lower emissions of GHGs and other conventional air pollutants).

States use a variety of policies to promote CHP, including encouraging private sector investment, coordinating at the federal level, partnering with and supporting other states, and identifying investment models beneficial to the multiple stakeholders involved. In several states, CHP can count toward a renewable energy or clean energy portfolio standard goal.

States Are Promoting CHP

Many states promote CHP through a variety of strategies and measures. For example, as of 2011, **19 state climate action plans** and **22 state energy plans** include CHP provisions, and **26 state portfolio standards** include CHP requirements.

- Kentucky is using a multi-pronged policy approach to advance CHP. It has factored in CHP as part of its efforts to meet the state energy plan's GHG emissions reduction target. It has established financial incentives under its Incentives for Energy Independence Act as well as energy efficiency loans for state government agencies. It also has interconnection standards in place that take CHP into consideration.
- In California, utilities must prepare an onsite generation forecast as part of their long-term procurement plans. Onsite generation, of which CHP is a subset, must also be considered as an alternative to distribution system upgrades by California's IOUs.
- In the 2008 *Iowa Climate Change Advisory Council Final Report*, policy recommendation CRE-12, "Combined Heat and Power," suggests promoting CHP across Iowa by providing incentives for CHP development. Suggested incentives include tax credits, grants, zoning provisions, and offset credits for avoided emissions.

Promoting Energy Efficiency, Renewable Energy, and CHP through Electric Utilities

Electricity Resource Planning and Procurement

Planning and procurement play key roles in increasing clean resources in the electric sector. Since most utility decisions are long-term in nature, decisions made during the planning and procurement process can have environmental and economic implications for decades.

Utility planning is an opportunity to examine non-traditional electricity resources such as energy efficiency, renewable energy, and CHP with the same rigor as traditional generation resources. States are also now considering anticipated environmental regulations in electricity planning, including promulgated, proposed, planned, and emerging environmental regulations.

State environmental and utility regulators are increasingly coordinating and consulting with one another as they set new policies. This helps ensure that environmental goals are reflected in electricity planning decisions and vice versa.

States Are Including Energy Efficiency, Renewable Energy, and CHP in Electricity Planning and Procurement

Most states require utilities to engage in some form of electricity resource planning. As of January 2015, **integrated resource plan (IRP) processes are required or present in more than 30 states**; they provide an opportunity for states to examine how energy efficiency, renewable energy, and CHP affect utility operations, customer costs, system reliability, and risks. **At least 26 states have at least some form of discrete resource approvals through a Certificate of Public Convenience and Necessity process.** Examples of state policies for electricity planning include the following:

- Nevada IRP rules require that electric utilities submit a plan every 3 years to increase the state's electricity supply or the demands made on its system. The state public utility commission (PUC) prescribes the contents of these plans. Recent changes to the authorizing statutes require that utilities also file plans to reduce emissions from coal-fired electricity generation plants and replace that capacity with capacity from renewable facilities.
- In Oregon, investor-owned gas and electric utilities file individual 20-year least-cost plans or IRPs with the PUC every 2 years.
- Many states have benefitted from fostering interagency collaboration during the planning process. In 2007, Massachusetts consolidated its environmental and energy offices. However, even without combining agencies, utility and environmental regulators can find many opportunities to coordinate. For example, PUC staff can alert environmental managers about ongoing planning processes and engage them to vet long-term environmental outcomes; environmental regulators can similarly alert PUC staff and ratepayer advocates about air and water permit applications.

Policies That Sustain Utility Financial Health

States have found that well-designed financial incentive structures for utilities encourage them to actively support demand-side resources such as energy efficiency, distributed renewable energy, and CHP.

Under traditional regulatory approaches, utilities recoup their costs through the amount of energy they sell. This approach discourages investment in energy efficiency, distributed renewable energy, and CHP, all of which reduce sales volume—which in turn reduces utility revenue.[1] To overcome this disincentive, many states have decoupled utility revenue from sales volumes, whereby utilities are allowed to recover their costs regardless of projected sales volume. States have found that utility payment structures that ensure program cost recovery, along with performance-based shareholder incentives, can encourage a lower cost, cleaner, and more reliable energy system. For example, utilities can be incentivized to encourage energy efficiency, even though it may reduce the volume of electricity they sell.

Most states have either implemented, or are currently considering, at least one of these forms of decoupling and incentive regulations.

[1] The effect of this linkage is increased in the case of distribution-only utilities, as the revenue impact of electricity sales reduction is disproportionately larger for utilities without generation resources.

States are Adopting Policies to Sustain Utility Financial Health

Nearly all states have adopted incentives for demand-side resources. For example:

- Arizona has recently undertaken regulatory efforts to address incentive regulation, approving both performance incentives and revenue decoupling mechanisms on a case-by-case basis for utilities. The state's two largest investor-owned utilities both have partial revenue decoupling mechanisms and performance incentives in place,
- In New York, all six major electric and all 10 major gas companies have revenue decoupling mechanisms in place. In 2008, the Public Service Commission established incentives for electric utility energy efficiency programs in which utilities earn incentives or incur negative adjustments based on the extent to which they achieve energy savings targets.
- In Nevada, 2009 Senate Bill 358 directed the Public Utilities Commission of Nevada (PUCN) to remove financial disincentives for energy efficiency faced by utilities. In 2010, the PUCN approved a lost revenue adjustment mechanism for utilities, which allows them to recover lost revenues during annual demand-side management (DSM) filings. As of March 2015, a docket (12-12030) was open to investigate another method besides lost revenue recovery to compensate utilities for providing DSM programs. The PUCN has also adopted rules permitting gas utilities to propose decoupling profits from sales through a revenue-per-customer system.

Interconnection and Net Metering Standards

States have found that using standard interconnection and net metering rules for onsite generation systems (i.e., systems where customers generate their own electricity), such as renewable energy and CHP, accelerates the development of clean energy. The requirements for connecting onsite generation systems to the grid are important, since they affect electrical system safety and reliability. States have found that poorly designed requirements can create unintentional barriers to onsite generation systems.

Standard interconnection rules stem from state legislation that directs state public utility commissions (PUCs) to establish uniform processes and technical requirements for grid-connected electric generators. States also use legislation to direct their PUCs to develop standard net metering rules. Net metering rules often serve as a form of interconnection policy as well as a cost recovery mechanism for smaller onsite generation systems. Net metering policies allow onsite generation system owners to receive credit for electricity generated by their systems that is exported to the utility grid. In effect, customers can bank exported generation to offset future electricity use they would otherwise have to purchase at the utility's full retail rate.

Nearly all states have some sort of interconnection or net metering policy; however, many states' standards do not currently meet established best practices or model rules. To further the deployment of energy efficiency, distributed renewable energy, and CHP, states can consider updating and improving their existing interconnection and net metering policies. Specifically, interconnection and net metering standards must be sensitive to variations in process, cost, system size, and technology. Also, technical standards, procedures, and agreements should be transparent and uniform to reduce uncertainty and prevent delays that clean onsite generation systems can encounter when seeking approval for electric grid connection.

State Interconnection and Net Metering Standards

Nearly all states have some sort of interconnection or net metering policy.

- Oregon has three separate interconnection standards: one for net metered systems (including its primary IOUs) and its municipally and cooperatively owned utilities, one for small generator facilities (non-net metered systems), and one for large generator facilities (non-net metered systems). Both fossil-fueled and renewably fueled net metered systems, including CHP systems, are eligible for standardized interconnection. Oregon is one of the few states to receive an "A" grade for both its interconnection and net metering policies in a FreeingTheGrid.org survey of state policies.
- Utah requires the state's IOU and cooperatively owned utilities serving more than 10,000 customers to offer net metering to customers who generate electricity. In 2013, FreeingTheGrid.org gave Utah's interconnection and net metering policies an "A" ranking based on a scoring system that compares state rules against a standard best practice model policy. In Utah, renewable fuels, including waste gas and waste heat capture and recovery, are eligible under the state's interconnection standards. Only renewably fueled CHP systems are eligible under the state's net metering and interconnection standards.

Customer Rates and Data Access

State PUCs have many options for how utilities will charge customers for service. The design of these charges is often referred to as the customer's rate structure and includes charges for consuming electricity, interconnecting with the electricity grid, and generating electricity at the customer's premises. States have found that rate structures can either encourage or discourage energy efficiency, renewable energy, and CHP. For example, increasing customer rates with higher usage under inclining block rates encourages investment in energy efficiency. States have also found that some rates charged by electric utilities (e.g., standby rates) may provide a disincentive for customers to invest in distributed renewable energy and CHP, such as solar panels. This is particularly true when rates are designed to reflect customers relying on grid electricity during high-cost times only.

Providing customers, utilities, and others access to energy use information is another important way to incentivize energy efficiency, renewable energy, and CHP. For example, access to energy use data from tenants in commercial and multifamily residential buildings is critical for building owners and managers to benchmark energy use, identify the best opportunities for improvement, and measure efficiency effort impacts. Utilities may also analyze customer data to improve the design and implementation of energy efficiency and renewable energy programs.

A well-designed and supportive rate structure, complemented by access to energy data, can be critical to helping customers justify investments and evaluate their impacts.

States Are Using Customer Rates and Data Access to Encourage Energy Efficiency, Renewable Energy, and CHP

- In New York, the utility Consolidated Edison's default residential rate is a blend of flat and inclining block rates. The inclining block rate charges customers approximately 1.3 cents per-kWh more for electricity use exceeding 250 kWh in the summer months.
- In 2010, Hawaii instituted a feed-in tariff for a variety of renewable energy technologies. Owners of eligible onsite generation installations can sign 20-year contracts with one of the three IOUs in Hawaii. Under these contracts, the utility agrees to purchase the onsite generation system's output at a fixed per-kWh price. Eligible technologies include solar photovoltaic, concentrating solar thermal, in-line hydroelectric, on-shore wind, and all other renewable technologies that qualify for Hawaii's RPS.
- Access to energy use data is critical for benchmarking energy use in commercial and multifamily buildings; however, building owners may not have access to whole-building data if tenants pay their bills directly to the utility. Some states have mandated that utilities provide energy use data to building owners, especially where building benchmarking is mandated at the state or local level.

Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration

States have traditionally made electricity grid investments with goals of providing reliable service, alleviating congestion, recovering from outages, and expanding to meet new or growing customer demand. While these remain primary goals, leading states are also working to ensure that current and future grid investments are planned and managed to increase system energy efficiency, support end-use energy efficiency, and accommodate the anticipated growth in renewable resources.

For example, utilities can reduce energy losses along the distribution system itself, as well as at end-use, by managing voltage along distribution systems. Throughout the United States, electricity must be delivered to most customers within a range of voltages. Delivering electricity closer to the lower end of this voltage range can save customers energy because some equipment operates more efficiently at lower voltage. Some of the same technologies and strategies used to adjust system voltage can be used to better handle the reactive power needed to manage current and voltage in alternating current electricity systems—used almost universally in the United States to deliver electricity to customers. Better reactive power management can reduce the fuel needed to operate the grid while improving the quality of power delivered to customers.

Many states have found that appropriate management of grid assets is essential to realizing the full extent of grid investments. Leading states are investing in new technologies and management practices to achieve energy efficiency and enhance renewable energy integration.

States Planning for Energy Efficiency and Renewable Energy Benefit from Grid Investments

- In Indiana, the legislature created a new tracker, which is overseen by the Indiana Utility Regulatory Commission, to encourage utility investment in transmission, distribution, and storage system improvements. Before costs can be passed through to consumers, the utility is required to submit a 7-year plan that is subject to public comment and approval by the Indiana Utility Regulatory Commission.
- As part of its transition into the next 3-year phase of the EmPOWER Maryland Energy Efficiency Act of 2008, the Maryland Public Service Commission approved a proposed utility conservation voltage reduction (CVR) program and directed all other regulated companies to develop or accelerate CVR programs.
- The Massachusetts Department of Public Utilities issued an order in June 2014 requiring all of the state's utilities to develop and submit 10-year grid modernization plans designed to achieve the following goals: minimize outages, reduce system and customer costs by optimizing demand, facilitate integration and higher penetration of distributed resources, and improve asset and personnel management.

For More Information

To Obtain a Copy of the *Guide to Action*

Please visit EPA's State and Local Climate and Energy Program:
http://www.epa.gov/statelocalclimate/resources/action-guide.html

For More Information about the *Guide to Action*

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Table ES.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Chapter 3: Funding and Financial Incentive Policies				
Funding and financing programs, as well as direct financial incentives that enable residents and businesses to increase energy efficiency, renewable energy, and CHP.	o Direct cash incentives (grants, rebates, performance-based incentives). o Tax incentives. o Loans and financing programs. o Green banking.	o Select specific target markets and technologies based on technical and economic analyses of clean energy markets and technologies. o Create conditions for long-term market stability and growth—i.e., be predictable and stable. o Eligibility clearly defined. o Used in conjunction with complementary policies, in support of broader goals. o Track outcomes and costs to allow for program evaluation.	AK, CA, CO, CT, HI, MI, NC, NJ, NY, TX, WA	o Description and key considerations of various options for providing funding and financial incentives. o Discussion of barriers addressed by each type of program. o Examples of how other states have implemented policies.
Chapter 4. Energy Efficiency Policies				
Section 4.1: Energy Efficiency Resource Standards				
EERSs encourage or require that energy suppliers in their state meet a certain percentage of their demand forecast through energy efficiency measures.	o EERSs can be mandatory or voluntary. o Utilities often have flexibility in how they meet their EERS targets.	o Determine which entities would be subject to the EERS. o EERS target can either be a percentage of load (or load growth) or a fixed number of energy units. When setting the target, conduct analysis to determine realistic potential for energy efficiency, as well as the benefits of different energy efficiency levels. o Consider timing and duration of the EERS. States have found that energy efficiency benefits are usually realized over the course of many years. o Need to consider the interaction with federal and state policies. Complementary policies can help achieve the EERS targets.	AR, AZ, CA, IL, VT	o Information about state experiences. o Information about measurement and verification. Examples of legislation and PUC rulemakings.

Table ES.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Section 4.2: Energy Efficiency Programs				
Energy efficiency programs can contribute to EERSs, help reduce demand, or achieve other state goals.	o Program specifics can vary widely, but funding might be used to provide rebates for energy-efficient appliances, encourage building retrofits, or provide upstream incentives to increase availability of energy efficiency technologies in the market.	o Determine who will administer energy efficiency programs. o States have found that it is usually beneficial to establish a portfolio of programs, and any single program may not be sufficient to meet goals.	MA, MO, MS, VT	o Discussion about identifying key players and establishing funding sources. o Information about evaluating the cost-effectiveness of programs. o Overview of program evaluation, measurement, and verification.
Section 4.3: Building Codes for Energy Efficiency				
Building energy codes establish minimum energy efficiency requirements for residential and commercial buildings, thereby setting a minimum level of energy efficiency.	o Minimum energy efficiency requirements for residential and commercial buildings. o Periodic review and updates to existing codes. o Code implementation, compliance, and evaluation assistance.	o Develop effective program implementation, compliance, and evaluation approaches. o Work collaboratively with builders, developers, and building owners to ensure compliance. o Establish requirements and process for periodically reviewing and updating codes to reflect changes in building technology and design. o Promote “beyond code” building programs to achieve additional cost-effective energy efficiency.	AZ, CA, IL, MA, TX	o Information about individual state codes. o Best practices for energy code implementation.

Table ES.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Section 4.4: State Appliance Efficiency Standards				
State appliance efficiency standards set minimum energy efficiency standards for equipment and appliances not covered by federal efficiency standards.	o Minimum energy efficiency levels for consumer products and commercial equipment. o Periodic evaluation and review of standards, markets, and product applications.	o Identify products not covered by federal law that have potential for notable efficiency improvements. o Use established test methods to set efficiency levels for the state appliance standards. o Consider implementation issues, including product certification, labeling requirements, and enforcement.	CA, CT, OR	o General and state-specific information about standards. o Information on products covered under some state standards. o Examples of enabling legislation and state rulemakings.
Section 4.5: Lead by Example				
Lead by example programs support a range of activities designed to lower energy costs within state operations, buildings, and fleets, and to demonstrate the feasibility and benefits of energy efficiency, renewable energy, and CHP to the larger market.	o Energy savings targets for public buildings. o Energy efficiency and renewable energy purchase commitments for state facilities.	o Collaborate across public agencies, local governments, schools, and private sector and nonprofit organizations. o Measure, verify, and communicate energy savings.	CA, NH, TX	o Information on program evaluation. o Description of how state lead by example efforts interact with federal programs.
Chapter 5: Renewable Portfolio Standards				
RPSs establish requirements for electric utilities and other retail electric providers to serve a specified percentage or amount of customer load with eligible renewable sources.	o Promoting specified technologies through technology tiers and credit multipliers. o Allowing alternative compliance payments. o Allowing trading of renewable energy certificates.	o Develop broad support for an RPS, including top-level offices of the state government, by performing studies that analyze job creation, economic development, and customer bill impacts. o Specify which renewable energy technologies will be eligible. o Allow utility cost recovery, establish cost caps, and consider flexible compliance mechanisms.	CA, MA, NJ, RI, WI	o Example state RPS requirements and eligible technologies. o Information on program design, including compliance mechanisms.

Table ES.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Chapter 6: Policy Considerations for Combined Heat and Power				
CHP, also known as cogeneration, is the simultaneous production of electricity and heat from a single fuel source with commercially proven technology.	o Bond o Commercial PACE o Feed-in tariff o Grant o Interconnection standard o Loan o Net metering o Portfolio standard o Production incentive o Public benefits fund o Rebate o State climate change plan o State energy plan o State utility rate policy o Tax o Utility rate	o Assess local CHP potential. o Review and select approaches for project development. o Enter maintenance contracts. o Involve local planning departments. o Sell excess energy.	IA, KY, NY, RI	o Discussion of various policy options for encouraging CHP.

Table ES.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Chapter 7: Electric Utility Policies				
Section 7.1: Electricity Resource Planning and Procurement				
Longer term planning and procurement decisions related to electricity provide opportunities to incorporate energy efficiency, renewable energy, and CHP.	o Integrated resource planning. o Certificate of Public Convenience and Necessity. o Planning for electricity supply in states with restructured electricity markets.	o Develop a load forecast, including both peak demand and energy. o Address existing and anticipated environmental regulations. o Consider both supply options and demand-side resources. o Electricity system plans require some form of electricity system modeling.	CT, GA, NJ, NV, OR	o Description and key considerations of the main types of state electricity resource planning. o Policy options for fully integrating energy efficiency, renewable energy, and CHP in planning. o Descriptions of how states incorporate energy efficiency, renewable energy, and CHP in planning.
Section 7.2: Policies That Sustain Utility Financial Health				
Financial incentive structures help align utility profit goals with the delivery of cost-effective demand-side resources such as energy efficiency, distributed renewable energy, and CHP.	o Decoupling o Lost revenue adjustment mechanisms o Alternate rate structure	o How to compensate utilities for energy efficiency programs so they are incentivized to maximize energy saved and, in turn, sell less electricity. o Designing shareholder incentives to include features related to performance, energy efficiency, and renewable energy.	AZ, CA, NV, NY	o Explanation of how rates can be structured to incentivize energy efficiency, distributed renewable energy, and CHP. o Discussion of how to align shareholder incentives with state energy and environmental goals.

Table ES.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Section 7.3: Interconnection and Net Metering Standards				
Standard interconnection rules establish processes and technical requirements that reduce uncertainty and delays when projects seek grid connection.	o Standard interconnection rules for onsite generation systems through defined application processes and technical requirements. o Net metering, which defines application processes and technical requirements, typically for smaller projects.	o Develop standards that cover the scope of the desired onsite generation technologies, generator types, sizes, and distribution system types. o Address all components of the interconnection process, including issues related to the application process and technical requirements. o Create a streamlined process for generators that are certified compliant with technical standards. o Consider adopting portions of national models and successful programs in other states.	MA, OR, UT	o State-by-state assessment and references. o Information on federal and other resources. o National standards organizations. o Examples of standard interconnection rules.
Section 7.4: Customer Rates and Data Access				
The design of customer rates can incentivize adoption of energy efficiency, renewable energy, and CHP. Providing customers, utilities, and others access to energy data can also incentivize adoption.	o Energy consumption rates o Flat rates o Inclining block rates o Time-varying rates o Demand charges o Data access o Technology-targeted rates o Standby rates o Exit fees o Net metering o Buyback rates o Electric vehicle rates	o Determine whether it is voluntary or mandatory for customers to move to the new rate structure, which provides greater incentives for energy efficiency. o Determine how and with whom customer data may be shared. o Determine how to fairly compensate customers for investments in distributed renewable energy. o Monitor utility implementation.	CA, CT, GA, HI, IL, NY	o Overview of the different rate structures. o Information on different users for energy data.

Table ES.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Section 7.5: Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration				
Electricity grid technologies can be deployed to achieve energy efficiency and improve renewable energy integration.	o Improved voltage and reactive power management. o Strategic use of customer data. o Renewable energy integration opportunities. o Complementary role of demand response and storage.	o Environmental considerations are an important factor in grid modernization efforts. o Gaining operational experience through pilot initiatives helps inform the business case. o Broad deployment may require stakeholder input and state review to ensure utility actions maximize energy efficiency and renewable energy.	CA, IN, MA, MD, Pacific Northwest	o Detailed discussion on how to reduce line losses from electricity distribution systems. o Policy options for grid modernization investments support end-use energy efficiency. o Technology and policy options to support the integration of renewable energy, including storage.

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Chapter 1. Introduction and Background

Summary

Across the nation, many states and regions have shown strong leadership and innovation in creating and implementing energy efficiency, renewable energy, and combined heat and power (CHP) policies, programs, and measures over the last two decades. The *Energy and Environment Guide to Action* is based on state experience; it documents the best practices for designing and implementing these state policies and demonstrates how the policies have helped states save money, reduce air pollution, enhance economic development, and maintain energy reliability and resiliency. With the *Guide to Action*, states can learn from and build upon each other's successes to achieve their energy efficiency, renewable energy, and CHP policy goals.

The *Guide to Action* explains many state best practice strategies used across the United States, ranging from direct regulations and financial incentives to leading by example. State energy, economic, and environmental policy-makers should specifically use it to:

- Develop a comprehensive state strategy to increase energy efficiency, renewable energy, and CHP tailored to the policy-makers' circumstances and priorities.
- Identify and evaluate energy efficiency, renewable energy, and CHP options they could implement in their states.
- Enhance their existing efforts to achieve a cleaner, more efficient energy system by learning about best practice policies in other states.
- Understand the roles and responsibilities of key decision-makers, such as environmental regulators, state legislatures, public utility commissions (PUCs), and state energy offices.
- Access and apply technical assistance resources, funding, and tools available for state-specific analyses and program implementation.

What Are Energy Efficiency, Renewable Energy, and CHP?

The policies discussed in this document include demand- and supply-side strategies to meet customer demand for energy services in a clean, reliable, and cost-effective manner. The strategies covered in this document generally fall within the following categories:

Energy efficiency refers to technologies and practices that reduce the amount of energy needed to produce products, provide services, or perform various activities. Energy efficiency provides the same or improved level of service while using less overall energy.

Renewable energy comes from sources that replenish themselves over time. Renewable energy definitions vary by state, but usually include solar, wind, geothermal, biomass, biogas, and low-impact hydroelectric power.

CHP, also known as cogeneration, is a clean, efficient approach to generating electric and thermal energy from a single fuel source.

The *Guide to Action* was originally released in 2006. Since then, there has been a lot of momentum by states to implement and learn from policies and programs that support energy efficiency, renewable energy, and CHP. The 2015 release reflects:

- Updated information about state adoption of policies, including drivers and refined best practice approaches for design, implementation, and evaluation.
- New state case studies and examples.
- New resources available to help states design and implement policies.

- New funding instruments, such as green banks, which are now available for energy efficiency, renewable energy, and CHP.
- Utility policies, such as interconnection, net metering, and utility rates, which the original *Guide to Action* described in relation to CHP but now apply to onsite renewable energy, including solar panels.
- Increased state adoption of long-term electricity resource planning and new utility policies to maximize energy efficiency, renewable energy, and CHP as part of electricity delivery infrastructure investments.

The *Guide to Action* focuses on energy associated with electricity, heating and cooling for homes, buildings, and industry. It does not address transportation decisions, although they play an important role in both reducing fossil fuel use and the associated environmental impacts, and can potentially affect electricity demand.[2]

Information for Energy Efficiency, Renewable Energy, and CHP Options

The *Guide to Action* provides the following information for each of the included energy efficiency, renewable energy, and CHP options:

- The objectives and benefits of the policy.
- Examples of states that have implemented the policy.
- Responsibilities of key players at the state level, including typical roles of the main stakeholders.
- Opportunities to coordinate implementation with other federal and state policies, partnerships, and technical assistance resources.
- Best practices for policy design, implementation, and evaluation, including state examples.
- Action steps for states to take when adopting or modifying their clean energy policies, based on established state programs.
- Resources for additional information on individual state policies, legislation and regulations, and analytical tools and methods to quantify emission reductions and estimate energy and cost savings.

Why Should States Encourage Energy Efficiency, Renewable Energy, and CHP?

Many states are leaders in tackling public health, environmental, economic, and related challenges. States have found the benefits of energy efficiency, renewable energy, and CHP offer a cost-effective way to meet these challenges, while also meeting the nation's growing demand for electricity. The benefits include:

- Reduced greenhouse gas (GHG) emissions and other air pollutants.
- Lower customer energy bills.
- Enhanced economic development and job creation.
- Improved reliability and resiliency of the energy system.

A more detailed discussion of state challenges, and ways energy efficiency, renewable energy, and CHP can help address those challenges, follows.

Public Health and Environmental Issues

Fossil fuel-based electricity generation is a major source of GHGs and other air pollutants, which pose serious risks to people's health and the environment. States have found that reducing their reliance on fossil fuel-based electricity generation can lower these emissions and their negative impacts. Specific pollutants that can be reduced include:

[2] Transportation is acknowledged only in the context of electric vehicles. Electric vehicles are mentioned as grid storage options in Chapter 7, "Electric Utility Policies." Section 7.4, "Customer Rates and Data Access," considers electric vehicle rate design.

- *Fine particle pollution ($PM_{2.5}$)* may aggravate respiratory and cardiovascular disease, cause decreased lung function, and make allergies worse. People with heart or lung diseases, children, and older adults are the most likely to be affected by $PM_{2.5}$, but even healthy people may experience temporary symptoms. A growing number of scientific studies suggest that $PM_{2.5}$ exposure may be related to low birth weight and increased infant mortality (EPA 2009).
- *Ground-level ozone* can cause health problems even at relatively low levels. Breathing ozone can trigger chest pain, coughing, throat irritation, shortness of breath, and congestion. It can worsen bronchitis, emphysema, and asthma, and also make people's lungs more susceptible to infection.
- *GHGs* contribute to climate change. Climate change will impact people's health and wellbeing through changes in temperature, extreme weather (i.e., flooding, heat-waves, storms, fires, and droughts), agricultural production, the distribution of infectious diseases, and the seasonal distribution of allergenic pollen species (IPCC 2007). Climate change also poses risks to infrastructure critical to homes, roads, and cities, and the ecosystems that support life.

While some climate change impacts are global in scale, no two states are experiencing climate change in precisely the same way. State governments are well positioned to implement strategic adaptive measures to protect infrastructure, plan for sea-level rise, and increase their resiliency to extreme weather. Many states are already preparing for future climate change impacts with adaptation plans, many of which include energy efficiency and renewable energy recommendations.

Economic Issues

Energy is essential to everyday life. Electricity, heat, and other energy sources are needed to run homes, offices, stores, and industry. Changes in energy bills can therefore have a very real impact on individuals and businesses. For example, on average, households spent $1,945 on heating, cooling, appliances, electronics, and lighting in 2012. Low income households spent an average of 6 percent of their pre-tax income on energy bills in 2012 (EIA 2013). Reducing energy bills can have a significant impact on household expenses, particularly low-income families.

States have found that energy efficiency and CHP can help households and businesses use less energy and lower their bills. Tapping into cost-effective renewable energy expands the available supply of energy, helping utilities meet demand in a cleaner way while keeping utility rates lower. It also brings diversity to the energy supply mix, helping to buffer against large swings in energy prices. Further, states have found that energy efficiency, renewable energy, and CHP also contribute to economic development through job growth. There were more than 566,000 jobs in U.S. energy efficiency and renewable energy sectors in 2010, with job growth rates exceeding 2.5 percent annually from 2003 to 2010 (Muro et al. 2011).

Potential Energy Savings from State Energy Efficiency and Renewable Energy Programs

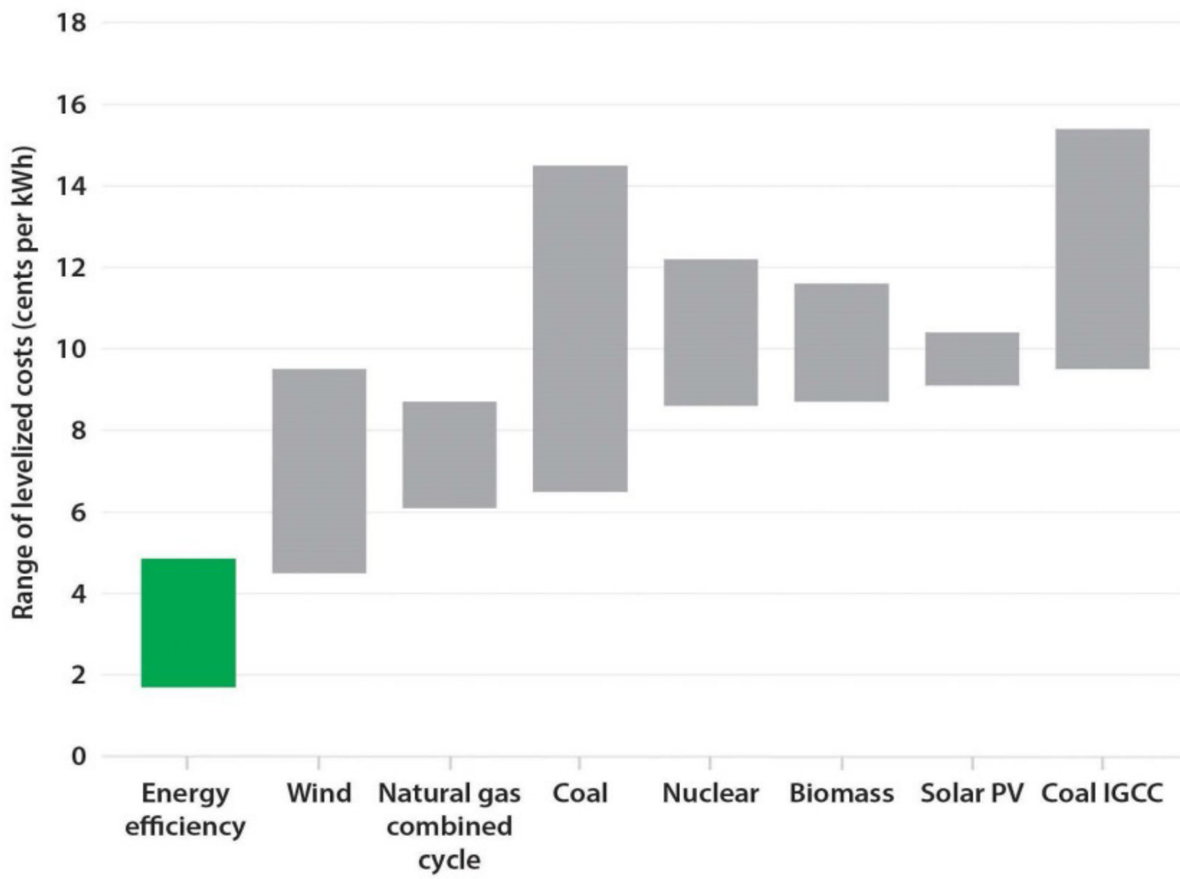
The potential energy savings achievable through energy efficiency are significant. A 2012 American Council for an Energy-Efficient Economy report suggests that more aggressive energy efficiency efforts in the residential, commercial, industrial, and transportation sectors could reduce U.S. energy consumption by up to 60 percent in 2050. These efforts could also add 2 million jobs nationwide (compared with a base case) and save the equivalent of $2,600 per household in annual energy costs (ACEEE 2012).

Meanwhile, a 2012 report by the National Renewable Energy Laboratory estimates that there is the technical potential to generate 481,800 terawatt-hours (TWh) from renewable sources in the United States (NREL 2012), which is higher than total U.S. electricity sales in 2010 (3,754 TWh).

Well-crafted energy policies can help states tap into this impressive savings potential, dramatically reducing energy needs and meeting the remaining need with a much cleaner energy mix.

State policies and programs are successfully expanding the role of energy efficiency, renewable energy, and CHP in the U.S. energy system, and are finding these resources to be cost-competitive with fossil fuel-based generation. Figure 1.1 illustrates the comparative cost of electricity from a range of sources, including energy efficiency and renewable energy, under typical assumptions.

Figure 1.1: Levelized Costs of Electricity Resource Options



IGCC= integrated gasification combined cycle; kWh= kilowatt-hour; PV= photovoltaic

Source: ACEEE 2014d

Energy Infrastructure Issues

States have found that meeting increased demand for energy involves challenges beyond just procuring more energy sources. For example:

- Transmission systems are overburdened in some places. This limits the flow of economical electricity and, in some cases, affects reliability of the electricity delivery.[3] States have found that this can cause reliability problems and high electricity prices in or near areas with congested transmission systems.
- Many existing power plants are aging. Significant retrofits may be needed to ensure older generating units meet current and future emissions regulations.

[3] See Chapter 7, "Electric Utility Policies," for an overview of the electricity grid.

- When new energy supply and delivery infrastructure needs to be built to meet increasing demand, there are many challenges involved in siting new facilities, including community opposition and concerns about the health and environmental impacts of these facilities.
- Energy reliability, resiliency, and security are crucial. Transmission and distribution congestion can limit delivery of electricity when demand for it is high, resulting in brownouts. Furthermore, concerns associated with certain fuel types—such as year-to-year uncertainty about the availability of hydro resources—can be partly eased by investing in more diverse energy sources. Owners of energy generation, transmission, and distribution systems, and all levels of government, are paying more attention to the need to build resilience in the face of extreme weather, ensure energy security, and address emerging risks such as climate change that affect critical energy infrastructure.

Energy efficiency and CHP can help reduce a state's need for new energy infrastructure, saving money and avoiding community concerns about siting fossil-fueled power plants. They also help relieve transmission congestion. When generating electricity close to where it is consumed, renewable energy and CHP help improve the reliability and resilience of the electricity system and contribute toward modernizing the electricity grid. Such onsite electricity generation may also be operated independent of the grid in the event of a disruption to central systems. They can also be targeted to areas that suffer from limited electricity generation, high growth, and/or congested transmission lines (known as load pockets) to reduce grid congestion, potentially deferring or displacing more expensive transmission and distribution infrastructure investments.

State Projections of Energy Savings from Energy Efficiency and Renewable Energy

EPA estimates that state policies promoting energy efficiency could save 57,000 gigawatt-hours during the peak hour by 2018—a savings equivalent to an entire year's total electricity sales in the state of Massachusetts. Maryland and Indiana have the greatest share of these savings, with 11 percent and 10 percent respectively (EPA 2013b).

Energy Efficiency, Renewable Energy, and CHP Can Help States Meet Energy Demand Cleanly and Cost-Effectively

Energy efficiency can make a significant dent in our future energy demand. Study estimates vary, but most show achievable potential on the order of 15 to 20 percent of U.S. electricity demand that could be met through energy efficiency over the next 10 to 15 years (ACEEE 2008, 2014b; Sreedharan 2013).

As an example, since the 1970s, California's energy efficiency programs have helped to save more than $65 billion, lower residential electricity bills to 25 percent below the national average, avoid the need for at least 30 power plants, and prevent climate-warming carbon pollution equivalent to the emissions of 5 million cars annually. The state's planned 2015 energy efficiency programs are estimated to save enough energy in California's homes and businesses to lower energy bills by $200 million after accounting for the cost of the programs, reduce emissions equivalent to more than 100,000 cars, and avoid the need for a medium-sized power plant (NRDC 2014).

Meanwhile, renewable energy costs have decreased significantly in recent years, and in some cases are competitive with traditional fuel sources, greatly expanding our options for cost-effectively meeting our energy needs.

The almost 83 gigawatts of CHP operating in the United States as of late 2013 represent over 8 percent of total U.S. power generation capacity. This CHP avoids more than 1.8 quadrillion British thermal units of fuel consumption annually, along with an estimated 241 million metric tons of carbon dioxide (equivalent to the emissions of over 40 million cars) compared to separate production of heat and power (ICF 2014).

System reliability also benefits from energy efficiency and renewable energy strategies by reducing spikes in energy demand, and decreases the likelihood of or power failures.

Opportunities for State Action

To capture the many benefits of a diverse energy portfolio, many states have implemented policies and programs to increase the use of energy efficiency, renewable energy, and CHP. For example:

- As of 2014, at least 27 states have set some sort of energy efficiency goal.
- By 2015, Twenty-nine states and Washington, D.C., have adopted renewable portfolio standards (RPSs) to increase the amount of wind, solar, biomass, and other renewable resources in their energy portfolios. Notably, 67 percent of all non-hydro renewable energy capacity additions between 1998 and 2012 were in states with existing or impending RPSs. Existing RPS requirements are estimated to achieve a total of 94 gigawatts (GW) of new renewable energy by 2035 (LBNL 2013a). That is roughly equivalent to the current total capacity of all power plants in New York and Illinois combined (EIA 2014b).
- Nineteen states and Washington, D.C., have adopted public benefits funds (PBFs) that support cost-effective energy efficiency, renewable energy, and CHP (C2ES 2014).
- In 2012, approximately 82 GW of CHP were operational in the United States (DOE and EPA 2012), roughly equivalent to the current total capacity of all power plants in Pennsylvania and Michigan combined (EIA 2014b).

Nevertheless, significant opportunities remain for states to reap the benefits of implementing policies and programs that spur greater investment in energy efficiency, renewable energy, and CHP. This section provides an overview of opportunities for state action in each of these areas.

Energy Efficiency

States have shown that well-designed and administered energy efficiency programs can cost-effectively offset a significant portion of expected growth in energy demand. Over the last decade, state energy efficiency programs have contributed to a dramatic flattening of national electricity demand growth (ACEEE 2014e). Furthermore, each dollar invested in electric energy efficiency measures yields $1.24 to $4.00 in total benefits for all customers. These benefits include avoided energy and capacity costs, lower energy costs during peak demand periods like heat waves, avoided costs from building new power lines, and reduced pollution (ACEEE 2014d).

Studies continue to find great potential for achievable energy savings from energy efficiency, on the order of meeting 15 to 20 percent of U.S. electricity demand over the next 10 to 15 years (ACEEE 2008, 2014b; Sreedharan 2013). State- and regional-level studies have also proliferated: a $17 billion investment in best-practice energy efficiency programs in Southwest states was projected to create $37 billion in utility system and other public benefits, and to create up to 28,000 jobs over 10 years (SWEEP 2012). These analyses indicate that there is an abundance of state-level energy efficiency resource potential.

Chapter 2, “Developing a State Strategy,” presents more information about state clean energy potential studies and links to individual state analyses. These studies build on more than a decade of state experience showing that well-designed energy efficiency efforts cost less than traditional sources of generation while offering environmental and economic benefits that continue to accrue year after year. State energy efficiency programs are saving energy at a levelized life-cycle cost of less than $0.03/kilowatt-hour (kWh) saved, which has stayed relatively constant for more than a decade, and is an increasingly small fraction of the typical cost of new power sources and of the average retail price of electricity (ACEEE 2004, 2014c; EIA 2005).

Approximately $4.8 billion was spent in 2010 on state electric and gas energy efficiency programs (LBNL 2013c). This funding is provided both through state PBF programs and through programs planned and funded by utilities. These programs are reducing electricity sales by more than 1 percent per year in leading states with comprehensive energy efficiency programs (ACEEE 2014c).

Many studies have found that more energy efficiency potential exists, which could be captured through expanding energy efficiency programs.[4] Across the 50 states, 2013 spending on energy efficiency programs as a percentage of utility revenues averaged 1.09 percent (ACEEE 2014c). This was up from 0.5 percent in 2003 (ACEEE 2005). The top 10 states (shown in Table 1.1) are spending between 2.83 and 8.55 percent of utility revenues on energy efficiency (ACEEE 2014c).

Table 1.1: 2013 Energy Efficiency Spending as Percentage of Utility Revenues

Top 10 States	Spending as a Percent of Annual Total Revenues
Rhode Island	8.55
Massachusetts	6.42
Vermont	5.32
Washington	4.60
Oregon	4.32
New Jersey	3.88
Connecticut	3.28
California	3.18
Maryland	2.85
Iowa	2.83
U.S. Average	1.09

Source: ACEEE 2014c

Renewable Energy

Renewable energy comes from sources that replenish themselves over time. Definitions of renewable energy vary by state but usually include wind, solar, biomass, and geothermal energy; some states also include low-impact or small hydro, biogas, waste-to-energy, and CHP.

Use of renewable energy technologies continues to grow rapidly in the United States. Total non-hydro renewable capacity was around 13,000 megawatts (MW) in 1998. In 2012, total installed capacity was over five times higher with 80,000 MW of non-hydro renewable capacity (LBNL 2013b). This was more than the total electric generation capacity of Florida and Washington, D.C., combined (EIA 2014b). In particular, there has been substantial growth in the wind and photovoltaic (PV) markets in the past decade.

The market for renewable technologies is growing for several reasons. First, the cost of renewable energy technologies has fallen significantly over time. The average production cost of wind has ranged between $0.05 and $0.09 per kWh since 1996, falling from over $0.55/kWh in 1980 (NREL 2013). Solar prices have also fallen dramatically over a short period of time; average costs per watt have decreased from over $9.00/watt in 2000 to $4.50/watt in 2013 (NREL 2013).

While many state policies have propelled the development of renewable energy, there are several that have been particularly important. Mandatory RPSs in 29 states and Washington, D.C., are important motivators of utility renewable energy installations. About two-thirds of all installations since 1998 are in states with a mandatory RPS (LBNL 2013b); by 2025, RPS targets will account for just under 10 percent of U.S. retail electric sales (EIA 2014a). Many state incentives are also encouraging onsite renewable energy installations, primarily solar PV. As of March 2015, 20 states have at least one state tax credit or rebate for solar installations (DSIRE 2015a), and 44 states (as well as Washington, D.C., and four territories) have rules or provisions for net

[4] See McKinsey (2009) and discussion of additional state potential studies in Chapter 2 of the *Guide to Action*.

metering, which allows owners of solar installations to receive credit for electricity generated on site that is exported to the utility grid (DSIRE 2015b). In effect, the customer can bank exported generation to offset future electricity use that the customer would otherwise have to purchase at the utility's full retail rate.

Combined Heat and Power

CHP, also known as cogeneration, is the simultaneous generation of electric and thermal energy from a single fuel source. Instead of purchasing electricity from the distribution grid and also burning fuel in an onsite furnace or boiler to produce thermal energy, an industrial or commercial facility can use CHP to provide both energy services in one energy-efficient step (DOE and EPA 2012). CHP is not a specific technology, but an efficient application of technologies to meet an energy user's needs.

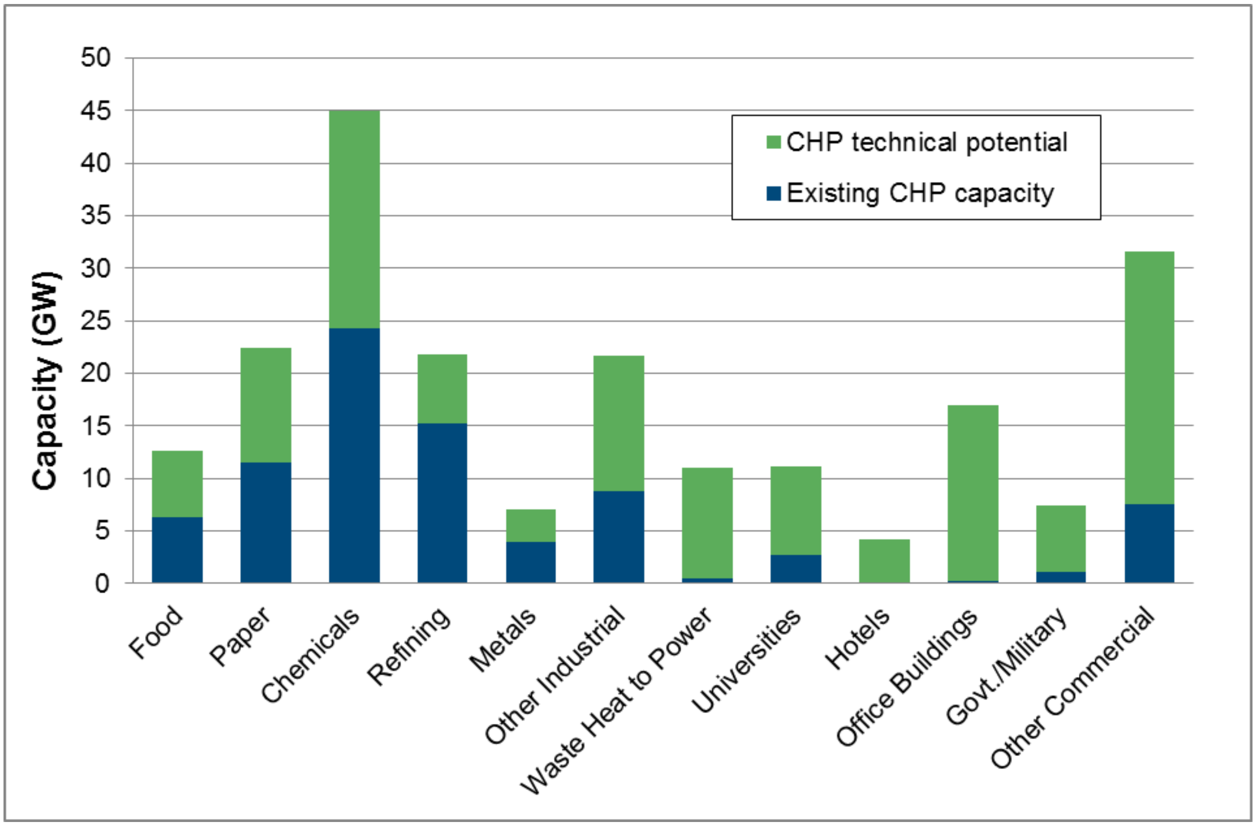
Typically, close to two-thirds of the energy in a conventional power plant is lost when the waste heat is not recovered. CHP captures and uses the waste heat to meet the thermal needs (e.g., process heat, space heating, cooling hot water) of commercial and industrial facilities. A CHP system is substantially more efficient than purchasing electricity from the grid and meeting thermal needs with a boiler or process heater. Typical CHP system fuel use efficiencies range between 65 and 75 percent, and can reach as high as 80 percent, a significant improvement over the average efficiency of separate heat and power (ACEEE 2014a; DOE and EPA 2012). This improvement in efficiency is an effective pollution prevention strategy that reduces air pollution as well as fuel costs.

As of the end of 2013, approximately 82.7 GW of CHP were operational in the United States at over 4,300 industrial and commercial facilities, up from less than 10 GW in 1980 (ICF 2013). This represents over 8 percent of total U.S. power generation capacity. It avoids more than 1.8 quadrillion British thermal units (Btus) of fuel consumption annually and an estimated 241 million metric tons of carbon dioxide (equivalent to the emissions of over 40 million cars) compared to separate production of heat and power (ICF 2014). In addition, CHP can lower energy costs by displacing higher priced electricity and boiler fuel with lower cost, self-generated power and recovered thermal energy (DOE and EPA 2012). Until recently, most CHP capacity (86 percent) has been located at industrial manufacturing facilities. Since 2010, there has been noteworthy growth in the commercial and institutional CHP markets – rising from 14 percent of historic installed capacity to 38 percent of new installed capacity between 2010 and 2013 (ICF 2014).

There is potential to add more CHP to a variety of applications, including district energy at universities and downtown areas, large-scale CHP in many industry sectors (e.g., chemicals, paper, and food manufacturing), and in commercial buildings such as hotels and casinos. ICF International estimates that there is approximately 130 GW of technical potential[5] for CHP systems to serve existing onsite electric loads at facilities conducive to CHP. Estimated CHP technical potential by sector is shown in Figure 1.2.

[5] Technical potential represents the amount of capacity that could serve the electric and thermal needs of target sites and does not consider economic factors or other issues impacting the likelihood of CHP system investments.

Figure 1.2: Existing CHP vs. Estimated Technical Potential



Source: ICF 2013

The *Guide to Action*: An Overview

The *Guide to Action* is intended for state energy, economic, and environmental policy-makers, and is based on state-level experience and policy innovation. State staff can use the *Guide to Action* to learn about proven energy efficiency, renewable energy, and CHP policies and best practices in other states so they can:

- Identify and evaluate energy efficiency, renewable energy, and CHP options they could apply in their states.
- Explore best practices, key features, and examples of effective implementation.
- Understand the roles and responsibilities of key decision-makers, such as environmental regulators, state legislatures, PUCs, and state energy offices.
- Access and apply technical assistance resources, models, and tools available for state-specific analyses and program implementation.

Using the *Guide to Action*

Many states have significant experience with the policies included in the *Guide to Action*. Some of these policies represent different paths to a goal or can be used in combination to achieve a goal. States can select the appropriate combination of policies to achieve their goals. For example, Kentucky's 2011 Climate Action Plan includes 46 specific recommendations (including actions to promote cost-effective GHG emissions reduction through greater use of energy efficiency, renewable energy, CHP, improving transmission efficiency, and other activities).

Policy-makers can use the *Guide to Action* to develop a state strategy that will help them meet their state energy and environmental goals. Chapter 2 describes the process for creating a state strategy.

Policy-makers can review Table 1.2 to see a list of energy policies and programs that have been successful in other states. More details on each of these policies are provided throughout the rest of the *Guide to Action*.

- Learn from each other as they develop or enhance their own energy efficiency, renewable energy, and CHP programs and policies.

The *Guide to Action* is organized in the following chapters:

Chapter 2: "Developing a State Strategy." This chapter describes a series of steps states have taken to successfully develop programs or strategies that provide clean, low-cost, reliable energy while achieving state energy, environmental, and/or economic goals.

Chapter 3: "Funding and Financial Incentive Policies." This chapter demonstrates how states are using targeted funding and incentive programs to increase investment in energy efficiency, renewable energy, and CHP technologies and services by residents, industries, and businesses.

Chapter 4: "Energy Efficiency Policies." This chapter describes how states are promoting improvements in energy efficiency through the use of programs, standards, and codes.

Chapter 5: "Renewable Portfolio Standards." This chapter offers a range of strategies and approaches that states are using to increase the use of renewable energy.

Chapter 6: "Policy Considerations for Combined Heat and Power." This chapter describes state policy options to capture CHP's environmental, energy, economic, and reliability benefits, either by providing CHP-specific incentives or incentivizing CHP with other similar technologies or fuel types.

Chapter 7: "Electric Utility Policies." This chapter offers details on many strategies that states can use to further promote energy efficiency, renewable energy, and CHP. These strategies include electricity planning and resource procurement, utility incentives, interconnection and net metering standards, customer rates and data access, and maximizing grid investments to increase transmission and distribution system efficiency and support renewable integration.

Table 1.2 presents a summary and additional details about energy efficiency, renewable energy, and CHP strategies. It includes specific approaches states can use to implement each policy, key design issues and resources, and state examples of each policy. (Note that many other states have also implemented these policies; for more information, see the individual policy chapters in the *Guide to Action*.)

Table 1.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Chapter 3: Funding and Financial Incentive Policies				
Funding and financing programs, as well as direct financial incentives that enable residents and businesses to increase energy efficiency, renewable energy, and CHP.	o Direct cash incentives (grants, rebates, performance-based incentives). o Tax incentives. o Loans and financing programs. o Green banking.	o Select specific target markets and technologies based on technical and economic analyses of clean energy markets and technologies. o Create conditions for long-term market stability and growth—i.e., be predictable and stable. o Eligibility clearly defined. o Used in conjunction with complementary policies, in support of broader goals. o Track outcomes and costs to allow for program evaluation.	AK, CA, CO, CT, HI, MI, NC, NJ, NY, TX, WA	o Description and key considerations of various options for providing funding and financial incentives. o Discussion of barriers addressed by each type of program. o Examples of how other states have implemented policies.
Chapter 4. Energy Efficiency Policies				
Section 4.1: Energy Efficiency Resource Standards				
EERSs encourage or require that energy suppliers in their state meet a certain percentage of their demand forecast through energy efficiency measures.	o EERSs can be mandatory or voluntary. o Utilities often have flexibility in how they meet their EERS targets.	o Determine which entities would be subject to the EERS. o EERS target can either be a percentage of load (or load growth) or a fixed number of energy units. When setting the target, conduct analysis to determine realistic potential for energy efficiency, as well as the benefits of different energy efficiency levels. o Consider timing and duration of the EERS. States have found that energy efficiency benefits are usually realized over the course of many years. o Need to consider the interaction with federal and state policies. Complementary policies can help achieve the EERS targets.	AR, AZ, CA, IL, VT	o Information about state experiences. o Information about measurement and verification. Examples of legislation and PUC rulemakings.

Table 1.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Section 4.2: Energy Efficiency Programs				
Energy efficiency programs can contribute to EERSs, help reduce demand, or achieve other state goals.	o Program specifics can vary widely, but funding might be used to provide rebates for energy-efficient appliances, encourage building retrofits, or provide upstream incentives to increase availability of energy efficiency technologies in the market.	o Determine who will administer energy efficiency programs. o States have found that it is usually beneficial to establish a portfolio of programs, and any single program may not be sufficient to meet goals.	MA, MO, MS, VT	o Discussion about identifying key players and establishing funding sources. o Information about evaluating the cost-effectiveness of programs. o Overview of program evaluation, measurement, and verification.
Section 4.3: Building Codes for Energy Efficiency				
Building energy codes establish minimum energy efficiency requirements for residential and commercial buildings, thereby setting a minimum level of energy efficiency.	o Minimum energy efficiency requirements for residential and commercial buildings. o Periodic review and updates to existing codes. o Code implementation, compliance, and evaluation assistance.	o Develop effective program implementation, compliance, and evaluation approaches. o Work collaboratively with builders, developers, and building owners to ensure compliance. o Establish requirements and process for periodically reviewing and updating codes to reflect changes in building technology and design. o Promote "beyond code" building programs to achieve additional cost-effective energy efficiency.	AZ, CA, IL, MA, TX	o Information about individual state codes. o Best practices for energy code implementation.

Table 1.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Section 4.4: State Appliance Efficiency Standards				
State appliance efficiency standards set minimum energy efficiency standards for equipment and appliances not covered by federal efficiency standards.	o Minimum energy efficiency levels for consumer products and commercial equipment. o Periodic evaluation and review of standards, markets, and product applications.	o Identify products not covered by federal law that have potential for notable efficiency improvements. o Use established test methods to set efficiency levels for the state appliance standards. o Consider implementation issues, including product certification, labeling requirements, and enforcement.	CA, CT, OR	o General and state-specific information about standards. o Information on products covered under some state standards. o Examples of enabling legislation and state rulemakings.
Section 4.5: Lead by Example				
Lead by example programs support a range of activities designed to lower energy costs within state operations, buildings, and fleets, and to demonstrate the feasibility and benefits of energy efficiency, renewable energy, and CHP to the larger market.	o Energy savings targets for public buildings. o Energy efficiency and renewable energy purchase commitments for state facilities.	o Collaborate across public agencies, local governments, schools, and private sector and nonprofit organizations. o Measure, verify, and communicate energy savings.	CA, NH, TX	o Information on program evaluation. o Description of how state lead by example efforts interact with federal programs.
Chapter 5: Renewable Portfolio Standards				
RPSs establish requirements for electric utilities and other retail electric providers to serve a specified percentage or amount of customer load with eligible renewable sources.	o Promoting specified technologies through technology tiers and credit multipliers. o Allowing alternative compliance payments. o Allowing trading of renewable energy certificates.	o Develop broad support for an RPS, including top-level offices of the state government, by performing studies that analyze job creation, economic development, and customer bill impacts. o Specify which renewable energy technologies will be eligible. o Allow utility cost recovery, establish cost caps, and consider flexible compliance mechanisms.	CA, MA, NJ, RI, WI	o Example state RPS requirements and eligible technologies. o Information on program design, including compliance mechanisms.

Table 1.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Chapter 6: Policy Considerations for Combined Heat and Power				
CHP, also known as cogeneration, is the simultaneous production of electricity and heat from a single fuel source with commercially proven technology.	o Bond o Commercial PACE o Feed-in tariff o Grant o Interconnection standard o Loan o Net metering o Portfolio standard o Production incentive o Public benefits fund o Rebate o State climate change plan o State energy plan o State utility rate policy o Tax o Utility rate	o Assess local CHP potential. o Review and select approaches for project development. o Enter maintenance contracts. o Involve local planning departments. o Sell excess energy.	IA, KY, NY, RI	o Discussion of various policy options for encouraging CHP.

Table 1.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Chapter 7: Electric Utility Policies				
Section 7.1: Electricity Resource Planning and Procurement				
Longer term planning and procurement decisions related to electricity provide opportunities to incorporate energy efficiency, renewable energy, and CHP.	o Integrated resource planning. o Certificate of Public Convenience and Necessity. o Planning for electricity supply in states with restructured electricity markets.	o Develop a load forecast, including both peak demand and energy. o Address existing and anticipated environmental regulations. o Consider both supply options and demand-side resources. o Electricity system plans require some form of electricity system modeling.	CT, GA, NJ, NV, OR	o Description and key considerations of the main types of state electricity resource planning. o Policy options for fully integrating energy efficiency, renewable energy, and CHP in planning. o Descriptions of how states incorporate energy efficiency, renewable energy, and CHP in planning.
Section 7.2: Policies That Sustain Utility Financial Health				
Financial incentive structures help align utility profit goals with the delivery of cost-effective demand-side resources such as energy efficiency, distributed renewable energy, and CHP.	o Decoupling o Lost revenue adjustment mechanisms o Alternate rate structure	o How to compensate utilities for energy efficiency programs so they are incentivized to maximize energy saved and, in turn, sell less electricity. o Designing shareholder incentives to include features related to performance, energy efficiency, and renewable energy.	AZ, CA, NV, NY	o Explanation of how rates can be structured to incentivize energy efficiency, distributed renewable energy, and CHP. o Discussion of how to align shareholder incentives with state energy and environmental goals.

Table 1.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Section 7.3: Interconnection and Net Metering Standards				
Standard interconnection rules establish processes and technical requirements that reduce uncertainty and delays when projects seek grid connection.	o Standard interconnection rules for onsite generation systems through defined application processes and technical requirements. o Net metering, which defines application processes and technical requirements, typically for smaller projects.	o Develop standards that cover the scope of the desired onsite generation technologies, generator types, sizes, and distribution system types. o Address all components of the interconnection process, including issues related to the application process and technical requirements. o Create a streamlined process for generators that are certified compliant with technical standards. o Consider adopting portions of national models and successful programs in other states.	MA, OR, UT	o State-by-state assessment and references. o Information on federal and other resources. o National standards organizations. o Examples of standard interconnection rules.
Section 7.4: Customer Rates and Data Access				
The design of customer rates can incentivize adoption of energy efficiency, renewable energy, and CHP. Providing customers, utilities, and others access to energy data can also incentivize adoption.	o Energy consumption rates o Flat rates o Inclining block rates o Time-varying rates o Demand charges o Data access o Technology-targeted rates o Standby rates o Exit fees o Net metering o Buyback rates o Electric vehicle rates	o Determine whether it is voluntary or mandatory for customers to move to the new rate structure, which provides greater incentives for energy efficiency. o Determine how and with whom customer data may be shared. o Determine how to fairly compensate customers for investments in distributed renewable energy. o Monitor utility implementation.	CA, CT, GA, HI, IL, NY	o Overview of the different rate structures. o Information on different users for energy data.

Table 1.2: Summary of Policies Covered in This Document

Policy Description	Specific Approaches	State Policy Considerations	State Examples in the *Guide to Action*	Key Resources in the *Guide to Action*
Section 7.5: Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration				
Electricity grid technologies can be deployed to achieve energy efficiency and improve renewable energy integration.	o Improved voltage and reactive power management. o Strategic use of customer data. o Renewable energy integration opportunities. o Complementary role of demand response and storage.	o Environmental considerations are an important factor in grid modernization efforts. o Gaining operational experience through pilot initiatives helps inform the business case. o Broad deployment may require stakeholder input and state review to ensure utility actions maximize energy efficiency and renewable energy.	CA, IN, MA, MD, Pacific Northwest	o Detailed discussion on how to reduce line losses from electricity distribution systems. o Policy options for grid modernization investments support end-use energy efficiency. o Technology and policy options to support the integration of renewable energy, including storage.

The policies discussed in the *Guide to Action* are relevant to a wide range of energy efficiency, renewable energy, and CHP technologies. Some states may be interested in advancing a particular technology or end-use. Table 1.3 provides examples of energy technologies organized by specific demand- and supply-side options. It also lists references to relevant chapters that states can explore for additional information.

Table 1.3: Sample of Energy Technologies Covered in the *Guide to Action*

Energy Technology	Demand Side Options			Supply Side and Electricity Delivery Options	Relevant Chapter
	Residential	Commercial	Industrial		
Energy Efficiency					
Heating, ventilating, and air conditioning equipment (inclusive of heat pumps)	✓	✓	✓		3, 4.1, 4.2, 7.1, 7.2, 7.4, 7.5
Lighting	✓	✓	✓		3, 4.1, 4.2, 4.3, 4.5, 7.1, 7.2, 7.4, 7.5
Plug loads (appliances and electronics)	✓	✓	✓		3, 4.1, 4.2, 4.4, 4.5, 7.1, 7.2, 7.4, 7.5
Water heating	✓	✓	✓		3, 4.1, 4.2, 4.5, 7.1, 7.2, 7.4
Windows/skylights/doors	✓	✓	✓		3, 4.1, 4.2, 4.5, 7.1, 7.2, 7.4
Insulation/building envelope improvements	✓	✓	✓		3, 4.1, 4.2, 4.3, 7.1, 7.2, 7.4
Whole-house energy efficiency	✓				3, 4.1, 4.2, 4.3, 4.4, 7.1, 7.2, 7.4
Whole-commercial building energy efficiency		✓			3, 4.1, 4.2, 4.3, 4.4, 7.1, 7.2, 7.4
Whole-industrial facility energy efficiency (inclusive of agriculture)			✓		3, 4.1, 4.2, 4.4, 7.1, 7.2, 7.4
Building energy management systems	✓	✓	✓		4.1, 4.2, 4.5, 7.1, 7.2, 7.4, 7.5
Occupant behavior	✓	✓	✓		4.1, 4.2, 4.5, 7.1, 7.2, 7.4, 7.5
Distribution system efficiency (conservation voltage reduction)				✓	4.1, 4.2, 7.1, 7.2, 7.5
CHP					
CHP	✓	✓	✓	✓	3, 4.1, 5, 6, 7.1, 7.2, 7.4
Waste energy recovery			✓	✓	3, 4.1, 5, 6, 7.4

Table 1.3: Sample of Energy Technologies Covered in the *Guide to Action*

Energy Technology	Demand Side Options			Supply Side and Electricity Delivery Options	Relevant Chapter
	Residential	Commercial	Industrial		
Renewable Energy					
Wind turbines				✓	3, 5, 7.5
Distributed solar (including community solar)	✓	✓	✓	✓	3, 5, 7.3, 7.4, 7.5
Concentrated solar (utility scale)				✓	3, 5, 7.5
Geothermal				✓	3, 5, 7.5
Biomass and biomethane (includes landfill gas and biofuels)				✓	3, 5, 7.3, 7.4, 7.5
Waste to energy (inclusive of municipal solid waste)				✓	3, 5, 7.3, 7.4, 7.5
Clean onsite generation	✓	✓	✓	✓	3, 5, 7.1, 7.2, 7.3, 7.4, 7.5
Anaerobic digestion				✓	3, 5, 7.4, 7.5
District energy				✓	3, 5
Other Clean Technologies					
Distributed solar	✓	✓	✓	✓	3, 5, 7.1, 7.2, 7.3, 7.4
Thermal energy				✓	5, 7.1
Storage				✓	5, 7.1, 7.4, 7.5
Demand response	✓	✓	✓		4.2, 7.1, 7.2, 7.4, 7.5
Fuel cells				✓	5, 7.1, 7.3
Microgrids				✓	5, 7.1, 7.3, 7.4, 7.5
Electric vehicles	✓				7.1, 7.4, 7.5
Advanced metering infrastructure				✓	7.5

The policies discussed in the *Guide to Action* often complement or relate to one another and may be touched on to some extent in multiple chapters, beyond just the primary chapter devoted to it. States can use Table 1.4 to identify relationships between policies and determine additional chapters where a policy is mentioned, so that they can acquire a full understanding of how the policies can interact and maximize the impact of their efforts.

Table 1.4: Crosswalk of *Guide to Action* State Policies

Policies	Chapter 3: Funding/Financial Incentives	Chapter 4: Energy Efficiency					Chapter 5: Renewable Energy	Chapter 6: CHP	Chapter 7: Utility Level Planning				
	Funding/Financial Incentives	EERS	Energy Efficiency Programs	Building Codes	Appliance Standards	Lead by Example	RPS	CHP	Electricity Resource Planning and Procurement	Policies that Sustain Utility Financial Health	Interconnection and Net Metering Standards	Customer Rates and Data Access	Grid Investments
Funding/financial incentives	★	●	●				●	●	●	●	●	●	●
EERS	●	★	●				●	●	●	●	●	●	●
Energy efficiency programs	●	●	★	●	●	●	●	●	●	●		●	●
Building codes			●	★					●				
Appliance standards			●		★				●				
Lead by example			●			★		●	●				
RPS	●	●	●			●	★	●	●		●	●	●
CHP	●	●	●				●	★	●		●	●	
Electricity resource planning and procurement	●	●	●	●	●	●	●	●	★	●	●	●	●
Policies that Sustain Utility Financial Health	●	●	●						●	★	●	●	●
Interconnection and net metering standards	●	●					●	●	●	●	★	●	●
Customer rates and data access	●	●	●				●	●	●	●	●	★	●
Grid investments	●	●	●				●		●	●	●	●	★

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Chapter 2. Developing a State Strategy

Summary

This chapter presents a process states may follow to select programs or strategies that use energy efficiency, renewable energy, combined heat and power (CHP), and other clean onsite generation technologies. Such strategies provide clean, low-cost, reliable energy, while achieving state energy, environment, and/or economic goals.[6] The process draws upon states' experiences and describes key steps states have taken to develop a comprehensive strategy for energy efficiency, renewable energy, and CHP. These include creating a collaborative process, establishing goals, exploring options to adopt new or expand existing policies, and developing an implementation strategy that taps states' available potential and meets their unique needs.

To develop a comprehensive strategy, states have found it useful to:

- Assess the environmental, energy, and economic benefits of energy efficiency, renewable energy, and CHP.
- Identify and remove market, regulatory, and institutional barriers to energy efficiency, renewable energy, and CHP.
- Integrate energy efficiency, renewable energy, and CHP with specific environmental protection or economic development objectives.
- Encourage and enhance coordination across state agencies and with electric and natural gas utilities; businesses; environmental groups; local governments; and energy efficiency, renewable energy, and CHP industries.
- Identify opportunities to coordinate with and build on ongoing state activities, investments and financing mechanisms, federal programs, and private sector investments.
- Incorporate evaluation into policy design and implementation.
- Create an enabling environment (via laws and regulations) for local actions such as energy savings performance contracts and property assessed clean energy.

Statewide strategies for advancing energy efficiency, renewable energy, and CHP often include the policies and programs described in this *Guide to Action* and may be developed in conjunction with broad planning processes, such as comprehensive energy or air quality planning, statewide sustainability planning, and resource-specific planning for energy efficiency, renewable energy, and CHP supplies. Many states, for example, have developed climate change action plans that include energy efficiency, renewable energy, and CHP as a key strategy for saving energy and lowering greenhouse gas (GHG) emissions.[7] States have also developed "lead by example" action plans to increase the use of energy efficiency, renewable energy, and CHP in state facilities and operations (see Section 4.5, "Lead by Example").

Energy efficiency, renewable energy, and CHP policies and programs are typically developed and implemented across multiple agencies and regulatory jurisdictions. In some cases, the process of developing a comprehensive strategy to advance energy efficiency, renewable energy, and CHP may serve as an effective

[6] Clean onsite generation refers to small-scale renewable energy and CHP at the customer or end-use site (EPA 2011).

[7] Thirty-one states and Puerto Rico have developed climate change action plans (EPA 2014a).

platform for engaging relevant state agencies, local governments, and nongovernment stakeholders within a state, including industries, businesses, and the general public. In other circumstances, the process may provide an opportunity for regional collaboration that goes beyond political boundaries and capitalizes on the electricity grid's integrated nature (see the text box, "Regional Greenhouse Gas Initiative," as an example).

Strategies should reflect each state's unique set of circumstances with regard to individual energy needs, climatic conditions, planning processes, regulations, and economic goals. However, the steps involved in developing a comprehensive strategy for energy efficiency, renewable energy, and CHP are similar from state to state and include the following:

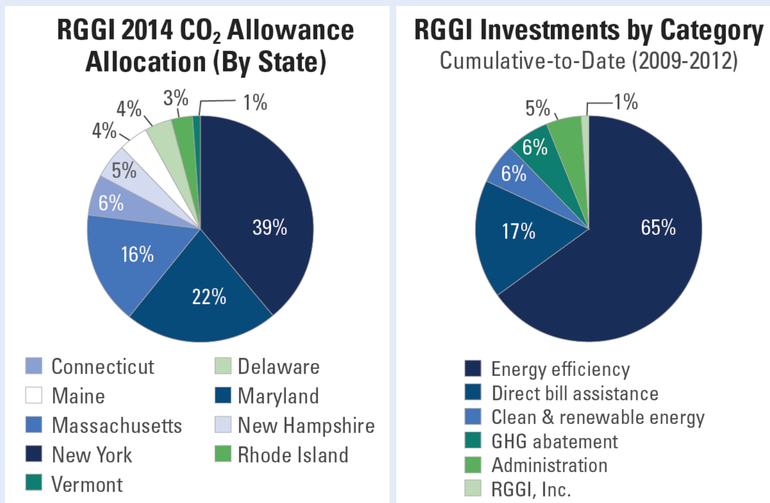
1. Engage with key state agency officials and stakeholders.
2. Clarify state priorities.
3. Understand your state's energy profile.
4. Assess energy efficiency, renewable energy, and CHP potential.
5. Identify energy efficiency, renewable energy, and CHP policy and program options.
6. Estimate potential policy and program impacts.
7. Prioritize and choose policies and programs.

The order of these steps can vary from state to state. For example, some states start by developing broad goals based on regional goals or agreements, other state activities, or political considerations and then determine the most effective way to achieve them. Others begin by conducting thorough analyses of

Regional Greenhouse Gas Initiative

The success of the Regional Greenhouse Gas Initiative (RGGI) was based on **engaging key officials and stakeholders**. In 2003, governors from nine Northeastern and Mid-Atlantic states began discussions to develop the first regional cap and trade program to address power plant carbon dioxide (CO_2) emissions. This collaborative was possible in part because most of the participating states had experience working together on the Ozone Transport Commission NO_X Budget Program and with the Northeast States for Coordinated Air Use Management. Their shared history of successful collaboration laid the groundwork for participation in RGGI, especially since many of the staff involved were already familiar with each other.

Through collaboration, the nine RGGI **states clarified the joint priority** of limiting CO_2 emissions from fossil fuel-fired power plants, which accounts for approximately 20 percent of CO_2 emissions in the region; 95 percent of regional CO_2 emissions come from electricity generation.



Elected officials, environmental agencies, and public utility commissions across the participating states worked together to design the program in a manner that would maximize the ability of each to reach respective goals. RGGI CO_2 allowances are allocated to states based on the **current profile** and **potential opportunities** to decrease CO_2 emissions. Each RGGI state established a CO_2 Budget Trading Program that reflected its own statutory and/or regulatory authority. A comprehensive 2012 Program Review led to the implementation of a new 2014 RGGI cap of 91 million short tons. The CO_2 cap then declines annually by 2.5 percent.

The states used extensive modeling to evaluate the impacts of different emission caps and to negotiate a regional CO_2 emissions budget.

Each RGGI state has developed its own approach to limiting emissions that reflects **viable policy and program options**. RGGI includes a reinvestment mechanism that uses allowance auction proceeds to fund subsequent programs falling into the four categories of energy efficiency, renewable energy, GHG abatement, and direct bill assistance programs.

The information and figures in this text box are from www.rggi.org. States interested in replicating a similar process or learning more about RGGI can visit the Initiative website.

their energy efficiency, renewable energy, and CHP potential; evaluating policy options; and assessing related opportunities before determining a goal. Regardless of the order, the steps are common across many statewide energy efficiency, renewable energy, and CHP planning processes. Each step is described in greater detail below. The information resources and publications at the end of this chapter can help states conduct the various steps.

1. Engage Key State Agency Officials and Stakeholders

Engaging key state agency officials and stakeholders early in the process can develop interest and increase buy-in. This may be essential to developing policies and programs that will be implemented. States typically engage interested parties from multiple organizations to provide valuable information and to generate support for the process. Key players include, but are not limited to:

- *State agencies,* such as state energy departments, environmental departments, and public utility commissions, which can provide government data, analytical expertise, and policy or regulatory interpretation.
- *Elected officials,* including the governor and state legislatures, who can provide leadership, help move action through regulatory channels, and ensure follow-through.
- *Academic and research institutions,* which can provide expertise, analytic support, and/or a neutral forum to convene stakeholder meetings.
- *Utilities*, which can provide technical expertise and data and often administer some programs.
- *Independent system operators and regional transmission organizations*, which can provide technical analyses and information.
- *Independent power producers, independent transmission owners, and energy suppliers*, who can provide information and analysis about electricity markets.
- *Environmental and consumer organizations,* which can provide data, analysis, and feedback.
- *Other private sector interests,* which often maintain significant data and analytic capabilities relevant to energy planning, and/or which may be affected by new energy policies.
- *The public,* who can provide new ideas, input, and/or feedback to the state.
- *Local governments,* which can implement specific actions to help meet statewide goals and targets by reaching key sectors or working with municipally owned utilities.

2. Clarify State Priorities

States have found that clarifying energy efficiency, renewable energy, and CHP priorities can help ensure that planning is focused on specific outcomes. Each state has its own economic, environmental, and energy objectives with its own unique potential for energy efficiency, renewable energy, and CHP. States have found it helpful to make clear their overall priorities and what they hope to achieve through energy efficiency, renewable energy, and CHP early in the planning process. For example, a state may be looking to use energy efficiency, renewable energy, and CHP to increase electricity reliability, lower energy demand, enhance economic development, and/or reduce GHG emissions and other air pollutants. By clarifying their goals upfront, states have recognized that they can better understand the criteria they should use to evaluate their options. This then enables them to determine the appropriate combination of policies and programs to support their priorities.

States have found that engaging stakeholders (Step 1) can be an effective way to begin establishing qualitative and quantitative goals that reflect the needs, conditions, and priorities of an individual state.

States often use qualitative goals to promote broad policy objectives, such as achieving all cost-effective energy efficiency or enhancing economic development. These objectives may then be further refined and presented with quantitative goals.

Quantitative goals are helpful when states are defining specific targets for energy efficiency, renewable energy, and CHP expansion. Quantitative goals may reflect expanding energy efficiency, renewable energy, and CHP by a given percentage by a certain year or by a fixed number. States typically compare potential goals against a state's unique energy efficiency, renewable energy, and CHP potential (see Step 4) to ensure they are realistic. Alternatively, states can define specific goals relative to environmental priorities, such as GHG emission reductions, and then develop a comprehensive approach for using energy efficiency, renewable energy, and CHP to meet those goals. A combination of interim quantitative goals can be an effective way for a state to measure if it is on track to reach long-term goals.

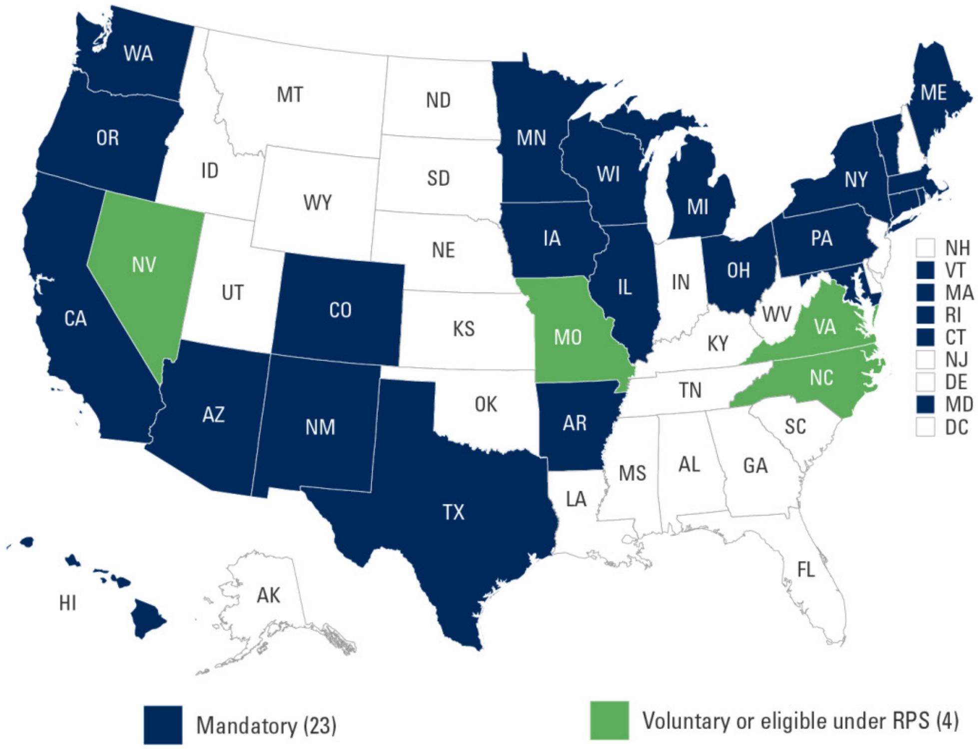
States use both qualitative and quantitative goals to ensure that all stakeholders and agencies clearly understand the project's desired outcome. By measuring success and identifying timelines for implementation, a state can evaluate progress and provide direction when mid-course corrections are necessary.

Many states have established clear quantitative energy efficiency, renewable energy, CHP, or greenhouse goals.

- As of March 2015, 27 states had an active energy efficiency resource standard (EERS) in place that establishes multiyear targets for energy savings (see Figure 2.1); four states have energy efficiency targets or goals that are voluntary (ACEEE 2014, DSIRE 2015a).
- As of March 2015, 29 states and Washington, D.C., have adopted a mandatory renewable portfolio standard (RPS) that requires retail electricity suppliers to supply a minimum percentage or amount of their retail electricity load with electricity generated from eligible renewable energy sources. An additional eight states have adopted non-binding renewable portfolio goals (DSIRE 2015b). In addition, two states have an RPS (see Figure 2.2) that provides the option for energy efficiency to meet requirements (ACEEE 2014).
- As of September 2014, 20 states and Washington, D.C., have set GHG emission targets (see Figure 2.3).[8] Although states use a variety of baseline target years, most states have a common ultimate target year of 2050 (C2ES 2014). For more information, see the text box, "Mandatory Statewide Climate Goals," on page 2-10.

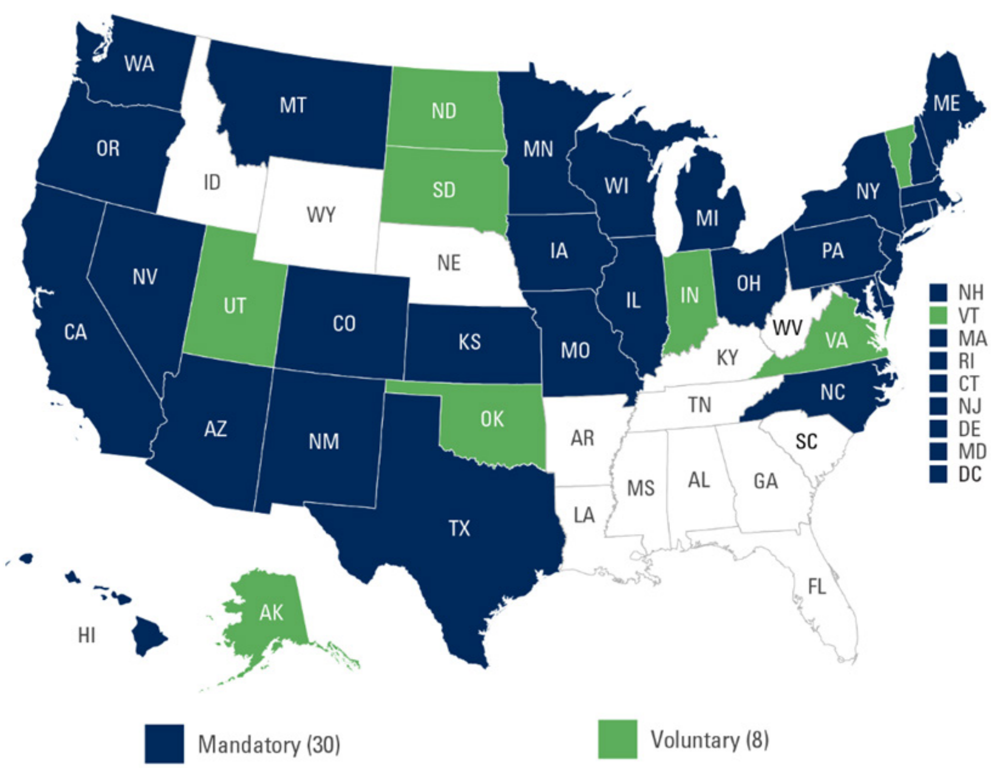
[8] In general, mandatory targets were set by legislation and voluntary goals were set by executive order (some non-binding goals were set by legislation).

Figure 2.1: States with EERSs



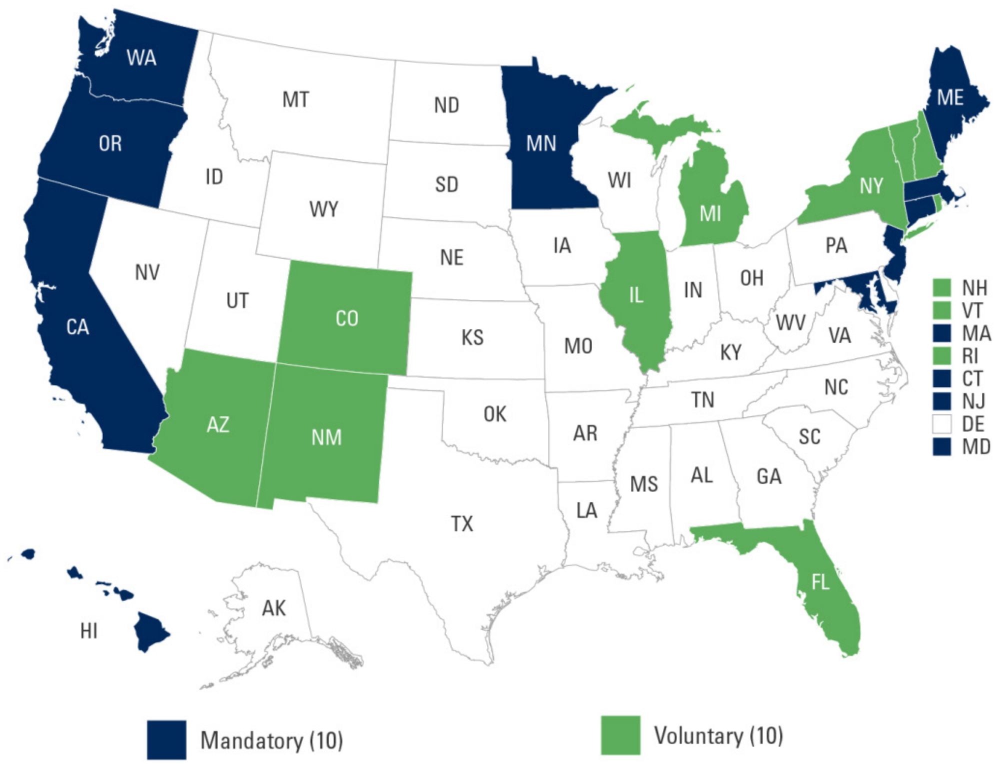
Sources: ACEEE 2014; VA, MO sourced from DSIRE 2015a.

Figure 2.2: States with RPSs



Source: DSIRE 2015b

Figure 2.3: Statewide GHG Emissions Targets



Source: C2ES 2014

3. Understand Your State's Energy Profile

States interested in increasing their energy efficiency, renewable energy, and CHP portfolios have found that establishing a baseline inventory of the state's energy production and use helps them understand the state's current profile and anticipated demand and provides a reference point for setting goals and measuring progress. States have found it helpful to quantify the amount of energy used in the state, identify which sectors or utilities are the largest consumers, develop a database of the energy efficiency, renewable energy, and CHP policies and programs that are already underway, and project future energy demand to understand the anticipated need for additional capacity. Many state energy offices already undertake comprehensive energy planning processes on a regular basis (for more information, see the "State Energy Planning" text box).

The U.S. Department of Energy's (DOE) Energy Information Administration offers state-level energy use data that can be projected into the future. Alternatively, some states rely on their own state-level data to model and forecast energy demand. By using a methodology or model that is transparent about assumptions and widely accepted by experts in the field, states can minimize challenges or confusion about how to interpret the results.

For states also interested in reducing GHG emissions, states have found it useful to include a baseline GHG inventory so that GHG emissions can be understood in the context of a state's energy profile. States can use EPA's State Inventory and Projection Tool to inventory and project their GHG emissions (for information about this and other tools offered by EPA, see the text box below).[9] The baseline and projection can help a state understand trends and identify sectors or sources that might be logical targets for policy intervention.

State Energy Planning

Comprehensive state energy planning can help meet current and future energy needs in a cost-effective and sustainable manner. State energy plans are traditionally led or coordinated by the state energy offices and include statewide coordination of policies and programs.

A state energy plan is a package of strategic goals with recommended policy and program actions to support these goals. These actions, which relate to all available energy resources, can be carried out in public and private sectors through methods such as legislation, investment incentives, energy conservation guidelines, and taxation. When states are interested in increasing the use of energy efficiency, renewable energy, and CHP, they look to their plans to learn about any options that have already been recommended.

Additional resources and information on state energy planning can be found at:

- U.S. Department of Energy's State Energy Program Guidance: http://energy.gov/eere/wipo/state-energy-program-guidance.
- National Association of State Energy Officials' State Energy Planning Guidelines: http://www.naseo.org/data/sites/1/documents/publications/NASEO-State-Energy-Planning-Guidelines.pdf.

4. Assess Energy Efficiency, Renewable Energy, and CHP Potential

States have found it useful to conduct energy efficiency, renewable energy, and CHP potential analyses to determine how much they could achieve with those policies, and to pinpoint where the greatest opportunities exist. Several methods and approaches exist for assessing statewide energy efficiency, renewable energy, and CHP potential.

Energy efficiency, renewable energy, and CHP potential can be assessed at different geographic scopes (i.e., national, regional, state, and utility service territory level) and at various degrees of aggregation (i.e., economy-wide, sector, and program). The assessments generally fall into one of the four following classifications: technical, economic, achievable, and program. The broadest classification is technical potential while the most specific is program assessment. Through assessing the potential viability of energy efficiency, renewable energy, and CHP, states can develop programs, plans, and budgets to maximize the expansion of these programs.

Technical Potential Assessment

"Technical potential" refers to the maximum theoretical amount of energy that could be produced (renewable energy) or displaced (energy efficiency), given existing limitations. The technical potential is limited by technology performance, topographic limitation, environmental, and land-use constraints. However, it does not consider non-engineering constraints such as the willingness of consumers to adopt new behaviors or purchase new appliances, and the costs of making the changes. Technical potential assessments often assume immediate implementation.

[9] EPA's State Inventory and Projection Tool is an interactive spreadsheet model designed to help states develop GHG emissions inventories and projections. It was created to lessen the time it takes to develop an inventory (collecting data, identifying emission factors, etc.). To download this free tool, go to http://www.epa.gov/statelocalclimate/resources/tool.html.

Tools and Resources for Assessing the Benefits of Clean Energy

EPA offers or supports several tools or resources to help states assess the benefits of clean energy policies.

- Information about these and other tools can be found at: http://epa.gov/statelocalclimate/resources/index.html.

Information and resources on estimating potential policy and program impacts can be found at:

- Clean energy benefits: http://epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits_ch1.pdf.
- Projections of energy impacts: http://www.epa.gov/statelocalclimate/state/statepolicies.html and http://www.epa.gov/statelocalclimate/state/activities/exploring-state-climate.html.
- Assessing energy impacts of policies and programs: http://epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits_ch2.pdf.
- Electric system benefits: http://www.epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits_ch3.pdf.
- Economic impacts: http://www.epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits_ch5.pdf.
- Air quality, GHG, and public health benefits: http://www.epa.gov/statelocalclimate/state/activities/assessing-air-quality-and-public-health.html.

Tools for States

To better understand greenhouse gas emissions and energy use in your state:

- State Inventory Tool (SIT): http://epa.gov/statelocalclimate/resources/tool.html.
- State Energy CO_2 Data Tables: http://www.eia.gov/environment/emissions/state/analysis/.
- Emissions and Generation Resources Integrated Database (eGRID): http://www.epa.gov/cleanenergy/energy-resources/egrid/.

To assess the air pollution impacts of energy efficiency, renewable energy, and CHP:

- AVoided Emissions and geneRation Tool (AVERT): www.epa.gov/avert.

To assess the air quality, public health benefits, and health cost savings of air pollution reductions:

- The Co-Benefits Risk Assessment (COBRA) screening model: http://epa.gov/statelocalclimate/resources/cobra.html.

To translate GHG emissions into easily understood metrics:

- Greenhouse Gas Equivalencies Calculator: http://www.epa.gov/cleanenergy/energy-resources/calculator.html.

Economic Potential Assessment

"Economic potential" refers to the subset of technical potential that is economically cost-effective. An economic potential assessment of energy efficiency, renewable energy, or CHP includes data that can vary based on the state or evaluator's inputs. Some economic potential assessments are limited to evaluating the upfront cost of the technology, the operating costs (including energy prices), the product lifetime, and a discount rate. Other assessments may include a broader set of inputs including factors such as consumer preferences and out-of-pocket consumer expenditures. The assessments all compare the energy efficiency, renewable energy, or CHP alternative to the conventional alternative or supply-side energy resources. Similar to technical potential assessments, economic potential assessments assume immediate implementation without regard to a phased adoption process or the time required for real-life implementation. Economic potential focuses on the cost of the energy efficiency, renewable energy, or CHP measure and may not reflect market failures, barriers to implementation, or transaction costs.

Achievable Potential Assessment

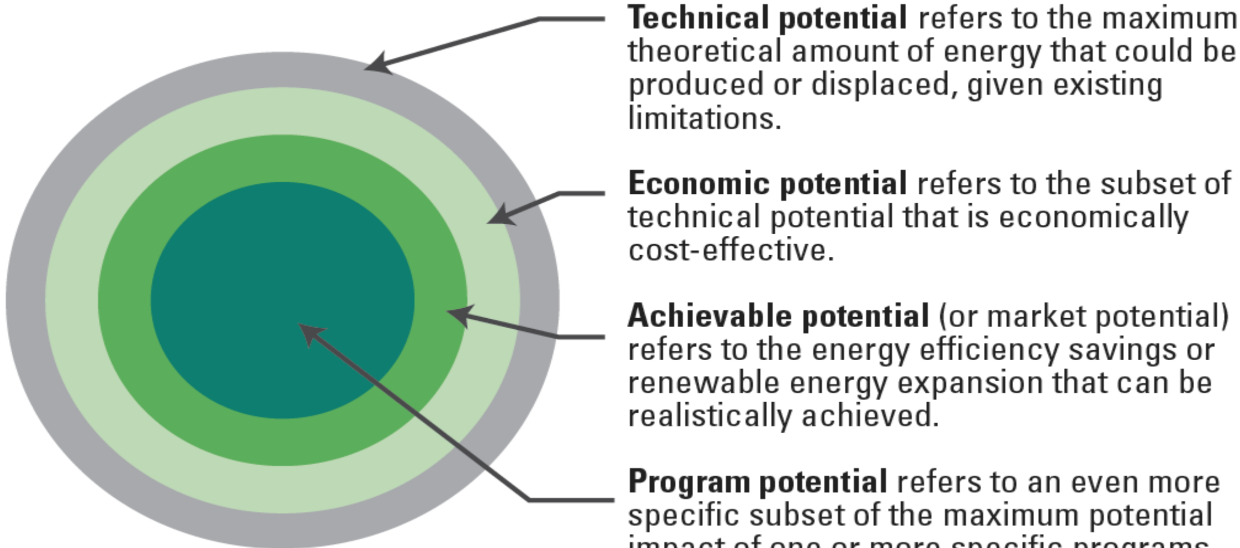
"Achievable potential" (or "market potential") refers to the energy efficiency savings or renewable energy expansion that can be realistically achieved. This is a subset of the economic potential. Achievable potential takes additional factors into account, such as the technology adoption process, market failures or barriers that inhibit technology adoption, transaction costs, consumer preferences, and social and institutional constraints. In contrast to economic and technical potential assessments, an achievable potential assessment may capture the capacity of a program and administrators to ramp up program activity over time, assuming that full implementation may not be immediate.

Program Potential Assessment

"Program potential" refers to an even more specific subset of the maximum potential impact. The program potential assessment is an analysis based on specific program funding levels and designs. This type of assessment provides the most specific detail and could consider a single program or a portfolio of multiple programs (EPA 2014b).

These analyses help states identify opportunities and determine the feasibility of different goals based upon technologies or resource availability.

Figure 2.4: Relationship Between Energy Efficiency Potentials



5. Identify Energy Efficiency, Renewable Energy, and CHP Policy and Program Options

When assessing how to best invest in or implement energy efficiency, renewable energy, and CHP, states have found it useful to both examine their existing policies and programs and to identify new policies and programs by exploring the experiences of other states. For states that already have energy efficiency, renewable energy, and CHP policies in place, opportunities and potential often exists to improve or expand them so that they can achieve greater impacts. Whether they have a lot or a little experience with energy efficiency, renewable energy, and CHP, most states find it valuable to learn best practices from other states that might be adaptable to local conditions.

Review Existing Policies

States often evaluate the success of existing programs to determine if and how they can be extended, expanded, or modified to achieve more energy efficiency, renewable energy, and CHP. States can start by using the policies in the *Guide to Action* as a checklist to see which policies they already have on the books. Since multiple agencies across a state influence clean energy investments and use it for purposes of energy, air quality, and/or GHG mitigation planning, states typically find it helpful to exchange information across agencies on how existing policies are working and where potential exists for expansion. States can also review other states' energy plans, air quality plans, and GHG emission reduction strategies to understand the breadth of state policies that advance clean energy.

When considering policy options, states often evaluate barriers to advancing cost-effective energy efficiency, renewable energy, and CHP programs simultaneously. For example, approval processes designed for large onsite generation systems seeking to connect to the grid may be too onerous to allow small systems to come online. Reexamining interconnection standards (discussed in Section 7.3, "Interconnection and Net Metering Standards") can stimulate the growth of renewable energy by making the process more appropriate to the size and scale of the project and cost-effective for the generation owners.

Mandatory Statewide Climate Goals

Several states have adopted mandatory climate goals through legislative action. The climate goals listed below are targets for overall emission reductions that could be met through a series of programs that include but are not limited to energy efficiency, renewable energy, and CHP.

California: Reduce emissions to 1990 levels by 2020, and to 80 percent below 1990 levels by 2050.

Connecticut: Reduce emissions to 10 percent below 1990 levels by 2020, and to 80 percent below 2001 levels by 2050.

Hawaii: Reduce emissions to 1990 levels by 2020.

Maine: Reduce emissions to 1990 levels by 2010, 10 percent below 1990 levels by 2020, and 75 to 80 percent below 2003 levels in the long term.

Maryland: Reduce emissions to 25 percent below 2006 levels by 2020.

Massachusetts: Reduce emissions to 25 percent below 1990 levels by 2020, and to 80 percent below 1990 levels by 2050.

Minnesota: Reduce emissions to 15 percent by 2015, 30 percent by 2025, and 80 percent by 2050, based on 2005 levels.

New Jersey: Reduce emissions to 1990 levels by 2020 and to 80 percent below 2006 levels by 2050.

Oregon: Reduce emissions to 10 percent below 1990 levels by 2020 and to 75 percent below 1990 levels by 2050.

Washington: Reduce emissions to 1990 levels by 2020, 25 percent below 1990 levels by 2035, and 50 percent below 1990 levels by 2050.

Identify New Policies

Once states have enumerated the existing energy efficiency, renewable energy, and CHP programs and policies, the additional potential can be assessed by consulting available data, using an assessment method described in Step 4, and exploring the *Guide to Action* to identify new policies and programs that are feasible in the state. For each policy or program, the *Guide to Action* describes objectives and benefits, state examples, roles and responsibilities of key players, opportunities for coordination with other programs or policies, best practices for policy design and evaluation, action steps for states, and resources for additional information. States can use the information about other states' successes and best practices to identify those options that they would like to explore further.

Chapters 3 through 7 of the *Guide to Action* provide information and resources relating to specific programs and policies that states have found useful for implementing cost-effective energy efficiency, renewable energy, and CHP. States can use the *Guide to Action* to determine an appropriate mix of new, modified, and expanded policies that warrant further analysis.

6. Estimate Potential Policy and Program Impacts

Evaluating the potential impacts of the range of policies and programs under consideration can help states choose which ones to implement or expand. States typically establish criteria to judge the options, consider various design options (such as related to timing and stringency), and then conduct quantitative and qualitative analyses to explore potential impacts on their state's energy system, environment, and/or economy.

Establish Criteria to Assess Policies

Assessment criteria vary from state to state, and depend on a state's unique priorities, goals, and circumstances. Criteria can include, but are not limited to: cost-effectiveness, ease of implementation, political feasibility, GHG and/or criteria pollution reduction effectiveness, payback period, and economic benefit (e.g., impacts on jobs). To avoid confusion, states have found it useful to define the criteria upfront. For example, when using cost-effectiveness as a criterion, states typically clarify whether they are using dollar per kilowatt-hour saved or dollar per tons of emissions saved. States have discovered that this prevents confusion and helps to identify the types of information and tools needed to assess the policies.

States have also found it helpful to evaluate initial policy recommendations according to qualitative criteria (e.g., ease of implementation, political feasibility) to identify options suitable for further consideration. These policies can then be ranked and sorted according to the criteria chosen.

Design the Policies

A policy's impacts vary depending upon design. For example, the impact of an RPS set at 2 percent to be achieved in 10 years will differ significantly from one set at 25 percent to be achieved in 5 years. States have found it valuable to evaluate policies using different designs or specifications to find the ones that best meet their criteria.

Some states have found it useful to consider how policies relate to the goal and interact with other policies and programs. To avoid confusion upon implementation, states have examined policies and programs upfront and assessed how to design them so that they are complementary and do not introduce conflicting barriers. For example, public benefits funds for energy efficiency can be used to bolster building code effectiveness through support for implementation and enforcement. Likewise, RPSs, net metering, interconnection standards, and grant programs can enhance the deployment of renewables. Alternatively, some policies may create barriers for other policies. For example, interconnection standards with low capacity limits (e.g., less than 10 kilowatts [kW] for residential applications and less than 100 kW for commercial applications), high liability insurance mandates, and other burdensome requirements may inhibit broader adoption of onsite generation (EPA 2014c).

When designing a policy, states have found it advantageous to identify the type of action required, the key players needed to implement the action, and the timeframe for implementation. For example, a regulatory action would require one set of specific agencies, stakeholders, and participants and occur on one timeline, whereas an energy efficiency program may require an entirely different set of players and take place over varying timeframes. Identifying this information upfront helps ensure that the appropriate experts can be involved and contribute their expertise early in the process. These experts can assist in shaping the policy to maximize its effectiveness. States have realized that this type of upfront planning and specificity improves coordination across programs, ensures that key players know what is expected of them, and facilitates future measurement, evaluation, and communication of results. This process also facilitates the development of an implementation strategy that is a key component of advancing clean energy.

Analyze the Potential Impacts

Once policies are designed, states can use analytic tools to evaluate the options based on the criteria they have developed. These tools help states quantify the impacts of the various policies and rank them according to the agreed upon criteria. Usually, this includes an assessment of the energy, economic, and/or environmental and public health impacts of the options, sometimes referred to collectively as co-benefits. States have found it particularly helpful to measure the policies' impact against the goal established in Step 2. This will enable the collaborative to choose those policies that bring a state closest to its goal. The EPA report, *Assessing the Multiple Benefits of Clean Energy,* provides tools and a framework for state policy-makers to assess the energy, environmental, and economic benefits of energy efficiency, renewable energy, and CHP policies and programs during development and implementation.

While analytical tools necessarily involve predictions and uncertainty, they can address a number of specific questions. It is important to thoroughly understand the strengths and weaknesses of the models used, the ways they interact with each other, and the underlying assumptions to avoid misinterpreting the results. As stated earlier, states have found it useful to select models that are widely accepted by experts in the field and are transparent in their assumptions and structures.

EPA offers or supports several tools or resources to help states assess the impacts of policies. States can use the tools provided in the "Tools and Resources for Assessing the Benefits of Clean Energy" text box in Step 4 to enhance their assessment of energy efficiency, renewable energy, and CHP policies.

7. Prioritize and Choose Policies and Programs

Once states have assessed and ranked policy options according to the desired criteria, most states have found it useful to review the findings with their collaborative. Based upon the rankings and discussion among the stakeholders, states typically present recommendations for action in a state strategy that can be referenced, implemented and measured against.

A complete strategy for advancing energy efficiency, renewable energy, and CHP typically includes the following components:

- The state goals (established in Step 2).
- Descriptions of the policies recommended in order to achieve the goal (developed in Steps 4 and 5).
- Projected policy impacts as they relate to the goal (developed in Step 5).
- An implementation strategy (outlined in Step 5).
- A measurement, evaluation, and reporting plan, described in Section 4.1, "Energy Efficiency Resource Standards."

As states design and evaluate energy efficiency, renewable energy, and CHP policy options, they find it beneficial to consider in advance how to measure success. States often specify an evaluation strategy, a timeline for reporting progress, the key metrics to be reported, and the key players involved. This measurement, evaluation, and reporting plan enables states to regularly check their progress against their goals and adjust their course as needed.

Together, these steps can help a state develop a strategy to deliver clean, low-cost, and reliable energy through the use of energy efficiency, renewable energy, and clean onsite generation. Several states have successfully completed energy efficiency, renewable energy, and CHP strategies that can serve as useful models for other states interested in reaping the multiple benefits of cost-effective energy efficiency, renewable energy, and CHP. Examples and links to many of these plans are listed in the information resources below.

Information Resources

Mandatory Statewide GHG Emission Targets

State	Title/Description	URL Address
Statewide GHG Emission Target Resources		
California	California Global Warming Solutions Act of 2006 (Assembly Bill No. 32). This bill requires California to reduce its GHG emissions to 1990 levels by 2020, a reduction of approximately 15 percent below emissions expected under a "business as usual" scenario.	http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf
Connecticut	An Act Concerning Connecticut Global Warming Solutions (H.B. No. 5600). This bill sets a statewide GHG emissions reduction target of 10 percent below 1990 levels by 2020 and an 80 percent reduction below 2001 levels by 2050.	http://www.cga.ct.gov/2008/ACT/PA/2008PA-00098-R00HB-05600-PA.htm
Hawaii	Hawaii Global Warming Solutions Act (Act 234). This act mandates that statewide GHG emissions be reduced to 1990 levels by 2020.	http://www.capitol.hawaii.gov/session2007/bills/GM1005_.PDF
Maine	An Act to Provide Leadership in Addressing the Threat of Climate Change. This act establishes statewide GHG emissions reduction targets to below 1990 levels by 2010, 10 percent below 1990 levels by 2020, and 75 to 80 percent below 2003 levels in the long term.	http://www.mainelegislature.org/ros/LOM/lom121st/5pub201-250/pub201-250-44.htm
Maryland	An Act Concerning Greenhouse Gas Emissions Reduction Act of 2009 (Chapter 171). This act requires the state to achieve a 25 percent reduction in statewide GHG emissions from 2006 levels by 2020.	http://www.mde.state.md.us/programs/Air/ClimateChange/Documents/2011%20Draft%20Plan/A_GGRA_Act.pdf
Massachusetts	An Act Establishing the Global Warming Solutions Act (Chapter 298 of the Acts of 2008). This act requires GHG emissions reductions from all sectors of the economy to reach a target of 25 percent reduction by 2020 and 80 percent reduction by 2050.	https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298
Minnesota	Next Generation Energy Act of 2007. This act establishes goals to reduce per capita use of fossil fuels by 15 percent by 2015 and to derive 25 percent of total energy used in the state from renewable power sources by 2025.	https://www.revisor.mn.gov/bin/bldbill.php?bill=S0145.2.html&session=ls85
New Jersey	Global Warming Response Act. This act mandates the statewide reduction of GHG emissions to 1990 levels by 2020, followed by an 80 percent reduction below 2006 levels by 2050.	http://www.njleg.state.nj.us/2006/Bills/A3500/3301_R2.PDF
Oregon	House Bill 3543. This bill establishes a goal of 10 percent reduction of GHG emissions below 1990 levels by 2020 and 75 percent reduction below 1990 levels by 2050.	https://olis.leg.state.or.us/liz/2007R1/Downloads/MeasureDocument/HB3543
Washington	Washington Senate Bill 6001. This bill commits the state to reduce statewide emissions to 1990 levels by 2020, 25 percent below 1990 levels by 2035, and 50 percent below 1990 levels by 2050.	http://lawfilesext.leg.wa.gov/biennium/2007-08/Pdf/Bills/Senate%20Bills/6001.pdf

Energy Efficiency, Renewable Energy, and CHP Potential Studies

Title/Description	URL Address
State Potential Studies	
HECO IRP-4: Energy Efficiency Study. This 2008 report, prepared by Global Energy Partners, LLC, for the Hawaiian Electric Company (HECO), details a study of energy efficiency and demand response potential and program development in support of HECO's integrated resource plan filing.	http://www.hawaiianelectric.com/vcmcontent/IntegratedResource/IRP/PDF/AppendixN_HECO_IRP4_Final_GEP_DSM.pdf
Missouri Statewide DSM Market Potential Study: Final Report. This 2011 study, prepared by KEMA, Inc., for the Missouri Public Service Commission, assessed the electric and natural gas demand-side management (DSM) potential for Missouri's residential, commercial, and industrial sectors. The goal was to determine the levels of DSM savings available, the costs associated with procuring them, and whether the measures delivering the savings are cost-effective.	http://energy.mo.gov/energy/docs/Finalreport_041411.pdf
Electric Energy Efficiency Potential for Pennsylvania: Final Report. This 2012 study, prepared by GDS Associates, Inc., for the Pennsylvania Public Utilities Commission, characterizes the technical, economic, and achievable potential for electric energy efficiency programs in Pennsylvania for 3-, 5-, and 10-year time periods, pursuant to Pennsylvania Act 129.	https://www.puc.pa.gov/electric/pdf/Act129/Act129-PA_Market_Potential_Study051012.pdf
Energy Efficiency and Renewable Energy Potential Study of New York State. This 2014 study, prepared by Optimal Energy, Inc., for the New York State Energy Research and Development Authority, presents the potential for increased adoption of energy efficiency, renewable energy, and CHP technologies in New York State using a 20-year study period, 2013–2032.	http://www.nyserda.ny.gov/Cleantech-and-Innovation/EA-Reports-and-Studies/EERE-Potential-Studies
Triennial Plan for Fiscal Years 2014–2016. The Efficiency Maine Trust was established by the Maine Legislature to reduce energy costs, administer cost-effective energy efficiency programs, ensure that expenditures are cost-effective, and promote investment in cost-effective energy measures that reduce overall energy costs. The Efficiency Maine Trust Act (2012) specifies that the Trust should prepare a strategic plan every 3 years.	http://www.efficiencymaine.com/docs/TriPlan2-11-26-2012.pdf
2013 Statewide Energy Conservation Plan. This report documents the state of New Hampshire's progress toward its goal of reducing fossil fuel consumption by 25 percent by 2025, in state buildings, on a square foot basis, compared with a 2005 baseline. The report also identifies challenges that may prevent the state from achieving its goal.	http://admin.state.nh.us/EnergyManagement/Documents/ConservationPlan2013.pdf
Texas' Clean Energy Economy: Where We Are, Where We're Going, and What We Need to Succeed. This 2010 report, prepared by Hamilton Consulting for the Cynthia and George Mitchell Foundation, examines the factors that affect the Texas energy economy and presents three possible scenarios for a clean energy economy over the next decade.	http://www.treia.org/assets/documents/HamiltonReportOnCleanEnergy.pdf

Title/Description	URL Address
U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis. This 2012 National Renewable Energy Laboratory (NREL) report details technical potential estimates for six different renewable energy technologies, as well as methods and results for several other renewable energy technologies from previously published reports. It summarizes the U.S. technical potential of the technologies examined.	http://www.nrel.gov/docs/fy12osti/51946.pdf
Electric Energy Efficiency Potential for Pennsylvania. This 2012 report for the Pennsylvania Public Utility Commission provides detailed information on energy efficiency measures that are the most cost-effective and have the greatest potential energy savings in the service areas of Pennsylvania's electric distribution companies.	https://www.puc.state.pa.us/electric/pdf/Act129/Act129-PA_Market_Potential_Study051012.pdf
Regional Energy Efficiency Potential Studies	
Air Pollution Prevention Forum Documents. This website contains documents from Western Regional Air Partnership's Air Pollution Prevention Forum, which examines barriers to energy efficiency, renewable energy, and CHP technology use, identifies actions to overcome such barriers, and recommends potential programs and policies that could result in a reduction of air pollution emissions from energy production and energy end-use sectors in the Grand Canyon Visibility Transport Region.	http://www.wrapair.org/forums/ap2/docs.html
Conservation Resources Advisory Committee. This committee was created to advise the Northwest Power and Conservation Council regarding policy and program alternatives to effectively develop the cost-effective conservation potential identified in the Seventh Pacific Northwest Conservation and Electric Power Plan.	http://www.nwcouncil.org/energy/crac/home/
From Potential to Action: How New England Can Save Energy, Cut Costs, and Create a Brighter Future with Energy Efficiency. This 2010 report was prepared for Northeast Energy Efficiency Partnerships and EPA's Office of Air and Radiation, Climate Protection Partnerships Division by Optimal Energy, Inc. It guides policy-makers, program administrators, advocates, and stakeholders in the New England states as they shape energy policy over the coming decade and beyond by compiling efficiency studies from the six states.	http://psb.vermont.gov/sites/psb/files/docket/7862VYRelicense/Exhibit%20PSD-ASH-8.pdf
Emerging Energy-Saving HVAC Technologies and Practices for the Buildings Sector (2009). The American Council for an Energy-Efficient Economy (ACEEE) periodically reviews technologies that promise to reduce energy consumption. This analysis highlights 15 of the most promising heating, ventilating, and air conditioning (HVAC) technologies.	http://aceee.org/research-report/a092
The State of the States: Energy Efficiency Policy in 2011. 2012. This ACEEE article highlights significant developments in energy efficiency, including increased utility-sector investments and increased adoption of policies and programs to promote energy-efficient transportation systems, at the state level in 2011.	http://www.aceee.org/blog/2012/01/state-states-energy-efficiency-policy

Title/Description	URL Address
Sixth Northwest Conservation and Electric Power Plan. This plan recommends five specific actions to help meet the Northwest region's growing electricity needs while reducing future uncertainties. The plan includes a detailed analysis of efficiency potential in hundreds of applications, and it demonstrates that a substantial amount of growth in electricity demand could be met by conservation.	http://www.nwcouncil.org/media/6284/SixthPowerPlan.pdf
Tennessee Valley Authority Potential Study. This 2011 energy efficiency study assesses the TVA market to deliver forecasts of energy use and peak demand, as well as forecasts of energy and peak-demand savings achievable through energy efficiency and demand response programs.	http://www.tva.com/news/releases/energy_efficiency/GEP_Potential.pdf
National Energy Efficiency Potential Studies	
The Long-Term Energy Efficiency Potential: What the Evidence Suggests. This 2012 ACEEE report examines the potential contributions of energy-efficient behaviors and investments in reducing overall energy use by the year 2050.	http://www.garrisoninstitute.org/downloads/ecology/cmb/Laitner_Long-Term_E_E_Potential.pdf
Unlocking Energy Efficiency in the U.S. Economy. This 2009 study from McKinsey and Company examines the potential for greater efficiency in non-transportation uses of energy, assesses barriers to achievement of that potential, and surveys possible solutions.	http://www.mckinsey.com/client_service/electric_power_and_natural_gas/latest_thinking/unlocking_energy_efficiency_in_the_us_economy
Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010–2030). This 2009 study, prepared by the Electric Power Research Institute (EPRI), assesses the achievable potential for energy efficiency and demand response programs to reduce the growth rate in electricity consumption and peak demand through 2030.	http://www.edisonfoundation.net/iee/Documents/EPRI_SummaryAssessmentAchievableEEPotential0109.pdf
U.S. Energy Efficiency Potential Analysis through 2035. EPRI updated their 2009 analysis in 2014. This report forecasts achievable energy efficiency by 2035.	http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001025477
Policy Drivers for Improving Electricity End-Use Efficiency in the U.S.: an Economic-Engineering Analysis. The Integrated Policy scenario in this 2014 paper demonstrates significant achievable potential: 261 TWh (6.5%) of electricity savings in 2020 and 457 TWh (10.2%) in 2035.	http://www.spp.gatech.edu/publications/working-papers/policy-drivers-improving-electricity-end-use-efficiency-us-economic
Recent Estimates of Energy Efficiency Potential in the USA. This 2013 paper by Priya Sreedharan summarizes recent potential studies and reviews their differing assumptions, methods, and data.	https://ethree.com/documents/EEPotential_Sreedharan_2012.pdf
State-Level Energy Efficiency Analysis: Goals, Methods, and Lessons Learned. This 2008 ACEEE publication provides a meta-analyses of energy efficiency potential studies conducted at the state level.	http://aceee.org/files/proceedings/2008/data/papers/8_468.pdf
Cracking the TEAPOT: Technical, Economic, and Achievable Energy Efficiency Potential Studies. This 2014 ACEEE report summarizes results from a wide range of U.S. energy efficiency potential studies.	http://aceee.org/sites/default/files/publications/researchreports/u1407.pdf

Clean Energy Plans and Planning Processes

Title/Description	URL Address
State Energy Efficiency Plans	
California's Secret Energy Surplus: The Potential for Energy Efficiency. This 2002 study, prepared for The Energy Foundation and The Hewlett Foundation, examines potential energy and peak demand savings from energy efficiency measures in California. It demonstrates that significant additional and long-lasting energy efficiency potential exists.	http://www.issuelab.org/click/download1/californias_secret_energy_surplus_the_potential_for_energy_efficiency
The State Energy Efficiency Scorecard. ACEEE's 2014 State Energy Efficiency Scorecard ranks states on their adoption of policies that encourage energy efficiency using metrics spanning seven different policy areas.	http://www.aceee.org/state-policy/scorecard
Hawaii Energy: Your Conservation and Energy Efficiency Program: Program Year 2012. This Science Applications International Corporation report presents Hawaii's 2012 annual plan, which describes the key elements of the state's vision of making energy conservation and efficiency the most cost-effective, sustainable, and utilized of any energy options available.	https://auction.hawaiienergy.com/images/resources/AnnualPlans_ProgramYear2012.pdf
Nevada Energy Efficiency Strategy. This 2005 Southwest Energy Efficiency Project report presents 14 policy options for further increasing the efficiency of electricity and natural gas and reducing peak power demand in Nevada.	http://www.eswaterheater.org/sites/default/files/library/1232/409.pdf
Leaders of the Pack: ACEEE's Third National Review of Exemplary Energy Efficiency Programs. This report profiles 63 leading energy efficiency programs that span a wide array of program types offered to utility customers.	http://www.aceee.org/research-report/u132
Texas Emissions Reduction Plan (TERP). The Texas Commission on Environmental Quality's TERP program provides financial incentives to eligible individuals, businesses, and local governments to improve air quality by reducing emissions from vehicles and equipment.	http://www.tceq.texas.gov/airquality/terp
National Action Plan for Energy Efficiency. The July 2006 Action Plan presents recommendations for creating a national commitment to energy efficiency through gas and electric utilities, utility regulators, and partner organizations. The Plan was developed by more than 50 organizations representing key stakeholder perspectives. EPA and DOE facilitated this partnership.	http://www.epa.gov/cleanenergy/documents/suca/napee_report.pdf

Title/Description	URL Address
Guide for Conducting Energy Efficiency Potential Studies: A Resource of the National Action Plan for Energy Efficiency. This 2007 document is designed to assist state officials, regulators, and others in implementing the National Action Plan for Energy Efficiency's recommendations, which was a private-public partnership facilitated by EPA and DOE. The Guide identifies three main applications for energy efficiency potential studies and provides examples of each, along with an overview of the main analytical steps in conducting a potential study.	http://www.epa.gov/cleanenergy/documents/suca/potential_guide.pdf
Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers. This 2008 guide assists utility regulators, gas and electric utilities, and others in meeting the implementation goals of the National Action Plan for Energy Efficiency's vision to achieve all cost-effective energy efficiency by 2025. The document reviews issues and approaches involved in considering and adopting cost-effectiveness tests for energy efficiency.	http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf
State Clean Energy-Environment Technical Forum: State Energy Forecasting. This background document, developed in 2008, provides an overview of the process of developing an energy forecast, available approaches, and issues that states should consider throughout the process.	http://www.epa.gov/statelocalclimate/documents/pdf/background061908.pdf
State Renewable Energy Plans	
Oregon's Renewable Energy Action Plan. This 2005 Oregon DOE plan outlines recommended actions for the state of Oregon to develop its renewable energy policy and meet a large fraction of energy needs with new renewable energy generation by the year 2025.	http://egov.oregon.gov/ENERGY/RENEW/docs/FinalREAP.pdf
A Framework for State-Level Renewable Energy Market Potential Studies. This 2010 NREL document provides a framework and next steps for state officials who require estimates of renewable energy market potential. The report gives insights on how to conduct a market potential study and distinguishes between goal-oriented studies and other types of studies while explaining the benefits of each type.	http://www.nrel.gov/docs/fy10osti/46264.pdf
Regional Clean Energy Initiatives or Plans	
Powering the South: A Clean and Affordable Energy Plan for the Southern United States. This 2002 Renewable Energy Policy Project report features a plan for the aggressive implementation of energy efficiency and renewable resources in six southeastern states. The analysis includes electricity market simulation modeling, a technical assessment of cost-effective energy opportunities, a technical and economic assessment of renewable resource potential, and policies for overcoming market barriers.	http://www.synapse-energy.com/sites/default/files/SynapseReport.2002-01.REPP_.Powering-the-South.00-02.pdf

Title/Description	URL Address
Repowering the Midwest: The Clean Energy Development Plan for the Heartland. This 2001 Environmental Law and Policy Center plan quantifies the Midwest's energy efficiency and renewable resources and lays out strategies, policies, and practices to advance a cleaner electricity future.	http://www.issuelab.org/resource/repowering_the_midwest_the_clean_energy_development_plan_for_the_heartland
Southern Alliance for Clean Energy. This organization works to find clean energy solutions in the southern United States by engaging directly with stakeholders and industries on energy issues and promoting policy change through education and outreach.	http://www.cleanenergy.org
Western Governors' Association (WGA) Regional Energy Initiative. WGA has developed multiple reports on opportunities for western states to develop and deliver energy in a secure, affordable, and environmentally conscious manner. WGA's *10-Year Energy Vision* sets regional goals and objectives that Governors have agreed should guide energy development, use, and policy in the West.	http://www.westgov.org/index.php?option=com_content&view=article&id=129&Itemid=57
Assessing the Multiple Benefits of Clean Energy: A Resource for States. This document helps state energy, environmental, and economic policy-makers identify and quantify the benefits of clean energy. The document presents a comprehensive review of these benefits with an analytical framework that states can use to assess those benefits.	http://epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits.pdf
Identifying and Analyzing Policy Options. This EPA State and Local Climate and Energy Program Web page highlights suggestions and resources for identifying and analyzing climate and clean energy policy options that states can implement to advance energy efficiency, renewable energy, and CHP.	http://epa.gov/statelocalclimate/state/activities/policy-options.html
Exploring State Climate and Clean Energy Actions. This EPA State and Local Climate and Energy Program website provides resources on policies and programs that states have adopted to reduce GHG emissions from the power sector. The website also identifies benefits of these policies and provides examples of GHG reduction strategies.	http://www.epa.gov/statelocalclimate/state/activities/exploring-state-climate.html
State Climate Change Plans	
State Examples. This EPA State and Local Climate and Energy Program interactive map documents state Lead by Example case studies, GHG inventories, and climate change action plans.	http://www.epa.gov/statelocalclimate/state/state-examples/index.html
Connecticut Climate Change Action Plan. This 2005 plan informs policy-makers, implementing agencies, organizations, institutions, and the public on Connecticut's efforts to reduce GHG emissions. The plan includes technical analysis of proposed policy actions.	http://www.ct.gov/deep/lib/deep/climatechange/ct_climate_change_action_plan_2005.pdf

Title/Description	URL Address
Commonwealth of Massachusetts: Global Warming Solutions Act 5-Year Progress Report. This 2013 publication reports on progress towards implementing Massachusetts' Global Warming Solutions Act and considers how measures and strategies taken to reduce GHG emissions affect other criteria and public policy considerations for the state.	http://www.mass.gov/eea/docs/eea/gwsa/ma-gwsa-5yr-progress-report-1-6-14.pdf
Developing a Greenhouse Gas Inventory. This EPA State and Local Climate and Energy Program website provides general guidance on developing a GHG inventory. It also includes training resources and tools for stakeholders looking to begin the process of developing an inventory.	http://epa.gov/statelocalclimate/state/activities/ghg-inventory.html
Maryland Commission on Climate Change: Climate Action Plan. This 2008 document presents timetables, benchmarks, and preliminary recommendations for reducing Maryland's GHG emissions.	http://www.mde.state.md.us/programs/Air/ClimateChange/Pages/Air/climatechange/legislation/index.aspx
Pennsylvania: Final Climate Change Action Plan. This 2009 report details the state of Pennsylvania's Climate Action Plan, which includes an integrated climate impact assessment and describes policy measures that can be taken to reduce GHG emissions.	http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_001957.pdf
Stakeholder Processes	
Rhode Island Greenhouse Gas Process (RI GHG). RI GHG formulated a Greenhouse Gas Action Plan for the state of Rhode Island in 2002 and has continued to meet to implement the plan, which includes a set of 49 consensus options for reducing the state's GHG emissions. RI GHG is composed of government, industry, environmental, and consumer groups.	http://righg.raabassociates.org/
Engaging Stakeholders. This EPA State and Local Climate and Energy Program website provides recommendations on engaging with stakeholders to implement climate and clean energy policies, including working with partner agencies, identifying other key stakeholders, and reaching the community.	http://epa.gov/statelocalclimate/state/activities/engaging-stakeholders.html

Title/Description	URL Address
Economic Impacts of Clean Energy Policies	
The Economic Impact of Pennsylvania's Alternative Energy Portfolio Standard. This 2012 report examines the economic effect of Pennsylvania's Alternative Energy Portfolio Standard, which requires that 10 percent of the state's energy be met by alternative energy sources—including waste coal as well as renewable sources such as solar, hydro, wind, and biomass—by 2021.	http://www.beaconhill.org/BHIStudies/PA-AEPS2012/PA-AEPS-study-BHI-Dec-2012.pdf
Job Jolt: The Economic Impacts of Repowering the Midwest: The Clean Energy Development Plan for the Heartland. This 2008 report for the Environmental Law and Policy Center provides a blueprint for producing economically and environmentally sound power by unleashing the Midwest's homegrown clean energy potential. It calls for reducing the use of coal and nuclear generating plants and increasing modern clean energy technologies.	http://elpc.org/wp-content/uploads/2008/06/jobjolt1.pdf
Advancing Energy Efficiency in Arkansas: Opportunities for a Clean Energy Economy. Prepared by ACEEE, this 2011 report presents a suite of energy efficiency policies and programs that have the potential to generate enough energy savings to satisfy the projected growth in electricity consumption by 2025 and reduce natural gas consumption by 8 percent below 2009 levels.	http://www.arkansasenergy.org/media/337914/eeo-aceee%20final%20report.pdf
Projected Job and Investment Impacts of Policy Requiring 25% Renewable Energy by 2025 in Michigan. This 2012 report, prepared by Michigan State University, focuses on the investment and job impacts that would be the result of increasing Michigan's renewable energy generation to 25 percent of total electricity by the year 2025.	http://www.environmentalcouncil.org/mecReports/MSU_Jobs_Report_25x25.pdf
Economic Impact Analysis of Clean Energy Development in North Carolina—2014 Update. This 2014 report prepared by RTI International provides a retrospective economic impact analysis of renewable energy and energy efficiency investments.	http://www.rti.org/pubs/ncsea_2013_update_final.pdf
Economic Development Opportunities for Arizona in National Clean Energy and Climate Change Legislation. In 2010, faculty and students from Northern Arizona University analyzed the potential economic impacts on Arizona of a national clean energy and climate change mitigation policy.	http://nau.edu/CEFNS/Centers-Institutes/Sustainable-Energy-Solutions/_Forms/NAU-Economic-Opportunities-for-Arizona-in-Clean-Energy-and-Climate-Change-Legislation/
The Economic Impact of the Kansas Renewable Portfolio Standard. This 2012 study prepared by the Kansas Policy Institute estimates the economic impacts of RPS mandates in Kansas.	http://www.kansaspolicy.org/researchcenters/budgetandspending/budgetandspendingstudies/d95311.aspx?type=view
Tools and Models to Analyze Economic Impacts	
Energy 2020. Energy 2020 is an integrated energy model by Systematic Solutions, Inc., containing detailed energy demand, energy supply, and pollution accounting sectors. The model can generate analyses that include the 50 states plus D.C., the 10 Canadian provinces, and the three Canadian territories.	http://www.energy2020.com/energy2020.html

Title/Description	URL Address
Minnesota IMPLAN Group, Inc., IMPLAN system. The IMPLAN system provides economic impact analysis to help users understand the economic impact and economic contributions of projects. The system uses regional Social Accounting Matrices to provide specialized models.	http://www.implan.com/
Applied Dynamic Analysis of the Global Economy (ADAGE). The RTI ADAGE model is an economy-wide model that can examine the effects of climate change mitigation and other energy policies. ADAGE contains a regional module and a power sector module (known as the Electricity Market Analysis).	http://www.rti.org/page.cfm?objectid=DDC06637-7973-4B0F-AC46B3C69E09ADA9
Regional Economic Accounts. The U.S. Department of Commerce Bureau of Economic Analysis provides data on GDP in the United States by state and metropolitan area, as well as personal income and employment by state and local area.	http://www.bea.gov/regional/index.htm
Regional Economics Applications Laboratory (REAL). The University of Illinois at Urbana-Champaign's REAL focuses on the development and use of analytical models for urban and regional forecasting and economic development. REAL provides analytical economic information for decision-making by public sector agencies, and it can provide both impact and forecasting analyses.	http://www.real.illinois.edu/
DOE-2.2 Model. DOE-2.2 is the newest version of DOE-2, which is a building energy analysis program that can predict the energy use and cost for all types of buildings by using a description of the building layout, construction, operating schedules, conditioning systems, and utility rates provided by the user, along with weather data, to perform an hourly simulation and estimate utility bills.	http://www.doe2.com/
Regional Input-Output Modeling System (RIMS II). The Bureau of Economic Analysis' RIMS-II produces regional multipliers that can be used in economic impact studies to estimate the total economic impact of a project on the region. A modified economic model will replace the original RIMS II in 2015.	https://www.bea.gov/regional/rims/
System Advisor Model (SAM). NREL's SAM is a comprehensive solar technology systems analysis model that allows users to investigate the impact of changes in physical, cost, and financial parameters to better understand their impact on system output (hourly, monthly, and annual), peak and annual system efficiency, levelized cost of electricity, net present value, system capital costs, and system operating and maintenance costs.	https://www.nrel.gov/analysis/sam/
Jobs and Economic Development Impact (JEDI) Models. NREL's JEDI estimates the economic impacts of constructing and operating power generation and biofuel plants at the local and state levels. The model can analyze biofuels, coal, concentrating solar power, geothermal, marine and hydrokinetic power, natural gas, and photovoltaic power plants.	http://www.nrel.gov/analysis/jedi/

Title/Description	URL Address
The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs. This 2014 ACEEE report reviews utility-sector energy efficiency program costs and calculates the levelized cost of saved energy using data collected by program administrators. The report finds that energy efficiency programs are holding steady as the nation's least-cost energy resource option.	http://www.aceee.org/research-report/u1402
The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025. This 2013 article features projections of future spending on and savings from energy efficiency programs funded by electric and gas utility customers under three scenarios through 2025. The three scenarios represent a range of potential outcomes under the current policy environment.	http://emp.lbl.gov/sites/all/files/lbnl-5803e.pdf

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ACEEE. 2014. State Energy Efficiency Resource Standards (EERS). American Council for an Energy-Efficient Economy. Accessed September 2014.	http://www.aceee.org/files/pdf/policy-brief/eers-04-2014.pdf
AKHR. 2010. House Bill 306. Alaska House of Representatives.	http://www.legis.state.ak.us/basis/get_bill_text.asp?hsid=HB0306Z&session=26
C2ES. 2014. Greenhouse Gas Emissions Targets. Center for Climate and Energy Solutions. Accessed September 2014.	http://www.c2es.org/us-states-regions/policy-maps/emissions-targets
DSIRE. 2015a. Summary Tables: Energy Efficiency Resource Standard. Database of State Incentives for Renewables and Efficiency. Accessed April 22, 2015.	http://programs.dsireusa.org/system/program?type=84&
DSIRE. 2015b. Summary Tables: Renewables Portfolio Standard. Database of State Incentives for Renewables and Efficiency. Accessed April 22, 2015.	http://programs.dsireusa.org/system/program?type=38&
EPA. 2011. Assessing the Multiple Benefits of Clean Energy: A Resource for States. U.S. Environmental Protection Agency.	http://epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits.pdf
EPA. 2014a. State Examples. State and Local Climate and Energy Program. U.S. Environmental Protection Agency. Accessed August 2014.	http://www.epa.gov/statelocalclimate/state/state-examples/index.html
EPA. 2014b. GHG Abatement Measures. U.S. Environmental Protection Agency. Accessed October 2014.	http://www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-ghg-abatement-measures.pdf
EPA. 2014c. Interconnection Standards. Combined Heat and Power Partnership. U.S. Environmental Protection Agency. Accessed October 2014.	http://www.epa.gov/chp/policies/interconnection.html

Chapter 3. Funding and Financial Incentive Policies

Policy Description and Objective

Summary

States are implementing many policies that affect the economics of energy efficiency, renewable energy, and combined heat and power (CHP). Such policies make investments more attractive by reducing cost barriers, lowering risk, and reducing regulatory compliance costs. These include targeted funding and incentive programs that increase investment in energy efficiency, renewable energy, CHP, and services by residents, industries, and businesses in their state.

Over the past three decades, states have diversified their programs from grants and loans into a broader set of programs that target specific markets and customer groups. This diversification has led to program portfolios with greater sectoral coverage, a wider array of partnerships with businesses and community groups, and reduced risk associated with programmatic investments in energy efficiency, renewable energy, and CHP.

The types of funding and financial incentive programs discussed in this chapter include:

- Direct cash incentives including grants, rebate programs, and performance-based incentives.
- Tax incentives.
- Loans and financing programs such as revolving loans, property assessed clean energy (PACE) financing, energy performance contracting (EPC), credit enhancement, and energy-efficient mortgages (EEMs).
- Green banks.

In addition to funding and financial incentives programs, states have found that other policies, such as standards, programs, and requirements, can improve the effectiveness of their energy efficiency, renewable energy, and CHP investments. These policies can lower investment risks; increase the pace of adoption; and create stronger markets for energy efficiency, renewable energy, and CHP. For example, state requirements, such as a renewable portfolio standard (RPS), can lower the costs of renewable energy over time as the technology deployment scales up; they can also lower risks as they demonstrate the benefits of action through experience. This chapter touches on these policies but many are discussed in greater detail in other chapters of the *Guide to Action*.

Objective

State-provided funding and incentives help support technologies, products, and practices that are new to, or are not otherwise captured by, the market. Such programs also encourage private sector investment. Financial incentives can reduce market barriers associated with high “first cost” or be used to spread the costs over a period of time so that costs and benefits are realized in a more synchronized fashion.

Benefits

States have found that providing funding and incentives for energy efficiency, renewable energy, and CHP can offer the following environmental, energy, social, and economic benefits:

- Reduces total energy costs by supporting cost-effective energy efficiency, renewable energy, and CHP projects.
- Ensures that renewable energy is delivered, specifies which technologies are used, and offers incentives to install technologies.
- Accelerates the adoption of clean energy technologies by improving the project economics and helping to lessen market, institutional, or regulatory barriers until those barriers can be removed.
- Establishes the necessary energy efficiency, renewable energy, and CHP technology or project development infrastructure to continue stimulating the market after the incentives are no longer in effect.
- Offers opportunities to lower energy bills and enhance comfort in low-income housing (sometimes known as "affordable comfort").
- Leverages federal incentives and stimulates private sector investment by further improving the economic attractiveness of energy efficiency, renewable energy, and CHP, which may lead to broad support and increase adoption of a technology or process.
- Stimulates energy efficiency, renewable energy, and CHP businesses and job creation within the state.
- Supports environmental objectives, such as improving air quality; reducing water discharges; frequently limiting water use and solid waste; and improving land resource use, including the reuse of formerly contaminated lands, landfills, and mine sites.
- Increases consumer awareness through program-related education campaigns.
- Transforms the market towards offering more energy efficiency, renewable energy, and CHP.

Guide to Action Roadmap of Funding and Financial Incentives

Several of the incentive programs identified in this chapter are also discussed in other chapters of the *Guide to Action*. The following table provides a roadmap for identifying policies described in the *Guide to Action* that use these incentives:

Table 3.1: Crosswalk of Funding and Financial Incentives and *Guide to Action* Policies

Category	Incentive	Section/Chapter				
		4.1	4.2	4.3	4.5	6.0
Direct Cash Incentive	Grant Programs	✓	✓			✓
	Rebate Programs and Performance-Based Incentives	✓	✓			✓
Tax Incentives			✓	✓		✓
Loans/Financing	Revolving Loan Funds	✓	✓		✓	✓
	On Bill Repayment or On Bill Financing					
	PACE Financing		✓	✓		✓
	Tax Increment Financing					
	Qualified Energy Conservation Bonds					
	EPC		✓	✓	✓	
	Credit Enhancement		✓	✓		✓
	EEMs		✓	✓		✓
Green Banks			✓	✓	✓	✓

Direct Cash Incentives

Direct cash incentives either help offset the cost of building or installing equipment or services, or provide a revenue source tied to performance. Typically, energy efficiency measures are supported through rebates or buy-downs that offset the cost of energy efficiency technologies or services, while renewable energy and CHP generation is supported by buy-downs, rebates, and generation-based incentives.

Quick Guide to Direct Cash Incentives

Grants are cash incentives that are allocated *prior to* installation and *do not* require repayment.

Rebates are cash incentives that are allocated *after* installation and *do not* require repayment.

Performance-based Incentives are similar to rebates but are administered *based on performance* of the upgrade and *do not* require repayment.

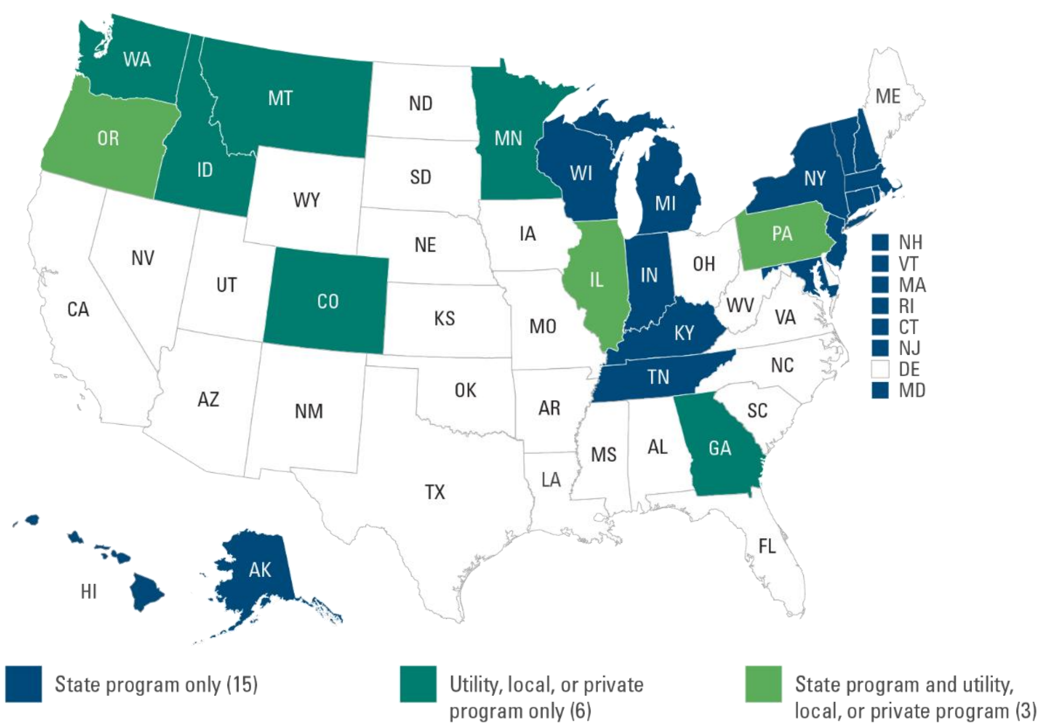
Ratepayer-funded programming is a significant source of funding for direct cash incentives (particularly incentives related to energy efficiency), which in many cases are administered by utilities with public utility commission (PUC) oversight.

Grant Programs

State grant programs cover a broad range of activities, and may help fund system installation costs, research and development, business and infrastructure development, system demonstration, and feasibility studies. Grants can be given alone or leveraged by requiring recipients to match the grant. Grants can also be bundled with other incentives, such as low-interest loans.

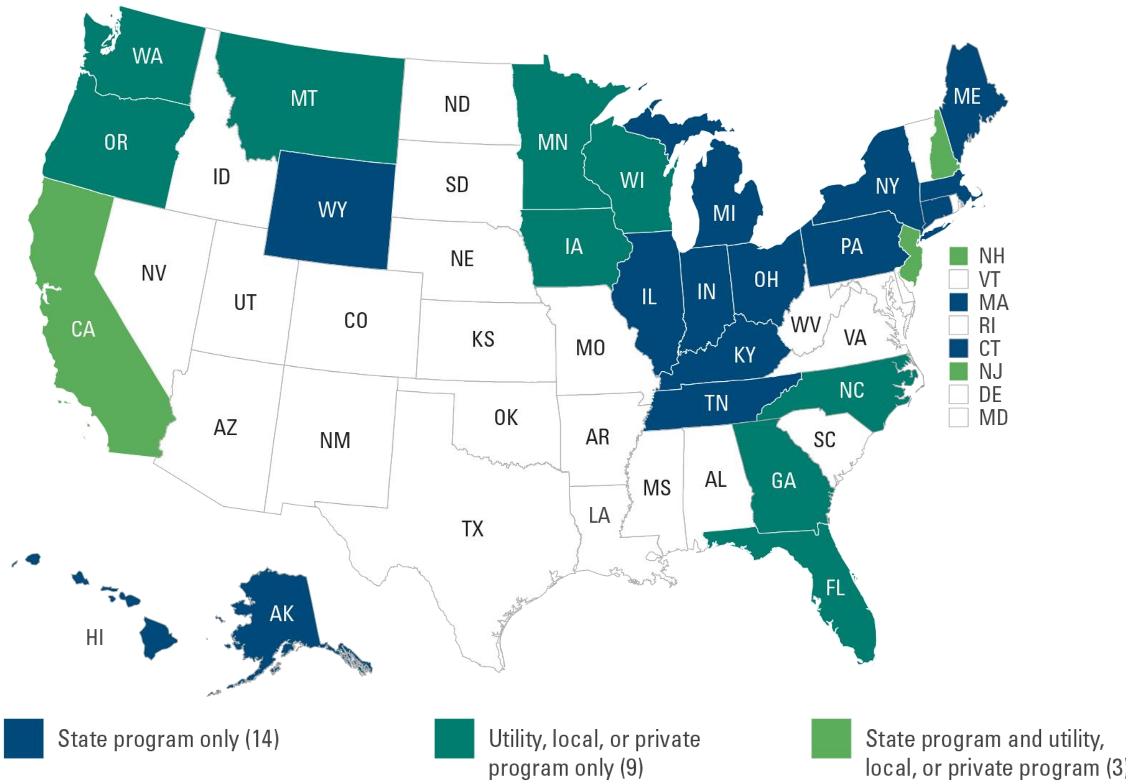
Twenty-four states have grant programs that promote renewable energy technologies, while 26 states have grant programs that promote energy efficiency technologies (DSIRE 2015c). These grant programs are usually administered by states, nonprofit organizations, and/or private utilities. For example, the New York State Energy Research and Development Authority (NYSERDA) oversees a grant program to help companies develop and deploy renewable energy technologies manufactured in New York.

Figure 3.1: States with Grant Programs for Renewable Energy, as of March 2015



Source: DSIRE 2015c

Figure 3.2: States with Grant Programs for Energy Efficiency, as of March 2015



Source: DSIRE 2015c

Rebate Programs and Performance-Based Incentives

Sometimes, the cost of installing renewable energy systems or purchasing energy efficiency equipment is a barrier to wider use of these technologies. Some states seek to lower this barrier by offering rebates or performance-based incentives that will reimburse system operators and consumers for some of the costs they incurred. Other states operate hybrid systems that incorporate both rebates and performance-based incentives to reduce initial costs *and* ensure that ongoing operation of the system is financially attractive.

Typically, rebates and performance-based incentives are funded by utility customers and administered by utilities, with oversight from PUCs. In a handful of states, they are administered by a state agency.[10] In most cases, utility bill charges are collected as a separate line item on the bill, discrete from other utility charges. In a few states, programs are funded by utilities directly under utility commission directives. For example, Minnesota's Conservation Improvement Program is funded by the state's utilities.

States have found that rebate and performance-based incentive programs can help create conditions for long-term market development and growth. States have found that to do this, rebate and incentive programs are most effective when they have some degree of stability and predictability, with the flexibility to adapt to changing market conditions. For example, if there is high market saturation of a particular technology, then incentives can be reduced or criteria can be increased to respond to market conditions.

[10] A database of state utility sector efficiency programs can be found at http://aceee.org/portal/programs.

Rebates

Rebates are usually used to offset the initial purchase cost of the renewable energy system or energy efficiency technology. For example, several states such as California and Maryland have employed programs that offer rebates to help reduce the initial upfront costs of onsite solar photovoltaic (PV) systems. Rebates are frequently used to encourage the purchase of energy-efficient appliances as well. In some cases, cash incentives are targeted to retailers, contractors, or homebuilders to ensure efficient options are available and promoted by suppliers. Suppliers can use the incentive to offer a lower price to consumers.

Rebate levels vary by technology and state. Fifteen states have renewable energy rebate programs (DSIRE 2015g). All 50 states and Washington, D.C., offer energy efficiency rebates or similar kinds of incentives from the state, local government, or utilities. For example, Alaska's Home Energy Rebate Program provides up to $10,000 in rebates to homeowners who make energy efficiency improvements to an existing home, and up to $10,000 for the construction of a qualified energy-efficient new home. States have found it helpful to continually reassess and adapt the suite of energy efficiency, renewable energy, and CHP rebates based on market opportunities.

States frequently provide rebates for solar PV, but rebates are also provided for other resources, technologies and applications, such as wind, biomass, and solar water heating. In general, rebates are provided on a systems capacity or per-watt basis, with the total rebate amount expressed as a maximum dollar amount or a maximum percentage of total system cost. For example, as of August 2014, NYSERDA provides a $1.00 per watt rebate for solar PV up to 50 kilowatts (kW) and an additional $0.60 per watt for installed capacity over 50 kW and up to 200 kW. Oregon's Small Wind Incentive Program provides a rebate of $5.00 per kilowatt-hour (kWh) (based on 1 year's expected generation) for systems expected to generate up to 9,500 kWh per year, and $1.75 per kWh for expected generation over 9,500 kWh per year. Total incentives are capped at 50 percent of the total installed cost.

Performance-Based Incentives

Performance-based incentives typically pay equipment owners/operators based on the output of renewable energy produced over time. Unlike an upfront rebate, a performance-based incentive helps ensure that only well-designed and maintained systems receive incentive payments over their intended operational life. Performance-based incentives have also been used to encourage whole-building energy efficiency improvement. In some cases, hybrid rebate and performance-based incentives are used to reduce initial costs *and* ensure that ongoing operation of the system is financially attractive.

In contrast to incentives that help finance initial capital costs (e.g., rebates and sales tax exemptions), some states distribute funds based on the amount of energy generated by a renewable energy system or the energy conserved by installing energy-efficient technology. For example, the California Solar Initiative, though currently at its funding limitation, has provided incentive payments of $0.39 per kWh during the first 5 years for solar systems 30 kW and larger ($0.50 per kWh for government entities and nonprofits). The rebate is based on the actual electricity generated by PV systems. This performance-based incentive is paid monthly depending on the actual amount of energy produced for a period of 5 years. New Jersey's Clean Energy Program uses a pay-for-performance model that rewards incentives based partially on the completion of a post-construction benchmarking report. The report verifies energy reductions from energy efficiency that exceed 15 percent savings after a year of post-construction operations.

Twenty-nine states offer some form of performance-based incentive (DSIRE 2015f).

Hybrid Approach—Combining Rebates and Performance-Based Incentives

Hybrid incentives can be used to share the investment risk between the funding organization and the recipient. Through a hybrid approach, rebates are used to decrease the initial cost of investing in energy efficiency, renewable energy, and CHP technologies, while the performance-based incentive limits the funding organization's investment until the recipient demonstrates the project's effectiveness (ACEEE 2013). Hybrid incentives can be used for energy efficiency, renewable energy, and CHP projects, and are frequently used for large CHP systems, which can vary in performance and have high initial costs.

California established a tiered capacity payment for CHP projects over 30 kW (projects under 30 kW receive the entire incentive up front), in which 50 percent of the total incentive is paid up front, and the remaining incentive is paid out over several years based on the program's performance (ACEEE 2013). In New York, larger CHP systems (greater than 1.3 megawatts [MW] nameplate capacity) are eligible for both a performance-based incentive (based on output) and an initial capacity-based incentive (based on projected reduction in peak demand). Bonus incentives are paid based on performance, and projects not meeting certain performance standards receive a reduced payment (NYSERDA 2014).

Tax Incentives

Tax incentives can be used to reduce income, property, or sales tax burdens, thus making investments in energy efficiency, renewable energy, and CHP more attractive. State tax incentives can be directed towards individuals or corporations. They can be administered through sales, property, corporate, and income taxes imposed by the state and may take the form of credits, deductions, or incentives. See the "Quick Guide to Tax Incentives" text box for a brief explanation of each type presented in Table 3.2, which summarizes the incentives as of March 2015 (DSIRE 2015b).

Quick Guide to Tax Incentives

Tax Exemptions or credits are used to excuse *individuals* or *corporations* from paying income, sales, corporate, or property taxes on upgrades or state-designated equipment purchases.

Tax Deductions are used to reduce the amount of income upon which *individuals* or *corporations* pay taxes.

Table 3.2: Summary of Tax Incentives by State, as of March 2015

State	Sales Tax Incentive	Property Tax Incentive	Personal Tax Credit	Corporate Tax Credit	Personal Tax Deduction	Corporate Tax Deduction	Corporate Tax Exemption
AL					✓		
AK		✓					
AZ	✓	✓	✓	✓	✓		
AR							
CA	✓	✓					
CO	✓	✓					
CT	✓	✓					
DE							
FL	✓	✓		✓			
GA	✓						
HI		✓	✓	✓			
ID		✓			✓		
IL	✓	✓					

Table 3.2: Summary of Tax Incentives by State, as of March 2015

State	Sales Tax Incentive	Property Tax Incentive	Personal Tax Credit	Corporate Tax Credit	Personal Tax Deduction	Corporate Tax Deduction	Corporate Tax Exemption
IN	✓	✓			✓		
IA	✓	✓	✓	✓			✓
KS		✓			✓	✓	
KY	✓	✓	✓	✓			
LA		✓	✓	✓			
ME							
MD	✓	✓	✓	✓			
MA	✓	✓	✓			✓	✓
MI		✓					
MN	✓	✓					
MS							
MO	✓	✓		✓	✓		
MT		✓	✓	✓		✓	
NE	✓	✓	✓	✓			
NV		✓					
NH		✓					
NJ	✓	✓					
NM	✓	✓	✓	✓			
NY	✓	✓	✓	✓			
NC		✓	✓	✓			
ND	✓	✓	✓	✓			
OH	✓	✓					
OK		✓	✓	✓			
OR		✓	✓	✓			
PA		✓					
RI	✓	✓	✓				
SC	✓		✓	✓			
SD	✓	✓					
TN	✓	✓					
TX	✓	✓				✓	
UT	✓		✓	✓			
VT		✓	✓				
VA	✓	✓			✓		
WA	✓						
WV		✓					✓
WI	✓	✓	✓	✓			
WY							

Source: DSIRE 2015b

Tax incentives can help spur innovation in the private sector by making investments in certain technologies more attractive, and can also help make energy efficiency and renewable energy technologies more cost-competitive with traditional technologies. However, unlike grants and rebates, tax incentives require the system owner to pay the entire cost up front and wait until after the owner files their taxes to receive the incentive. Additionally, tax-exempt sectors (i.e., municipal, education, and nonprofit) cannot receive these incentives because their expenditures are not taxed.

Forty-five states currently have a total of 203 personal, corporate, sales, and property tax incentive programs for renewable energy (DSIRE 2015b). These programs are typically funded by general taxpayers or some subset of taxpayers; therefore, it is important to model the likely uptake of the incentives so that states can budget appropriately. States have found it helpful to regularly reevaluate tax incentives to ensure that they continue to meet the program's objectives–spurring investment and making energy efficiency, renewable energy, and CHP technologies competitive.

The most common types of state tax incentives are credits on personal or corporate income tax, and exemptions from sales tax, excise tax, and property tax. In addition, some states have established production tax credits. For example, New Mexico offers a $0.01 per kWh production tax credit for solar, wind, and biomass. Because different tax incentives are suitable to different taxpayers' circumstances, states have found that they can use a range of tax incentives to match these circumstances. For example, property tax exemptions might be more attractive for large wind projects, while homeowners might prefer to claim an income tax credit for the purchase of a solar PV system.

The following are other examples of tax incentives:

- North Carolina offers a renewable energy tax credit equal to 35 percent of the cost of newly constructed, purchased, or leased renewable energy property. Eligible expenditures include equipment, design, construction, and installation costs (less any discount or rebates that may have already been applied). Nationally, North Carolina is currently ranked fourth in installed solar capacity (722 MW) and third in solar electric capacity (335 MW) installed in 2013 (SEIA 2014a).
- New Mexico offers income tax credits for energy production from CHP systems. States typically allow a broad range of CHP system designs for their tax incentives (EPA 2014a).

States also offer tax incentives for energy efficiency investment. Seventeen states have tax incentives for energy efficiency, for a total of 45 tax incentive programs (DSIRE 2015b). These incentives are typically offered as state income tax credits or deductions, but can also be structured as exemptions from state sales tax on appliances or titling tax on vehicles. States with tax incentives for energy efficiency investment include Maryland, Kentucky, Montana, New York, and Oregon (DSIRE 2015b). (See the *State Examples* section later in this chapter for more information.)

Loans and Financing Programs

Loans and financing programs help individuals and businesses overcome initial costs of installing or investing in energy efficiency, renewable energy, and CHP technologies. Although energy efficiency, renewable energy, and CHP upgrades can be cost-effective in the long run, some individuals, businesses, and state or local governments find it difficult to pay the upfront costs. Loans and financing programs provide a source of funding for those upfront costs, usually at favorable interest rates or loan terms. Oftentimes, these loan programs will fund activities or programs that otherwise might not be eligible for loans from traditional sources. Forty-eight states and Washington, D.C., offer loan programs for energy efficiency, renewable energy, and CHP (DSIRE 2015d). Loan and financing programs include revolving loan funds, on-bill programs, PACE financing, EPC, credit enhancement, tax increment financing (TIF), qualified energy conservation bonds (QECBs), EEMs, and third-party ownership/power purchase agreements (PPAs).

Loan Maturity

In addition to the interest rate, the loan maturity (or duration of the repayment period) is an important aspect of financing because it allows the consumers to achieve positive cash flow quickly and affects the opportunity for interest rate buydowns.

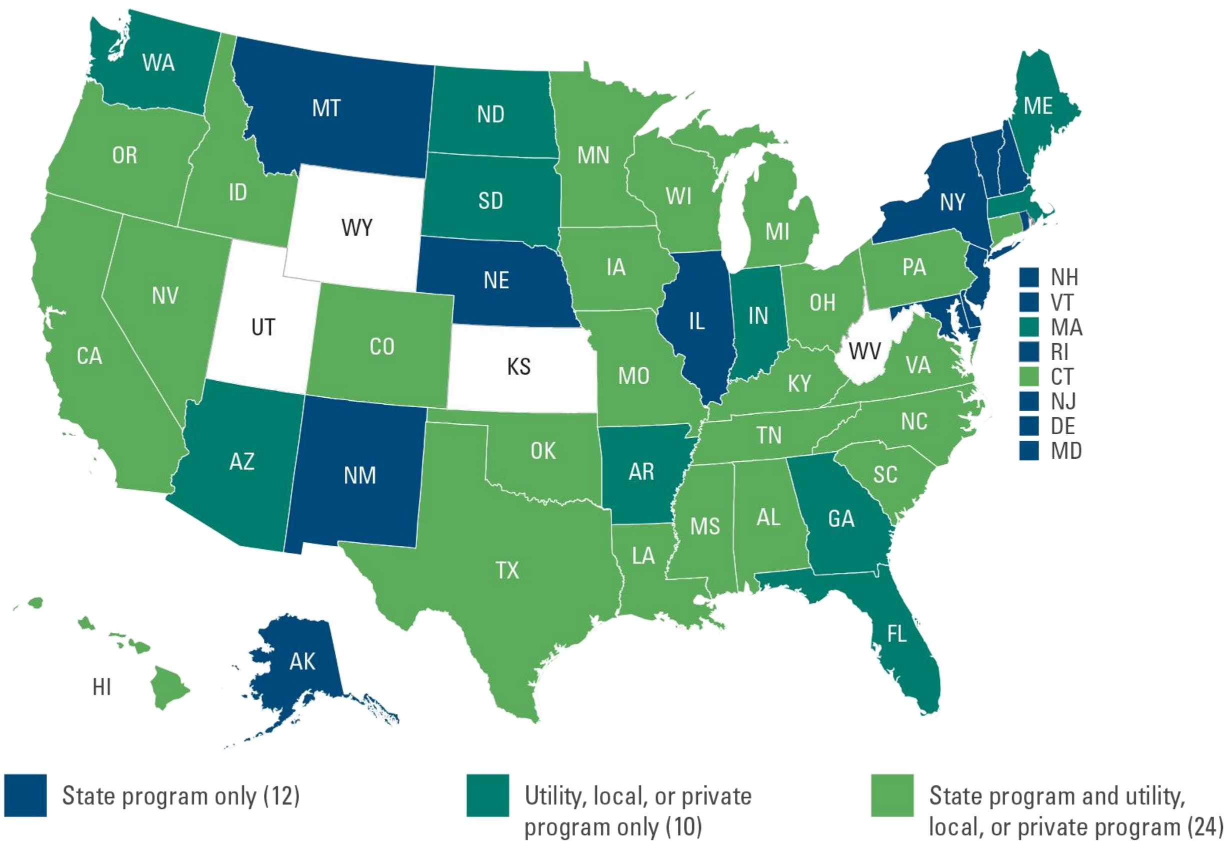
Positive cash flow. The longer the maturity on a loan, the more likely that consumers will see positive cash flow where the energy savings exceed loan payments. This enables consumers to go deeper on energy efficiency upgrades and renewable energy installation because there is quicker payback.

Interest rate buydown. It is better to encourage private investment to extend maturities through loss reserves rather than to have public entities buy down the interest rate on longer term maturities.

Table 3.3: Quick Guide to Loans and Financing Programs

Program	Definition	Program Audience		
		Government	Individuals	Corporation
Revolving Loan Funds	Self-supporting programs that use the payments from earlier borrowers to provide loans for new borrowers.	✓	✓	✓
On-Bill Programs	Allow participants to pay back loans through their regular utility bills.	✓	✓	✓
PACE Financing	Provides building owners upfront cash to install the technology through a lien, which can be paid off over several years and would be transferred to any subsequent property owners.		✓	✓
TIF	Allows local governments to sell debt in the form of bonds serviced by future tax increases that are anticipated to result from the project.	✓		
QECBs	Are used as a low-cost public financing tool that can be structured as a tax credit or direct subsidy to support community projects.	✓		
EPC	Uses reduced energy consumption to repay the upfront cost of a project. It is typically structured with the building owner repaying a third-party installer though energy savings.	✓	✓	✓
Credit Enhancement	Tool to reduce the perceived risk of loans to make more loans available for projects that may not be typically supported by a financial institution.	✓	✓	✓
EEMS	Special mortgages that allow a higher debt-to-income ratio and can be used to purchase homes that qualify as energy-efficient (such as an ENERGY STAR-certified home), based on future savings in operation costs.		✓	✓
Third-Party Ownership/PPAs	Contract vehicle through which a building owner can agree to allow a third party to install a renewable energy system on their property and agree to purchase the energy generated at a predetermined price.	✓	✓	✓

Figure 3.3: States with Loan Programs for Renewable Energy, as of March 2015



Source: DSIRE 2015d

Revolving Loan Funds

Revolving loan funds provide low-interest loans for energy efficiency, renewable energy, and CHP projects. These programs are administered directly by state governments, local governments, and utilities (DSIRE 2015d). States have used revolving funds primarily for energy efficiency investments in publicly owned buildings or for facilities with a clear public purpose.

The funds are designed to be self-supporting. States create a pool of capital when the program is launched. This capital then "revolves" over a multi-year period, as payments from borrowers are returned to the capital pool and are subsequently lent to new borrowers. Revolving funds can grow in size over time, depending on the interest rate that is used for repayment and the program's administrative costs.

States have found revolving loan funds can be created from several sources, including public benefits funds (PBFs), utility program funds, state general revenues, or federal funding sources. Loan funds are typically created by state legislatures and administered by state energy offices. One example is the Texas LoanSTAR program, which provides loans for energy

Texas LoanSTAR Program

The Texas LoanSTAR program is designed to provide low-interest loans to finance energy efficiency retrofits in state public facilities. Loans are repaid in 4 years or less, depending on expected energy savings, often by using cost savings from reduced energy costs. Energy savings are verified by benchmarked energy use before retrofits are installed, followed by monthly energy use analysis for each building.

efficiency projects in state public facilities. The loan fund is based on a one-time capital investment of $98 million from federal oil overcharge restitution funds and is funded at a minimum of $95 million annually.

States have found that revolving funds must be both well-capitalized (e.g., large enough to meet a significant portion of the market need) and long-term (e.g., to allow funds to fully recycle and be re-loaned to a sizable number of borrowers) to effectively contribute to state energy goals and be self-sustaining. In order to maintain a large pool of capital states have found it helpful to consider several tradeoffs. For example, states determine the balance between private and public sector loans and between short-term and long-term loans. Successful loan repayment programs are structured such that there are adequate funds to continue making new loans. Additionally, states have found that funds that have a higher volume of loans with multiple types of borrowers (i.e. commercial and industrial) spread the risk and are more resilient if a borrower defaults on a loan.

On-Bill Programs

On-bill financing (OBF) and on-bill repayment (OBR) are utility bill-based methods in which the consumer repays the program administrators through their regular utility bills. As of January 2014, on-bill programs were operating or preparing to launch in at least 25 states (SEE Action 2014a). Many states have found it helpful to adopt legislation that encourages the implementation of on-bill programs, and several state utility regulators have taken action to assess the feasibility of these programs in their states.

Interest Rate Buydown

Another type of incentive is an interest rate buydown. By paying an upfront fee when a loan is initiated (or refinanced), an administering agency can lower the interest rate for consumers. The JEA program in Jacksonville, Florida, found that buying interest rates down was an effective way to significantly increase customer participation. For more information about JEA, visit http://energy.gov/eere/better-buildings-neighborhood-program/strategic-financing-partnerships-help-jacksonville.

The State and Local Energy Efficiency Action Network's (SEE Action's) 2014 review of 30 existing programs[11] found that the programs had delivered over $1.8 billion of financing to more than 232,000 consumers for energy efficiency improvements. The Tennessee Valley Authority, Alliant Energy Wisconsin, United Illuminating/Connecticut Light & Power (CL&P), and National Grid are program administrators for some of the larger on-bill programs in the United States.

The 2014 SEE Action report identified several key attributes of on-bill programs that proponents advocate:

- Consumers are familiar with making utility bill payments.
- Energy investment (loan payments) and energy savings are reflected in the same bill; consumers can easily see the results of their investment.
- Default rates may be lower because service disconnection could result from non-payment.
- Lower default rates may make it possible for program administrators to offer more attractive financing, such as lower interest rates or longer loan terms, which could expand the number of qualified consumers.
- On-bill programs can be designed to address barriers to efficiency such as renter/owner split incentives.

SEE Action Network

SEE Action offers resources, discussion forums, and technical assistance to help states and local decision-makers develop financing programs. States have found SEE Action resources to be useful in designing effective programs.

A full list of SEE Action resources is available at https://www4.eere.energy.gov/seeaction/resources. Specific resources are included in the list of information resources at the end of this chapter.

[11] The report analysis included a few programs in Canada and the United Kingdom, as well as programs in the United States.

PACE Financing

PACE financing is a loan alternative that states and local governments can use to encourage energy efficiency, renewable energy, and CHP for commercial property owners who are deterred by the associated high upfront costs. Most PACE financing is positioned as a lien on the property, providing upfront cash to property owners to install the technology and allowing them to pay off the lien over several years. The lien will transfer to a new owner if the property is sold, reducing a disincentive for property owners to invest in technology if they believe they may move in a few years.

This type of financing does not reduce the total technology cost, but reduces the upfront burden by spreading the system's cost over a long period of time. It also helps the technology payment coincide more closely with the benefits received from it. Commercial PACE financing has been used to upgrade office buildings, restaurants, industrial properties, multi-family homes, and municipal properties (PACE*Now* 2014). Due to the larger scale use of energy by commercial property owners relative to residential homeowners, the expansion of PACE to the commercial sector has the potential to greatly increase the impact of PACE financing. PACE financing can be used to finance CHP programs.

PACE financing has been authorized in 31 states and Washington, D.C., and a handful of local governments have created similar programs. Maine authorized PACE financing in April 2010 for energy efficiency, renewable energy, and CHP projects. The state received $30 million in funds from the U.S. Department of Energy's (DOE's) Better Buildings Program to implement PACE financing. Although the legislation does not stipulate what types of properties are eligible, the program mainly supports residential properties (DSIRE 2013). Connecticut's PACE financing program supports commercial, industrial, and multi-family property owners for energy efficiency, renewable energy, and CHP improvements through a special assessment on their property tax bill; it is repaid over a period of up to 20 years.

In most states and localities, residential PACE financing programs are on hold due to the Federal Housing and Finance Agency's (FHFA) concerns over senior-lien provisions in PACE programs. Specifically, FHFA is concerned that PACE obligations linked to senior liens on homes with Fannie Mae or Freddie Mac-purchased mortgages would add potential risk to residential mortgage markets. However, FHFA does not oppose PACE programs in which loan obligations are structured as secondary (subordinate) liens, which are not paid off ahead of first-mortgage holders. Secondary-lien PACE programs thus are not seen as affecting risks associated with first mortgage holders (FHFA 2014). Accordingly, a few states have enacted legislation that explicitly removes the senior lien provision in PACE programs, giving PACE obligations a subordinate-lien position (DSIRE 2015e).

Tax Increment Financing

TIF was initially introduced to encourage redevelopment and finance infrastructure in jurisdictions where such investments may not otherwise occur. This financial tool allows local governments to sell debt in the form of bonds that are serviced by future tax increases and those that are anticipated to result from the project. Some states are exploring opportunities to expand the use of TIF to finance energy efficiency and renewable energy upgrades.

Qualified Energy Conservation Bonds

QECBs are a low-cost, public financing tool that enables qualified state, tribal, and local government issuers to borrow money for energy conservation projects. The U.S. Department of the Treasury subsidizes the issuer's borrowing costs. QECBs can be structured as tax credit bonds or direct subsidy bonds (DOE 2015).

Energy Performance Contracting

EPC uses cost savings from reduced energy consumption to repay the cost of installing energy conservation measures (HUD 2014). Under an EPC program, an energy service company (ESCO) conducts an energy audit. The ESCO then designs and constructs a project that achieves the building owner's energy efficiency needs and arranges for the project's financing, usually through a third party. The third party is repaid by the building owner/operator from the savings in their energy costs. Thus, the builder owner/operator does not need to incur upfront expenses, but will experience the benefits of the upgrades, including monetary savings once the financer's costs have been repaid (ICF 2007).

EPC programs have been used extensively by state, federal, and local facilities to reduce utility and operating costs and to help meet environmental and energy efficiency goals. These energy efficiency improvement projects can include the use of CHP. Forty-nine states have implemented performance contracting activities, primarily through legislation, covering a combination of entities that include public agencies, school districts, municipalities, state colleges and universities, counties, or the state (ESC 2013). While EPC programs are widespread, states have found that they can further utilize this approach by extending eligibility to all public facilities in the state.

EPCs are often used to meet state, federal, or municipal requirements regarding the energy performance of government-owned buildings. For example, in 2001, the Washington legislature adopted legislation requiring all state facilities to conduct energy audits. Their goal was to identify energy savings opportunities and to use performance contracting as their first option for achieving those savings. This law led to a surge in EPC activity: through 2010, over $200 million was invested in project implementation by the private sector, with total avoided energy costs of over $90 million by 2010 (WA DES 2010; Washington HB 2247 2001).

Credit Enhancement

Credit enhancements are tools to reduce the perceived risk of lending money or financing projects. By reducing the perceived risk, more financial partners may be willing to make funds available for loans or projects, increasing the overall funding available; they can also make financing available to projects or borrowers who would otherwise not meet the financial partners' lending criteria. Credit enhancements are frequently used to help finance commercial-scale renewable energy projects, but are also used to finance energy efficiency efforts.

A common type of credit enhancement is the establishment of a loan loss reserve fund. Under a loan loss reserve fund, public funds are set aside proportional to the total amount loaned through the loan program (usually about 5 percent of total amount loaned) (SEE Action 2014b). This reserve fund would cover some of the lenders' losses if some of the loans were not repaid, effectively reducing the lenders' risk. This type of credit enhancement is also known as a "first loss reserve," as it is the first source of capital to take a loss (NREL 2014).

Another type of credit enhancement is co-investment between public and private equity. A public entity will invest alongside a private investor, taking an equal risk on potential losses, but not necessarily an equal stake in potential financial returns (NREL 2014). This arrangement allows a private investor to potentially realize greater returns at a relatively lower risk.

A third type is known as mezzanine investment. In this arrangement, a credit enhancement party will invest in a project with the agreement that their investment will be paid back after the investments of lenders (but before the investment of equity partners) (NREL 2014). This arrangement allows for additional funds to be available for a project while keeping the risk to the lenders lower.

Michigan Saves is an example of a loan loss reserve fund. Established with a $6.5 million grant from the Michigan Public Service Commission, Michigan Saves has used the grant funds to attract private investors in order to create a $60 million lending program for residential and commercial energy efficiency loans. Michigan Saves has a loan loss reserve of 5 percent of total loans, and this reserve can be used to cover up to 80 percent of a defaulted loan amount (DOE 2014).

Many states are rolling these financing approaches into state-capitalized, quasi-public green banks that perform a wide array of financing activities to further develop renewable energy and CHP capacity (see Chapter 5, “Renewable Portfolio Standards,” and Chapter 6, “Policy Considerations for Combined Heat and Power”).

Energy-Efficient Mortgages

EEMs are mortgages used to purchase homes that qualify as energy-efficient (such as an ENERGY STAR-certified home). Because the homes will have lower utility costs, the mortgages will allow higher debt-to-income ratios, meaning borrowers may be approved for larger mortgages. To get approved for an EEM, a home energy rating is usually required to ensure that the house is really energy-efficient.

EEMs sometimes also refer to energy improvement mortgages (EIMs), which are mortgages used to purchase homes that will have energy efficiency improvements made to them after the home sale. The cost of the energy efficiency improvements are included in the mortgage, with the energy savings being used to pay for the additional cost of the mortgage (ENERGY STAR 2014).

The Colorado Energy Office (CEO) offers an EEM and EIM program that is administered through mortgage lenders. For new homes, the incentive ranges from $2,000 for homes meeting a Home Energy Rating System (HERS) Index Rating of at least 50, to $8,000 for homes meeting a HERS Index Rating of at least 10 (on the HERS index scale, lower scores indicate more efficient homes). For existing homes, the incentive ranges from $2,000 for improvements that reduce the HERS score by at least 10 points, to $6,000 for improvements that reduce the HERS score by at least 66 points; the benefits cannot exceed more than half of the cost of the improvements themselves (CEO 2014).

Third-Party Ownership/Power Purchase Agreements

Third-party ownership agreements and PPAs are frequently used by states to promote distributed solar energy projects (although they can be used to support other renewable energy and CHP projects as well). Third-party ownership is a state policy decision that allows parties other than the utilities to generate and sell electricity to a purchaser. Once a state allows third-party ownership agreements, PPAs are used as the contract vehicle through which the agreement is executed between a developer and a purchaser. Under this agreement, a homeowner or building owner agrees to allow a third-party company to install solar panels and also agrees to purchase the solar electricity generated from the panels at a predetermined price. The predetermined price is usually set below the building owner’s regular rate when purchasing electricity from the electrical grid and can often include an energy cost escalator over time. The building owner benefits from reduced electricity bills without assuming the project’s investment, performance, or operational risk. The third-party company makes money from the sale of the electricity to the building owner, and capitalizes on available tax or other financial incentives (EPA 2014b).

States have found that laws require utilities to continue providing service to the building owner, and in many cases the utilities must also purchase excess energy that is fed back into the grid (under net metering laws). Thus, the building owner is guaranteed reliable electricity even when the solar panels do not produce enough to meet all of the building's needs. If net metering laws are in place, the third-party vendor can guarantee revenue even if the host building does not need electricity.

States have found that third-party ownership helps promote distributed solar projects. Many homeowners are deterred by the upfront cost of installing solar panels. The third-party company, however, is able to leverage financing, longer financial timeframes, and tax-based incentives to afford the upfront cost and still make money over time. With the establishment of a PPA, the third-party company lowers uncertainty about the long-term costs and benefits to the homeowner or building owner.

Energy Savings Agreement or Efficiency Services Agreement

An energy savings agreement is a partnership among a program administrator, service provider, and customer. The program administrator pays for the upfront cost of the upgrade and the service provider installs the project on the customer's property. This type of contract is similar to a PPA, but it is more commonly used for energy efficiency and CHP programs (Metrus 2015).

Designing Effective Funding and Incentive Programs

When developing and implementing effective funding and incentive programs, states have found it effective to consider a variety of key issues including design principles, key participants, level of funding, and program timing and duration. It is also important to consider interactions with federal and state policies, as well as opportunities to coordinate and leverage programs and resources.

How Other Policies Affect the Economics of Energy Efficiency, Renewable Energy, and CHP

States have found that beyond direct funding and financial incentive programs, other policies and programs, such as standards and requirements, affect and can improve the economics of energy efficiency, renewable energy, and CHP through indirect impacts on the economic viability of projects. These policies do not typically provide direct funding opportunities, but instead advance agreements, partnerships, and market development that make energy efficiency and renewable energy technologies financially viable. States have found it useful to consider aligning policies, programs, and funding incentives to optimize synergies that can further support economic viability and deployment of energy efficiency, renewable energy, and CHP upgrades. For more information, see *Interaction with State Policies* later in this chapter.

Design Principles

States have developed extensive experience in funding and incentives programs. While program design considerations are somewhat specific to the markets and technologies involved, four general design principles have emerged:

- Select specific target markets and technologies based on technical and economic analyses of a state's energy efficiency, renewable energy, and CHP potential, markets, and technologies.
- Use financing and incentives as part of a broader package of services designed to encourage investments by targeting public efforts to supplement, not supplant, private efforts.
- Establish specific technical and financial criteria for clean energy investments, such as those related to cost, size, or performance that matches desired outcomes.
- Track details of program participation costs, energy savings, and energy production to enable evaluation and improvement.

In designing their funding programs, states assess their intended markets and other funding sources, particularly the competitive commercial financing options that are available to their target customers. Some states take the approach of targeting markets that currently receive minimal attention from the commercial financing industry, rather than competing with private offers. Other states have sought to augment the incentives offered through private financing by working with the financial industry to design effective programs that address market barriers other than lack of capital alone, such as risk.

Some states have found that coordinating funding and incentives with other program policies results in more effective programs and creates opportunities to leverage investments. For example, Delaware offers a package of financial incentives, combined with its RPS, which has reduced the payback period for solar home systems to 5 years (NESEA 2013). Other program features that states bundle with financing and incentives include customer education and outreach; standardized and streamlined interconnection and permitting processes for clean energy production; and creation of effective partnerships with financial institutions, equipment providers, and installers.

Green banks offer an emerging approach used by an increasing number of states to evolve away from traditional state funded incentive programs. It uses creative financing to bring and leverage private capital to develop projects and markets. Green banks can be self-sufficient and manage their seed capital in perpetuity. They do not require ongoing funding from the legislative and state budget process once they are capitalized. Because green banks are effectively nonprofit organizations, they can offer a capital cost far lower than any other source of capital available in the market. States may want to consider consolidating their incentive programs and resources under a green bank framework. Examples include the New York Green Bank, and Connecticut Green Bank, and New Jersey's Energy Resilience Bank (ERB).

Participants

Participants include both public and private sector organizations. Public sector participants can include state and local government agencies, state legislatures, school districts, and nonprofit organizations. Private sector participants can include utilities, financial institutions, large corporations, small businesses, and individual residents. Depending on a state's energy efficiency goals, budgets, and general policy acceptance, certain stakeholders might be targeted more directly than others during the initial policy rollout phase or over the entire life of the program.

The following is a list of funding and incentive program participants and their typical roles and responsibilities:

- *State legislatures.* State legislatures pass bond legislation and authorize appropriations for incentives. They also authorize changes to state tax laws and state accounting and procurement rules that enable clean energy funding programs. State legislatures or executive branches can authorize outsourcing or conduct performance contracting in any facilities under their fiscal authority. They can pass legislation to create an independent, quasi-governmental entity (e.g., Connecticut Green Bank).
- *State energy offices and PUCs.* Energy offices and PUCs conduct statewide energy planning, administer financing programs, provide technical assistance, and measure and evaluate state-funded projects to ensure that intended results are being achieved.
- *Utilities.* Utilities administer related publicly- and privately-funded programs that states and energy customers can leverage, such as rebates, buydowns, OBF, and OBR.

- *Third parties.* Third parties, such as financial institutions and nonprofit organizations, can serve as financing centers to manage funds (e.g., the Iowa Energy Investment Corporation), as “trade allies” (e.g., equipment installers and ESCOs), and as lending institutions.
- *Businesses.* Businesses apply for funding and incentives, contribute their own financial resources, and purchase and/or use clean energy technologies.
- *Residents and other consumers.* Consumers apply for funding and incentives and purchase and/or use clean energy technologies.

Green Banks—A Sustainable Financing Alternative

Green banks serve as an umbrella framework through which states can coordinate many of their existing energy efficiency, renewable energy, and CHP incentive programs to maximize the efficiency and alignment of public dollars and attract private sector investment. Green banks are operated sustainably, allowing finite state resources to be utilized for greatest market impact.

State-level financing authorities for energy efficiency, renewable energy, and CHP initiatives, often referred to as “green banks” or “clean energy finance banks,” are established as a way to encourage investment in energy efficiency, renewable energy, and CHP technologies. A green bank is a public or quasi-public financing institution that provides low-cost, long-term financing support to clean, low-carbon projects. Through the use of various financial mechanisms—including some of the financing mechanisms discussed earlier in this chapter, such as PACE financing—green banks leverage public funds to attract private investment for clean energy projects. In this way, each public dollar supports multiple dollars of private investment. In fact, Connecticut’s Green Bank has demonstrated that for every $1 of public money invested in clean energy projects, it has been able to attract more than $9 of private investment.

Green banks offer states the opportunity to transition away from traditional government-funded grants, rebates, and other subsidies, and towards deploying private capital. Once capitalized, and if managed correctly, green banks can become self-sustaining enterprises. Green banks typically rely on public resources to get started (capitalized) and then use these resources to establish financial tools such as long-term and low-interest rate loans, revolving loan funds, insurance products (e.g., loan guarantees or loan-loss reserves), and low-cost public investments. For example, the New York Green Bank used a portion of the funds collected from the state’s energy efficiency portfolio standards, RPSs, and system benefits charges to encourage private investment.

According to the Coalition for Green Capital, creating and administering a green bank typically involves three steps:

- *Assessment*. In the first stage, the state identifies its specific green bank opportunities and needs, including a review of existing clean energy programs, prioritization of clean energy markets, identification of obstacles to clean energy market growth, and development of proposed green bank financing mechanisms and market development tools. During this stage, states also identify a legislative and capitalization strategy.
- *Establishment*. In this stage, the green bank organization is established, which includes hiring staff, building capabilities, identifying goals, assessing markets, and developing financial products.
- *Administration*. In the final stage, the green bank acquires customers, administers funds in partnership with private investors, and manages funds over time to ensure the bank is self-sustaining.

As of 2014, Connecticut, Hawaii, New Jersey, and New York have established state-level green banks or green bank-like institutions. In addition, several other states, including California, Vermont, Minnesota, Maryland, Rhode Island, and Nevada, are in the process of proposing or developing green banks or green bank-like institutions.

Resources for more information on green banks:

- The Coalition for Green Capital: http://www.coalitionforgreencapital.com/
- The Green Bank Academy: http://www.greenbankacademy.com/
- State Clean Energy Finance Banks: New Investment Facilities for Clean Energy Deployment (2012): http://www.cleanegroup.org/assets/Uploads/State-Clean-Energy-Banks-Sept2012.pdf.
- Working Paper: State Green Banks for Clean Energy (2014): http://energyinnovation.org/wp-content/uploads/2014/01/WorkingPaper_StateGreenBanks.pdf.
- Report: Green Bank Academy (2014): http://www.coalitionforgreencapital.com/uploads/2/5/3/6/2536821/green_bank_academy_report.pdf.

Funding

State clean energy programs that offer financing or financial incentives have used a wide range of funding sources, including:

- *PBFs.* As of June 2014, 22 states offer PBFs that can support energy efficiency, renewable energy, and CHP projects (C2ES 2014). Between 2002 and 2012, state clean energy funds supplied a total of $2.7 billion in support of renewable energy, and leveraged an additional $9.7 billion in federal and private sector investment. This $12 billion total investment supported the development of more than 72,000 renewable energy projects in the United States (Brookings-Rockefeller 2012).
- *Annual appropriations.* Some states support energy financing and incentive programs with general state revenues appropriated through the annual budget process.
- *Bonds.* States have used their bond issuance authority to raise capital for lending programs. In some cases, loan repayments are applied to bond debt service.
- *Utility budgets*. In states that have established utility incentives for demand-side resources, utilities provide funding support for energy efficiency, renewable energy, and CHP as part of their responsibility to deliver least-cost reliable service to their customers. Utilities can fund these resources in different ways, such as within their resource planning budgets or as a percent of total revenues, as directed by state policy.
- *Environmental enforcements and fines.* States that collect fines and penalties from environmental enforcement actions can use the proceeds to support clean energy financing and incentives. Alternatively, funds can come directly from a violator, through a supplemental environmental project (SEP).
- *Carbon dioxide (CO_2) offset programs. S*tates have used their CO_2 offset programs as a source of funding. For example, Oregon's 1997 state law, HB 3283, required new power plants in the state to offset approximately 17 percent of their CO_2 emissions. Power plants can do this directly or by paying the Oregon Climate Trust, which uses the funds to support offset projects, including sequestration, energy efficiency projects, and renewable energy projects. The program currently does not recognize CHP as an efficiency technology either in calculating the required offsets or in the generation of offsets.
- *Cap and trade allowance auction revenue*. CO_2 allowance auctions through the Regional Greenhouse Gas Initiative (RGGI) generate revenue that states can reinvest in consumer benefit programs, energy efficiency, renewable energy, direct energy bill assistance, and other greenhouse gas reduction programs. To date more than $707 million has been invested, with approximately $460 million invested in energy efficiency and $42 million invested in renewable energy (RGGI 2014).
- *Petroleum Violation Escrow (PVE) funds.* Legal settlements stemming from 1970s-era oil pricing regulation violations generated billions of dollars, which states used primarily during the 1980s and 1990s for clean energy programs.
- *EPA State Revolving Fund.* Primarily intended for water conservation, state agencies such as NYSERDA have been able to use these funds for clean energy and efficiency bonds (Clean Energy Group 2013).
- *DOE programs.* DOE provides multiple funding opportunities, including the State Energy Program, the DOE Loan Programs Office, QECBs, and Clean Renewable Energy Bonds.

Funding Levels

When designing financing and incentive programs, states have found it important to determine the incentive levels that are appropriate to market conditions. Ideally, incentives provide just enough inducement to generate significant new market activity and limit financial risk.

For loans or other credit-related incentives such as loan guarantees, public financing typically pays for just enough of the project cost to motivate private investment. If public financing covers too much of a project, it can promote projects that are not financially sound. If investors invest a significant amount of their own money in the project, they will likely be more motivated to make it succeed. Another method is to buy down the interest rates. This is often attractive to both businesses and homeowners. While different than loan guarantees, buy-downs can help put monthly payments within budgetary reach.

For financial incentives such as grants or rebates, the amount offered is often set at a level just high enough to induce private investment. Incentives that are too high can distort market behavior so that the technology does not sustain market share after the incentives end.

Timing and Duration

When developing funding and incentive programs, states have found another key consideration is determining how long the program will be in effect and whether funding will be available on a consistent year-to-year basis. State incentive and funding programs have been more effective when consistently sustained over time (e.g., the Texas LoanSTAR program).[12] Several years are typically required for a significant effort to become known and accepted in the marketplace. States with effective programs have typically established 5- to 10-year authorizations for their programs. Program cycles may be longer in some markets, especially where projects require long lead times for design, permitting, construction, and underwriting. In other cases—for example, in Oregon where faster-turnover consumer products are involved—programs can be conducted in a shorter timeframe. Programs involving incentives, loans, or other forms of financial assistance that have been offered on a short-term basis failed to allow time for markets to respond.[13]

States have found that the appropriate duration of an incentive or financing program also depends on the target market's characteristics and the program's goals. A revolving loan program can continue indefinitely, since the fund typically requires a single initial capitalization. If the size of the target market is large relative to the size of the fund principal, the program can run productively for many years. In other cases, an incentive effort might be targeted at acquiring a specific level of resources in a given timeframe; in such cases, funding levels would tend to be higher and the program duration shorter. Incentives are gradually reduced and ultimately eliminated when the technology or practice becomes standard practice in the target market.

[12] Personal communication with Bill Prindle, American Council for an Energy-Efficient Economy, July 29, 2005.

[13] Ibid.

Best Practices: Designing Energy Efficiency, Renewable Energy, and CHP Funding and Incentive Programs

The best practices identified below address common design elements for developing energy efficiency, renewable energy, and CHP funding and incentives programs. They are based on the experiences of states that have implemented successful programs and organized into three categories: research and design, implementation and integration, and review and modify.

Research and Design

- Conduct or review existing robust technical and economic analyses to screen technologies and program designs, as well as to ensure that the program is cost-effective and designed to achieve significant impacts.
- Conduct or review existing market research to understand customer preferences, market structures, and other factors that will affect program success, as appropriate.
- Analyze market potential to inform the development of targets and goals that reflect the actual economic and technical capacity of the energy-efficient or renewable energy technology.
- Keep program design and procedures as simple as possible, and make it easy to participate.
- Set technical requirements for eligible equipment and practitioners to encourage significant energy savings and system performance (for renewable energy and CHP), and to ensure that measures and projects receive appropriate quality control.

Implementation and Integration

- Incorporate incentives into an overall market development strategy; include installer training and certification.
- Consider how financial incentives can complement or leverage other state programs and policies and federal financial incentives.
- Engage utilities, industry allies, and market participants to reach key market “gateways.”
- Provide ongoing public education about energy efficiency, renewable energy, and CHP technologies and available incentives.
- Provide for hard-to-reach market segments, including public facilities, low-income households, small businesses, and nonprofit organizations.
- Provide stable, long-term program funding where appropriate and plan for decreasing funding as markets change.
- Develop a coordinated package of incentives and other services, including:
  - For energy efficiency: customer promotions and industry ally partnerships for marketing, training, and education.
  - For renewable energy: interconnection standards and net metering.

Evaluation and Modification

- Establish a consistent but cost-effective quality assurance mechanism.
- Design the program to be valuable by creating program tracking and reporting systems that allow review of completed projects.
- Allow flexibility for program modifications.
- Consider lifetime savings to avoid emphasizing near-term savings and overlooking low-cost, long-term measures.
- Identify opportunities to enhance the program with innovative strategies.

Interaction with Federal Policies

Several kinds of federal policies and programs can interact with incentive and financing programs. These programs offer technical assistance, technical specifications for eligible products or projects, federal funding, and opportunities to coordinate delivery of state efforts with regional and national programs. Examples of federal initiatives with which state programs can form partnerships or otherwise interact include:

- *ENERGY STAR®.* Most states have used ENERGY STAR specifications as the basis for incentive or financing qualifications. Since the late 1990s, EPA has worked with utilities, state energy offices, and regional non-profit organizations to help them leverage ENERGY STAR messaging, tools, and strategies and to enhance their local energy efficiency programs. By leveraging ENERGY STAR in local energy efficiency programming, these organizations initiate their programs more quickly; increase their program’s uptake and impact; help drive local market share for ENERGY STAR-certified products, homes, buildings, and plants; contribute to long-term change in the market for these products and services; and deliver on local objectives to increase energy efficiency, maintain electric reliability, and improve environmental quality. (For more information, see http://www.energystar.gov/.)

- *Green Power Partnership.* The Green Power Partnership is a voluntary program developed by EPA to boost the market for green power resources. Although the program does not provide funding for green power purchases, state and local governments that participate in the partnership receive technical assistance and can use the program's *Green Power Purchasing Guide* to inform their green power purchasing decisions. (For more information, see http://www.epa.gov/greenpower/index.htm.)
- *Combined Heat and Power Partnership*. The Combined Heat and Power Partnership is a voluntary program that seeks to reduce the environmental impact of power generation by promoting the use of CHP. The Partnership works closely with energy users, the CHP industry, state and local governments, and other clean energy stakeholders to facilitate the development of new projects and to promote their environmental and economic benefits. Although the program does not provide funding assistance, the partnership maintains a CHP Policies and Incentives Database (dCHPP) which is useful to state and local governments developing and implementing policies to promote CHP. (For more information, see http://epa.gov/chp/index.html.)
- *EPA's RE-Powering America's Land Initiative.* EPA provides tools, technical assistance, and outreach to promote renewable energy installations on contaminated lands, landfills, and mine sites, when such development is aligned with the community's vision for the site. (For more information, see http://www.epa.gov/renewableenergyland/.)
- *Economic Development Administration (EDA) Green Growth.* EDA makes investments to promote American innovation and accelerate long-term sustainable growth in economically distressed communities. To promote environmentally sustainable economic development, EDA directs investments to cultivate innovations with regional energy clusters and cutting-edge technologies. (For more information, see http://www.eda.gov/pdf/GreenGrowthOverview.pdf.)
- *Community Reinvestment Act.* The Office of the Comptroller of the Currency and associated agencies provide oversight and implementation of the Community Reinvestment Act of 1977, which was designed to eliminate discriminatory housing practices such as redlining. In 2014, the Office proposed clarification of community development loans to include loans related to renewable energy or energy-efficient technologies that have a community development component. (For more information, see http://www.occ.gov/news-issuances/news-releases/2014/nr-ia-2014-121a.pdf.)
- *Rural Energy for America Program.* The U.S. Department of Agriculture's Rural Energy for America Program provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses to purchase or install renewable energy systems or make energy efficiency improvements. (For more information, see http://rurdev.sc.egov.usda.gov/BCP_ReapResEei.html.)

Interaction with State Policies

States have aligned their financial incentives with other state clean energy programs and policies to deliver even greater energy and cost savings. Funding and incentives programs interact with and can complement many state policies, including:

- *PBFs.* PBFs can be used as a source of direct incentives, such as rebates, and also as a source of financing assistance. PBFs are funds typically created by levying a small fee on customers' utility bills. PBFs in 16 states and Washington, D.C., support energy efficiency programs, and PBFs in 15 states and Washington, D.C., are used to promote renewable energy.

- *Portfolio management.* Portfolio management refers to an electric utility's energy resource planning and procurement strategies. Effective portfolios are diversified and include a variety of fuel sources, generation and delivery technologies, and financial incentives to encourage customers to reduce their consumption during peak demand periods. Portfolio management delivers clean air benefits by shifting the focus of procurement from short-term, market-driven, fossil fuel-based prices to long-term, customer costs and customer bills. It accomplishes this by ensuring that energy efficiency and renewable generation resources are considered. (See Section 7.1, "Electricity Resource Planning and Procurement.")
- *Environmental enforcement cases.* Under a settlement, a violator may voluntarily agree to undertake an SEP (an environmentally beneficial project) as a way to offset a portion of its monetary penalty.
- *Permitting standards and fees.* Reducing or waiving permit fees, plan check fees, design review fees, or other charges for renewable energy system installations, or expediting the permit process, can often translate into cost savings for a developer or consumer. There is a wide disparity in the charges assessed across jurisdictions—ranging in some cases from $0 to more than $1,200 per project regardless of size. By expediting the permitting process and reducing the financial burden of renewable energy development with permitting incentives and procedural changes, states and local jurisdictions can lessen one of the more significant barriers to project development.
- *Lead by example programs.* Many states lead by example by implementing programs that achieve energy cost savings within their own facilities, fleets, and operations. Lead by example programs include innovative financing mechanisms, such as revolving loan funds, tax-exempt master lease-purchase agreements, lease revenue bonds, performance contracting, and procurement policies and accounting methods. (See Section 4.5, "Lead by Example.")
- *RPSs.* In states with RPS requirements, financial incentives can be used strategically to support the development of more specific renewable energy generation in the state. Several states have established programs known as "RPS carve-outs" or "set-asides," which require that one or more specific renewable energy technologies be used to meet a portion of the RPS requirements. This practice is often used to stimulate economic development or energy diversity and to help develop markets for technologies that may currently be higher cost. In addition to carve-outs, some states may also include "credit multipliers" in their RPS program, which provide extra credit for electricity generated by favored technologies. Some states have decided to use financial incentives to support only renewable energy generation that occurs in addition to the state's RPS requirements. New Mexico, Arizona, Maryland, Colorado, New Jersey, and Delaware have enacted carve-outs for solar energy to meet over 2 percent of electricity sales. States can also add energy efficiency to the RPS, as in Pennsylvania. (See Chapter 5, "Renewable Portfolio Standards.")
- *Interconnection, net metering, feed-in tariff (FIT), and standby rates.* Some states have modified their interconnection standards, net metering rules, and/or standby rate structure to facilitate easier interconnection for distributed energy resources, to increase their profitability, and to provide incentives for renewable energy. In states where interconnection issues have not been addressed, renewable energy generators may face hurdles connecting to the grid and may not have the financial incentives required to ensure the system is sufficiently profitable. Net metering rules enable renewable energy system owners to sell excess production to the utility at retail rates rather than wholesale rates, effectively providing a per-kWh incentive. (See Section 7.3, "Interconnection and Net Metering Standards.") Some states are also reviewing utility standby rates to ensure that they are reasonable and appropriate and do not

unnecessarily limit the development of clean and efficient onsite generation. (See Section 7.4, "Customer Rates and Data Access.") FIT programs guarantee payment per unit of electricity generated and provided to the grid for customers who own a FIT-eligible renewable electricity generation facility.

- *Green power purchasing*. Some states stimulate the green power market by establishing mandates for state government facilities to satisfy a percentage of their electricity demands with green power (e.g., renewable energy certificates [RECs] or green power electricity products) and to make tariffs available for renewable-sourced purchases by all customers. For example, Green Mountain Power's Cow Power offers customers the option to opt in to a program to purchase energy produced by methane generators powered by Vermont's dairy farms (Green Mountain Power 2015). These mandates or standards are usually above and beyond applicable state-mandated RPS requirements. Affected agencies can meet these requirements by participating in utility green power programs, buying RECs, developing their own onsite systems, or entering into PPAs. These mandates help drive demand for renewable energy, encourage the development of new capacity, and provide a revenue stream to projects. As more and more renewable energy projects get under way, the scale of technology deployment can help further drive down costs. (See Section 4.5, "Lead by Example.")

Solarize Campaigns Rapidly Reach New Customers

Solarize Connecticut—a program of the Connecticut Green Bank (formerly the Clean Energy Finance and Investment Authority), implemented in partnership with the non-profit SmartPower—is an on-the-ground "group buy" program that works locally within communities, lowers acquisition costs, and makes solar installations more affordable. To date, 58 Connecticut communities have "Solarized" through the campaign, resulting in:

- The deployment of 16 MW of new solar PV capacity in 2,000 homes across the state in less than 2 years.
- A rate of adoption for residential solar installations between 24 and 64 times greater than the previous 9 years.
- Average savings per Solarize customer of $5,500 to $7,500 on their system compared to average market costs and state incentives at the time of purchase.

For more information, see http://solarizect.com/.

- *Building codes and equipment/appliance standards.* Building energy codes require new building construction and existing building major renovations to meet minimum energy efficiency, renewable energy, and CHP requirements. Well-designed and enforced codes create a market for energy efficiency design and construction practices. Some states have adopted energy codes; for example, the mandatory statewide 2012 Washington State Energy Code includes two versions for residential and commercial codes. As these practices become widespread within the building industry and property owners and managers take note of the reduced building energy costs, other property owners may be encouraged to invest in energy efficiency retrofits and upgrades that are not required by code. (See Section 4.3, "Building Codes for Energy Efficiency," and Section 4.4, "State Appliance Efficiency Standards.")
- *Contractor licensing and certifications.* States have found general contractor licensing requirements can lower transaction costs by ensuring that contractors have the knowledge to incorporate energy-efficient practices into building practices. Licensing contractors who install renewable energy technology also reduce transaction costs and promote consumer confidence within the market. By setting aggressive minimum standards for the knowledge of these practices, states can encourage a healthy market for energy efficiency and renewable energy projects. Similarly, some states have introduced certification programs that identify building operators who are knowledgeable in operating building systems efficiently.

Implementation and Evaluation

Implementing and Administering Funding and Incentives Programs

States have found that the most appropriate agency to implement and administer funding and incentive programs varies depending on the state and type of incentive program offered. In many states, the state energy office manages the program. Other agencies involved in program implementation include the state department of general services, treasury department, and others. In some states (e.g., Oregon and Iowa), a private nonprofit organization implements and evaluates funding and incentive programs.

States have found that the administering agency's objectives include (ACEEE 2002):

- Creating sufficient budget authorizations and appropriations to ensure the program's effectiveness, measured against actionable performance criteria where possible.
- Allowing for an adequate time period (typically 5 to 10 years) for the funding to influence the market.
- Determining an appropriate incentive level for targeted technologies and markets (e.g., incentives should be large enough to generate the investment needed to meet program goals and moderate enough to stay within the budget).
- Establishing funding caps per project and per customer to keep programs affordable and sustainable.
- Setting clear program goals for which technologies should be encouraged. Examples of program focuses include:
  - The most cost-effective technologies, to maximize immediate return.
  - Technologies that are currently underutilized, perhaps due to a market failure, to spur market development.
  - High-efficiency technologies and practices to encourage the high end of the market.
- Being flexible with respect to who receives the incentives so that the most appropriate parties can participate.
- Incorporating sufficient reporting requirements to document program results accurately and prevent program abuse.
- Budgeting adequately for evaluation and conducting evaluations on regular cycles. Allowing for selected detailed audits of larger and more complex projects.

The implementing/administering agency is also responsible for ensuring that an adequate program support structure is in place. States have found this might entail the following actions:

- Allocating sufficient personnel and time for program administration.
- Collaborating with other agencies.
- Establishing agreements with equipment installers, manufacturers, and service providers.
- Collaborating with utilities.
- Conducting public outreach and education campaigns.
- Conducting periodic program evaluations and take corrective measures, if necessary.

Best Practices: Implementing Funding and Incentive Programs

- Consult with other states to gain the benefit of their experiences with program implementation details.
- Reach out to the regional energy efficiency organizations to learn from other programs in your region.
- Select the most appropriate delivery organization(s) for program delivery.
- Approve long-term funding cycles (5 to 10 years) to enable programs to achieve significant market acceptance and impacts.
- Maintain stakeholder communications via working relationships, collaboratives, and advisory groups.
- Provide for adequate program tracking and reporting systems to enable effective evaluation and mid-course program corrections.

Evaluation

In general, states evaluate their state financial incentives programs based on quantitative metrics, such as the amount of money granted, energy savings, and the number of systems installed. In addition, the administrative process is frequently evaluated to track data such as the number of days it takes the state to process an application. While more challenging, states also attempt to determine if financial incentives have the desired effect on the marketplace (i.e., understanding the causal relationship between the incentives and the changes occurring in the market, accounting for "free riders" and estimating the net energy savings impacts achieved by incentives). Standardized reporting requirements and independent evaluation, measurement, and verification (EM&V) of program impacts provide the information required to redirect future investment dollars for optimal effectiveness.

States have found that EM&V methods are critical for ensuring that sufficient projected savings are realized. This determines if funding and incentive investments provide their expected return. For simpler measures with well-established savings performance records, a "deemed savings" approach can be used. A project-specific EM&V approach is warranted for more complex measures, newer technologies, and larger projects. (For more information on EM&V methods, see Section 4.1, "Energy Efficiency Resource Standards," and Section 4.2, "Energy Efficiency Programs.")

Best Practices: Evaluating Funding and Incentive Programs

States have found that evaluating funding and incentive programs requires tracking program use, cost, and energy savings. States best practices include:

- Evaluating programs regularly, rigorously, and cost-effectively.
- Using methods proven over time in other states, adapted to state-specific needs.
- Providing "hard numbers" on quantitative impacts, process feedback on the effectiveness of program operations, and ways to improve service delivery.
- Using independent third parties, preferably with reputations for quality and unbiased analysis.
- Measuring program success against stated objectives, providing information that is detailed enough to be useful and simple enough to be understandable to non-experts.
- Providing for consistent and transparent evaluations across all programs and administrative entities.
- Communicating results to decision-makers and stakeholders in ways that demonstrate the benefits of the overall program and individual market initiatives.

State Examples

The following examples illustrate effective state programs, innovative approaches, and program results for each of the key types of financing and incentive programs.

Direct Cash Incentives

Grant Programs

New York

NYSERDA implements a grant program to assist companies in developing, testing, and commercializing renewable energy technologies manufactured in New York. The program focuses on product and technology development rather than on installation of individual renewable energy systems. Projects are selected based on whether they will be commercially competitive in the near term and the company's ability to achieve specific performance and quality milestones. Eligible technologies include solar thermal, PV, hydro, alternative fuels, wind, and biomass.

Website: http://www.nyserda.org/

Rebate Programs and Performance-Based Incentives

Alaska Home Energy Rebate Program

The Home Energy Rebate Program, administered by the Alaska Housing Finance Corporation, provides up to $10,000 in rebates to homeowners who make energy efficiency improvements to an existing home, and up to $10,000 for the construction of a qualified energy-efficient new home. For existing homes, a home energy rater will evaluate the home before and after improvements, and the amount of the rebate will depend both on the amount spent on improvements, and the amount of efficiency gained. For new homes, the amount of the rebate depends on the energy efficiency rating of the home.

Website: http://www.ahfc.us/efficiency/energy-programs/home-energy-rebate/

California Solar Initiative

California Solar Initiative offers solar incentives to encourage energy customers to implement solar systems in their existing buildings. The initiative began in 2007, has a budget of $2.4 billion over 10 years and sets a goal of 1,940 MW of new solar capacity by 2016. Program components include incentives for single family and multi-family housing, low-income solar water heating, solar thermal, and solar PV. For solar PV, the program uses a tiered structure that decreases the incentive over time. Early adopters (second tier) that installed residential and commercial systems up to 30 kW could receive $2.50 per watt; customers who waited to participate only receive $0.20 per watt. For systems larger than 30 kW, the program offers a performance-based incentive decreasing from $0.39 per kWh (early adopters) to $0.10 for later participants for the first 5 years. Higher incentives are available for government and nonprofit participants. As of March 2015, rebates for Pacific Gas and Electric and Southern California Edison customers had been exhausted.

Website: http://www.cpuc.ca.gov/PUC/energy/solar

New York

NYSERDA provides performance-based incentives for existing facilities to encourage applicants to implement large scale energy efficiency projects. Funding ranges from $30,000 to $2 million for electric efficiency, energy storage, natural gas, demand response, or monitoring-based commissioning projects. Proposed projects must meet minimum savings thresholds, as well as require an engineering analysis to verify energy savings upon project completion.

Website: http://www.nyserda.org/

Hybrid Approach–Combining Rebates and Performance-Based Incentives

California

California, for example, established a tiered capacity payment for CHP projects over 30 kW (projects under 30 kW receive the entire incentive upfront), in which 50 percent of the total incentive is paid up front, and the remaining incentive is then tied to a fixed rate based on the expected generation of the system and the number of years that performance payments will be given out. This way, facilities have an additional incentive to operate systems at expected levels (ACEEE 2013).

New York

In New York, large CHP systems (greater than 1.3 MW nameplate capacity) are eligible for both a performance-based incentive (based on output) and a capacity-based incentive (based on reduction in peak demand). Systems receive payments of $0.10 per every kWh generated as well as between $600 and $750 for every kW of summer peak demand reduced. Projects are also eligible for bonus incentive payments based on the location and load the system is serving as well as the system fuel conversion efficiency. Projects not meeting certain performance standards receive a reduced payment (NYSERDA 2014).

Website: https://www.nyserda.ny.gov/Energy-Efficiency-and-Renewable-Programs/Commercial-and-Industrial/CI-Programs/Combined-Heat-and-Power.aspx.

Tax Incentives

North Carolina

North Carolina offers a renewable energy tax credit equal to 35 percent of the cost of eligible renewable energy property that is constructed, purchased, or leased by a taxpayer. The 2009 bill was extended to include geothermal equipment and the expiration was extended to December 2015. The credit ceilings depend on the technology and type of renewable system (DSIRE 2015a). As a result of the tax credits, and other renewable energy policies, North Carolina is ranked fourth nationally in installed solar capacity. As of 2013, 722 MW of solar energy have been installed, enough to power 64,500 homes (SEIA 2014a).

Expenditures eligible for the tax credit include equipment, design, construction, and installations costs, less any discounts, rebates, allowances, assistance credits, or any other similar reductions. The credit may not exceed 50 percent of the taxpayer’s tax liability for the year (DSIRE 2015a).

Loan and Financing Programs

Revolving Loan Funds

Texas LoanSTAR

Texas LoanSTAR, also known as the Loans to Save Taxes and Resources program, began in 1988 as a $98.6 million retrofit program for energy efficiency in buildings (primarily public buildings such as state agencies, local governments, and school districts). As of January 2014, the program has funded over 237 loans, totaling more than $395 million. It is the largest state-run building conservation program in the country. Funding for the program comes from PVE funds. The Texas State Energy Conservation Office (SECO) administers the funds.

SECO provides extensive program oversight and documentation, ensuring that the data used to establish claims for energy savings are accurate. SECO has developed procedures and guidelines that allow LoanSTAR to prove that the financed energy retrofits would pay for themselves. As part of its quality control, SECO:

- Issues energy assessment guidelines.
- Trains energy engineering consulting firms on audit techniques and LoanSTAR guidelines.
- Develops protocols to meter and monitor each LoanSTAR project to track pre- and post-retrofit energy consumption.
- Develops new methods to analyze energy savings from retrofits.

Projects funded through the LoanSTAR program have had a significant impact on environmental pollutants, preventing the release of 11,291 tons of nitrogen oxides (NO_x), 3.7 million tons of CO_2, and 8,134 tons of sulfur oxide. The program, which is considered one of the most successful building energy efficiency programs in the country, has achieved over $419 million in savings.

Website: http://www.seco.cpa.state.tx.us/ls

PACE Financing

Commercial Property Assessed Clean Energy Program

The Connecticut Green Bank (CGB) is the statewide administrator of its Commercial Property Assessed Clean Energy (C-PACE) program. The CGB maintains a warehouse of capital from which it finances C-PACE transactions and sells to capital markets upon completion. The C-PACE program allows for transferring the obligation and its associated tax lien to the next building owner in the event of a property sale. In the event of a default or foreclosure, all delinquent payments must be brought current by the succeeding property owner. Because of this feature, financed improvements must be permanently fixed to the property; eligible “fixed” improvements include insulation, mechanicals, solar rooftop installations, fuel cells, and underground natural gas piping. The CGB also requires a savings-to-investment ratio greater than 1 over the life of the project improvements.

As of December 2014, 105 towns (of 169 statewide) had opted into CGB’s C-PACE program, giving over 88 percent of the commercial and industrial properties in the state access to C-PACE financing. Over 200 contractors were trained for participation in the program, and 16 capital providers were approved. Additionally, over $58 million in C-PACE assessment advances were approved, delivering 20 to 40 percent energy savings for energy efficiency projects and 50 to 90 percent energy savings for renewable energy projects. An initial portfolio of $30 million comprised of 32 energy efficiency and solar PV projects across a dozen municipalities was sold to Clean Fund, a CGB C-PACE capital provider, in March 2014. Using an auction process, bids for the portfolio were solicited across all of CGB's capital providers. The structure is, in effect, a "private securitization" of the underlying portfolio.

Website: http://www.c-pace.com/

Energy Performance Contracting

Washington

In 2001, the Washington legislature adopted legislation requiring all state facilities to conduct energy audits to identify energy savings opportunities, as well as to use performance contracting as their first option for achieving those savings (Washington HB 2247 2001). This law has led to a surge in performance contracting activity: $100 million has been invested in project implementation by the private sector, with net savings of over $8.3 million annually.

The Washington Department of General Administration (DGA) energy team has designed an EPC program specifically for state agencies, colleges and universities, cities and towns, counties, school districts, ports, libraries, hospitals, and health districts. The EPC program provides assistance to public facilities in completing EPC projects and includes free preliminary audits and consulting services. The program complies with competitive statutory requirements to save time and money. The DGA helps state agencies qualify for the low-interest state treasury financing that is available for EPC projects.

Credit Enhancement

Michigan Saves

Michigan Saves is a statewide energy efficiency lending program established in 2010. It started with grant money from the Michigan Public Service Commission. The program initially focused on residential energy efficiency projects but has since expanded to include commercial programs. It leveraged $3 million of state funds to attract an additional $57 million in loan capital from local credit unions. Michigan Saves has a loan loss reserve fund equal to 5 percent of the outstanding balance of the loans. If any loans default, this reserve fund will cover up to 80 percent of the lenders' losses from that default. Michigan Saves offers loans of up to $30,000 to homeowners, and up to $250,000 to business owners, to make energy efficiency improvements.

Website: http://michigansaves.org/

GreenSun Hawaii

GreenSun Hawaii, administered by the Hawaii Community Reinvestment Corporation (HCRC), is a loan loss reserve fund that covers up to 100 percent of losses on eligible energy efficiency and renewable energy system financing. The fund was created to reduce the risks for financial institutions participating in the Clean Energy Initiative, which aims to achieve 70 percent energy efficiency, renewable energy, and CHP by 2030. Financial providers are able to provide more favorable loan terms to homeowners, businesses, and others who wish to install energy-efficient or renewable energy technologies. GreenSun Hawaii was developed in 2009 with Recovery Act funds from DOE. The program has leveraged $2.67 million into $53 million in energy efficiency equipment loans across the state.

Homeowners are allowed to finance ENERGY STAR refrigerators or air conditioners, solar thermal hot water systems, or solar PV systems. Non-residential owners are required to get an energy audit before they can use the program to finance lighting or air conditioner retrofits/upgrades, solar thermal systems, solar electric systems, or energy-efficient windows.

Website: https://www.hcrc-hawaii.org/community-development/financing-programs2.html

Energy-Efficient Mortgages

Colorado Energy Office

CEO offers two EEM programs, one for new homes and one for existing homes. Under both programs, mortgage lenders can provide Colorado homebuyers with a mortgage incentive at the time of closing. The amount of the incentive varies depending on the degree of energy efficiency (for new homes) or the improvement to the energy efficiency (for existing homes). Energy efficiency is determined through an audit using the HERS index.

The tiered incentive levels are shown in Table 3.4.

Table 3.4: Colorado Energy-Efficient Mortgage Incentives

New Homes	
HERS Index Rating 50–40	$1,000
HERS Index Rating 39–25	$2,500
HERS Index Rating 24–11	$3,000
HERS Index Rating 10 and below	$8,000
Existing Homes	
HERS Index Rating Improvement of 10 to 20 points	$2,000 benefit not to exceed half the improvement cost
HERS Index Rating Improvement of 21 to 35 points	$3,000 benefit not to exceed half the improvement cost
HERS Index Rating Improvement of 36 to 50 points	$4,000 benefit not to exceed half the improvement cost
HERS Index Rating Improvement of 51 to 65 points	$5,000 benefit not to exceed half the improvement cost
HERS Index Rating Improvement of 66 points or more	$6,000 benefit not to exceed half the improvement cost

Website: http://www.colorado.gov/cs/Satellite/GovEnergyOffice/CBON/1251649995727

Green Banks

New York Green Bank

The New York Green Bank, a division of NYSERDA, takes a wholesale financing approach and seeks to partner with financial institutions, retail lenders, and service providers who will then engage directly with end customers. It is a state-sponsored fund that was established in December 2013 with initial capital of $218.5 million. Initial capital came from uncommitted funds raised through clean energy surcharges on the state's investor-owned utility customers and auction proceeds from the RGGI. The Green Bank aims to reach $1 billion in capitalization in the coming years, with projections that this will attract an additional $8 billion in private sector funding into clean energy projects over the next 10 years. The fund is dedicated to increasing capital availability and overcoming obstacles in clean energy financing markets. The Green Bank is one component of the New York State Energy Plan, which emphasizes improving energy affordability, providing a more resilient and flexible power grid, giving customers more control over their energy use, aligning energy innovation with market demand, and unleashing the power of the private sector energy financing.

Website: http://greenbank.ny.gov/

New Jersey Energy Resilience Bank

On February 3, 2014, New Jersey announced its intent to establish the ERB, which will be capitalized with $210 million in Community Development Block Grant-Disaster Resilience funds provided by Congressional supplemental funding. The ERB will address the energy vulnerabilities that were revealed at critical facilities throughout the state and allow the most innovative and resilient energy projects, such as dynamic microgrids (such as those being designed for the NJ TransitGrid) to become a reality throughout the state.

The ERB would be the first bank of its kind in the nation; it would focus exclusively on hardening critical facilities to address energy vulnerabilities. The ERB would support energy infrastructure projects that lack funding, as well as projects that incorporate resilient energy technologies that allow infrastructure to continue operating even if the larger electrical grid fails. To the extent possible, the ERB would leverage limited federal dollars with state funding and private sector capital to maximize energy resilience at the most critical facilities. It will provide the resources New Jersey's critical facilities need to invest in fuel cells, CHP, solar with storage, and other technologies that better prepare water and wastewater facilities, schools and hospitals, police and fire stations, and other key community infrastructure for future weather events. DOE has been providing technical assistance in the design, structure, and pipeline development of the ERB.

Website: http://www.state.nj.us/bpu/commercial/erb/

Connecticut Green Bank

The CBG operates at a retail level by creating its own financial products, marketing them directly to end customers, and performing loan underwriting. It was established by the Governor and Connecticut's General Assembly on July 1, 2011, through Public Act 11-80 as a quasi-public agency that supersedes the former Connecticut Clean Energy Fund (CCEF). As the nation's first state "Green Bank," the CGB leverages public and private funds to drive investment and scale up clean energy deployment in Connecticut. The CGB's mission is to support the Governor's and Legislature's energy strategy to achieve cleaner, cheaper, and more reliable sources of energy while creating jobs and supporting local economic development. Its goals include:

- Attracting and deploying private capital to finance the clean energy goals of the state.
- Developing and implementing strategies to bring down the cost of clean energy to make it more accessible and affordable to consumers.
- Reducing the market reliance on grants, rebates, and other subsidies and moving it towards innovative, low-cost financing of clean energy deployment.

In its first 3 years of operation, the CGB has demonstrated the financing model's efficacy when compared to the subsidy model (see Table 3.5).

Table 3.5: Summary of Connecticut's Clean Energy Fund and Green Bank Programs

	FY 2000 FY 2011 (CCEF)	FY 2012 FY 2014 (CGB)
Model	Subsidy	Financing
Years	11	3
Clean Energy (MW/Lifetime GWh)	43.1/2,299	65.3/3,189
Total Investment ($MM)	$349.20	$350.20
Ratepayer Investment ($MM)	$168.10	$100.00
Investment as Loans (%)	9	57

GWh= gigawatt-hour

According to the CGB, the Bank is deploying more clean energy at a faster rate while using public resources more responsibly, creating nearly 2,500 jobs and reducing carbon emissions by over 580,000 tons over the life of the projects. [14]

Website: http://www.ctcleanenergy.com/

Hawaii Green Energy Market Securitization

In 2013, the Hawaii state legislature authorized a program that combines bond financing and OBR to finance clean energy infrastructure in the state. The program, known as Green Energy Market Securitization (GEMS),

[14] Comprehensive Annual Financial Report of the CGB (June 30, 2014). Available at http://www.ctcleanenergy.com/Portals/0/CGB%20-%20finalized%20financials.pdf.

will create a green infrastructure loan fund capitalized by low-interest utility tariff-financed bonds sold to private investors. Residents will be given access to low-cost loans from the loan fund that can be repaid through OBR on their utility bill. GEMS is targeted for implementation in late 2014.

Website: http://energy.hawaii.gov/testbeds-initiatives/gems/gems-overview

What States Can Do

States have diversified what were originally simple grant or loan programs into a broader set of funding and incentive programs that encourage specific markets and customer groups to invest in energy efficiency and clean supply projects. The information in this *Guide to Action* describes best practices for design, implementation, and evaluation; summarizes a wide range of state experiences with funding and incentive programs; and offers a variety of information resources on funding and incentive strategies. Based on these state examples, action steps for states that want to establish their own funding and incentives programs or strengthen and expand existing programs are described below.

Action Steps for States

States interested in creating or expanding funding and incentive programs for energy efficiency, renewable energy, and CHP can take the following steps:

- *Develop an inventory of current financing and incentive programs.* Review existing programs and identify the need for new or expanded offerings. Conduct market research, as necessary, to identify these needs.
- *Design funding and incentive programs based on the best practices developed by other states.* States' experiences with funding and incentive programs provide a rich source of information on how to develop successful programs.
- *Identify and secure funding sources*. This can be done via legislative and administrative initiatives, as appropriate. Seek to coordinate program targets and information collection efforts to avoid overlap and duplication.
- *Conduct rigorous evaluation*. Upon completion, report the results to policy-makers, industry, and the public.
- *Revise program*. Make program changes based on the results of the findings of the evaluation.

Information Resources

Information about States

Title/Description	URL Address
The *d*CHPP. The *d*CHPP provides information on state and federal policies and incentives for CHP.	http://epa.gov/chp/policies/database.html
Database of State Incentives for Renewables and Efficiency (DSIRE). This database contains information on federal, state, and local incentives that promote energy efficiency and renewable energy. It provides information for all 50 states and is updated regularly.	http://www.dsireusa.org
EISPC EZ Mapping Tool. This is a searchable database that contains information on policies and regulations.	https://eispctools.anl.gov/policy_query
Innovation, Renewable Energy, and State Investment: Case Studies of Leading Clean Energy Funds. This Lawrence Berkeley National Laboratory website contains case studies of various state clean energy funds.	http://emp.lbl.gov/publications/innovation-renewable-energy-and-state-investment-case-studies-leading-clean-energy-fu-0
Case Studies on the Effectiveness of State Financial Incentives for Renewable Energy. This National Renewable Energy Laboratory report presents state case studies on financial incentives for renewable energy.	http://www.nrel.gov/docs/fy02osti/32819.pdf
Performance Contracting By State. This Oak Ridge National Laboratory website contains information on performance contracting legislation by state. The site includes links to legislation and state performance contracting legislation.	http://web.ornl.gov/info/esco/legislation/newesco.shtml
Plugging in Renewable Energy: Grading the States. This Union of Concerned Scientists report assigns grades to each of the 50 states based on their commitment to supporting wind, solar, and other renewable energy sources.	http://www.ucsusa.org/assets/documents/clean_energy/plugging_in_renewable_energy.pdf

General Information

Title/Description	URL Address
Designing Financial Incentives	
Council of Development Finance Agencies (CDFA): CDFA Brownfields Financing Toolkit. This 2015 document provides easy-to-use best practices and information on revolving loan funds, TIF, bond financing, new markets tax credits, and the EB-5 visa program.	http://www.cdfa.net/cdfa/cdfaweb.nsf/ord/201502_BF_Toolkit/$file/CDFA%20Brownfields%20Financing%20Toolkit%2002.02.15.pdf
Credit Enhancement Overview Guide. 2014 SEE Action report describing successful credit enhancement strategies for residential and commercial buildings.	https://www4.eere.energy.gov/seeaction/publication/credit-enhancement-overview-guide
Energy Efficiency Financing Program Implementation Primer. 2014 SEE Action report about implementing successful energy efficiency financing programs in existing buildings.	https://www4.eere.energy.gov/seeaction/publication/energy-efficiency-financing-program-implementation-primer
Energy Efficiency Finance Programs: Use Case Analysis to Define Data Needs and Guidelines. 2014 SEE Action report about data collection practices for energy efficiency lending.	https://www4.eere.energy.gov/seeaction/publication/energy-efficiency-finance-programs-use-case-analysis-define-data-needs-and-guidelines

Title/Description	URL Address
Energy Efficiency's Next Generation: Innovation at the State Level. This 2003 American Council for an Energy-Efficient Economy (ACEEE) report describes state energy efficiency activities.	http://www.aceee.org/files/pdf/e031full.pdf
Revolving Loan Funds	
Financing Programs: GreenSun Hawaii. HCRC administers the GreenSun Hawaii financing program. Information on the program is available on the HCRC website.	https://www.hcrc-hawaii.org/community-development/financing-programs2.html
LoanSTAR Revolving Loan Program. The Texas SECO administers the LoanSTAR program. Additional information about the program is available at SECO's website.	http://www.seco.cpa.state.tx.us/ls
Energy Performance Contracting	
Putting Energy Savings to Work. The Energy Services Coalition (ESC) is a nonprofit organization that promotes energy service performance contracting.	http://www.energyservicescoalition.org/
National Association of Energy Service Companies (NAESCO). NAESCO is a trade association in the energy services industry, representing ESCOs, distribution companies, DG companies, engineers, consultants, and finance companies. The website contains information on energy efficiency for buildings.	http://www.naesco.org
Case Study Database. This section of the ESC website provides case studies about performance contracting programs by state.	http://www.energyservicescoalition.org/casestudies
Performance Contracting by State. This Oak Ridge National Laboratory website contains information on performance contracting legislation by state. The site includes links to legislation and state performance contracting legislation.	http://web.ornl.gov/info/esco/legislation/newesco.shtml
Tax Incentives	
DSIRE. This website provides information on state, local, utility, and selected federal incentives that promote energy efficiency renewable energy.	http://www.dsireusa.org/
Pace Financing. This National Conference of State Legislatures Web page has additional information about PACE financing, including state examples and legislation.	http://www.ncsl.org/research/energy/pace-financing.aspx
Tax Credits for Energy Efficiency and Green Buildings: Opportunities for State Action. This ACEEE report analyzes state tax energy efficiency incentives provided by the states for the private sector.	http://www.aceee.org/research-report/e021
Designing Financial Incentives	
Incentives, Mandates, and Government Programs Promoting Renewable Energy. This paper discusses major financial incentives used by federal and state governments and their effectiveness in promoting renewable energy.	http://lobby.la.psu.edu/_107th/128_PURPA/Agency_Activities/EIA/Incentive_Mandates_and_Government.htm
CHP Association. This website provides information on federal policies, including tax incentives, designed to promote more widespread use of CHP systems.	http://chpassociation.org/
Grants, Buy Downs, and Generation Incentives	
Energy Efficiency Programs. This site is ACEEE's energy efficiency program database.	http://aceee.org/portal/programs

Title/Description	URL Address
Emerging Renewables Program. This California Energy Commission (CEC) site provides information about the Emerging Renewables Program (formerly called the "Emerging Renewables Buy-Down Program"), which was created to stimulate market demand for renewable energy systems by offering rebates to reduce the initial cost of the system to the customer.	http://www.energy.ca.gov/renewables/emerging_renewables/
Financing Energy Improvements on Utility Bills: Market Updates and Key Program Design Considerations for Policymakers and Administrators. 2014 SEE Action report about the current state of on-bill programs.	https://www4.eere.energy.gov/seeaction/publication/financing-energy-improvements-utility-bills-market-updates-and-key-program-design
Rebates Available for Energy-Efficient Lighting; Heating, Ventilation, & Air Conditioning; Vending Machines; Commercial Kitchen Equipment and Commercial Clothes Washers. The CL&P Energy Efficiency at Work website describes the utility's Express Rebate Program. The programs offer CL&P business customers an opportunity to improve the energy efficiency of their stores or buildings.	https://www.cl-p.com/Business/SaveEnergy/BusinessRebates.aspx
California Public Utilities Commission (CPUC). The CPUC website provides information on CPUC activities and regulations.	http://www.cpuc.ca.gov/
Self-Generation Incentive Program. This site provides information about CPUC's program to provide rebates to encourage DG technologies.	http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/
New York State Department of Environmental Conservation. This website describes energy efficiency projects that the Department administers, including details on the Green Building Initiative tax credits.	http://www.dec.ny.gov/
North & West America Solar Services. This site provides information on the use of solar energy in the Northwest. It contains information on Washington's production incentive program.	http://northwestsolarcenter.org/
NYSERDA. This website provides information on NYSERDA's projects, including those promoting energy efficiency.	http://www.nyserda.org/
Renewable Resources Development Report. This report by the CEC provides details on actions the state is taking to promote development of renewable energy generation, with particular focus on RPS.	http://www.energy.ca.gov/reports/2003-11-24_500-03-080F.PDF
NO_x Set Asides for Energy Efficiency and Renewable Energy Projects	
Creating an Energy Efficiency and Renewable Energy Set-Aside in the NO_x Budget Trading Program. This EPA guidance document contains additional details on designing the set-aside application process, allocating to eligible projects, translating energy savings into emission reductions, determining a timeframe for implementation and awards, and establishing documentation and reporting procedures.	http://www.epa.gov/statelocalclimate//documents/pdf/ee-re_set-asides_vol2.pdf
Designing Measurement and Verification Requirements. This EPA document is under development and will provide additional guidance to states on options for measuring and verifying the potential emission reductions resulting from energy efficiency, renewable energy, and CHP projects.	URL not available.
Guidance on Establishing an Energy Efficiency and Renewable Energy (EE/RE) Set-Aside in the NO_x Budget Trading Program. This 1999 EPA guidance document discusses the elements that a state may consider when deciding whether to establish an energy efficiency, renewable energy, and CHP set-aside and how it should be designed (e.g., the size of the set-aside, eligibility, and the length of awards).	http://epa.gov/statelocalclimate/documents/pdf/ee-re_set-asides_vol1.pdf

Title/Description	URL Address
A Toolkit for States: Using Supplemental Environmental Projects (SEPs) to Promote Energy Efficiency and Renewable Energy. This EPA toolkit is intended to help state and local governments pursue energy efficiency or renewable energy projects through SEPs. It presents the case for pursuing energy efficiency and renewable energy within settlements, provides examples in which SEPs have been used to support such projects, offers additional ideas for projects, and includes a step-by-step regulatory "road map" for pursuing SEPs.	http://epa.gov/statelocalclimate/documents/pdf/sep_toolkit.pdf
Evaluation, Measurement, and Verification	
CALMAC Website. California's statewide CALMAC evaluation clearinghouse contains resources for deemed savings and project-specific EM&V techniques.	http://www.calmac.org/
Efficiency Vermont Technical Reference User Manual. Vermont provides a set of deemed-savings methods in this manual.	Contact Efficiency Vermont at 1-888-921-5990.
International Performance Measurement and Verification Protocol (IPMVP) Public Library of Documents. IPMVP Inc. is a nonprofit organization that develops products and services to aid in the EM&V of energy and water savings resulting from energy/water efficiency projects—both retrofits and new construction. The site contains the IPMVP, a series of documents for use in developing an EM&V strategy, monitoring indoor environmental quality, and quantifying emission reductions.	http://www.evo-world.org/index.php?option=com_content&view=article&id=272&Itemid=379&lang=en
M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3.0. This DOE Federal Energy Management Program (FEMP) document describes and provides links to numerous resources on the engineering techniques and tools used for energy savings verification.	http://www1.eere.energy.gov/femp/pdfs/mv_guidelines.pdf

Examples of Legislation

State	Title/Description	URL Address
Revolving Loan Funds		
Iowa	Legislative Guide: Energy Efficiency Programs. This guide provides an overview of the enabling legislation for state buildings' energy management program.	https://www.legis.iowa.gov/DOCS/LSA/Legis_Guide/2013/LGLSL001.PDF
Montana	Senate Bill No. 506. This 2001 bill established an Alternative Energy Loan Fund.	http://leg.mt.gov/bills/2001/billpdf/SB0506.pdf
	Senate Bill No. 50. This 2005 bill amended the Alternative Energy Loan Fund.	http://leg.mt.gov/bills/2005/billpdf/SB0050.pdf
Texas	Texas Administrative Code. Subchapter on Loan Program for Energy Retrofits. This subchapter describes the Texas revolving loan program for energy efficiency retrofits.	http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=T&app=9&p_dir=P&p_rloc=95986&p_tloc=&p_ploc=1&pg=2&p_tac=&ti=34&pt=1&ch=19&rl=43
Tax Incentives		
Maryland	2001 Clean Energy Incentive Act. Established tax incentives for energy-efficient equipment.	URL not available.
	Income Tax Credit for Green Buildings (House Bill 8). Provides tax credits for buildings meeting aggressive energy efficiency standards.	http://mgaleg.maryland.gov/2001rs/bills/hb/hb0008f.PDF

State	Title/Description	URL Address
New York	Green Building Credit. The New York Assembly passed the Green Building Tax Credit legislation in May 2000.	http://www.chej.org/ppc/docs/pvc_polyvinyl_chloride_or_vinyl/PVC_NYGL.pdf
Performance Contracting		
Colorado	Enabling Legislation for Performance Contracting. (See Title 29 Local Government 29-12.5-101, 29-12.5-102, 29-12.5-103, 29-12.5-104, and Title 24 State Government 24-30-2001, 24-30-2002, 24-30-2003.)	URL not available.
Washington	An Act Relating to the Management of State Energy Supply and Demand (EHB 2247). Washington's 2001 enabling legislation for performance contracting.	http://lawfilesext.leg.wa.gov/biennium/2001-02/Pdf/Bills/House%20Bills/2247.E.pdf
Grants and Rebates (Buy Downs)		
California	The California Solar Center. Tracks some of the legislation passed for financial incentives for solar in California.	http://www.californiasolarcenter.org/incentives.html
	Senate Bill No. 1038. Legislation for the Supplemental Energy Payments Program.	http://www.energy.ca.gov/portfolio/documents/documents/SB1038.PDF
Massachusetts	Massachusetts Technology Collaborative's Commercial, Industrial, and Institutional Initiative.	URL not available.
New York	The New York State Environmental Conservation Law (§§ 1-0101, 3-0301, 19-0103, 19-0105, 19-0305, 19-0311). Provides the New York DEC's authority.	http://www.dec.ny.gov/regulations/40195.html
	Current Funding Opportunities, PONs, RFPs, and RFQs. NYSERDA's information about its funding program.	http://www.nyserda.ny.gov/funding/
Washington	Providing Incentives to Support Renewable Energy (Senate Bill 5101). This bill establishes production incentives and economic multipliers for renewable energy.	http://apps.leg.wa.gov/billinfo/summary.aspx?bill=5101&year=2005

Examples of State Legislation and Program Proposals

State	Title/Description	URL Address
Illinois	Electric Service Customer Choice And Rate Relief Law of 1997 (220 ILCS 5/ Public Utilities Act). This legislation provides an example of exit fee provisions that encourage CHP.	http://www.ilga.gov/legislation/ilcs/ilcs4.asp?ActID=1277&ChapterID=23&SeqStart=35100000&SeqEnd=39400000
Massachusetts	220 CMR 11.00: Rules Governing the Restructuring of the Electric Industry. This legislation provides an example of exit fee provisions that encourage CHP.	http://www.env.state.ma.us/dpu/docs/restruct/96-100/cmr11-2.pdf

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	URL Address
ACEEE. 2013. CHP Implementation: Designing Combined Heat & Power Financial Incentives and Eligibility Requirements for Non-Residential Demand-Side Management Programs. American Council for an Energy-Efficient Economy.	http://www.aceee.org/files/proceedings/2013/data/papers/6_202.pdf
Brookings-Rockefeller. 2012. Leveraging State Clean Energy Funds for Economic Development. Project on State and Metropolitan Innovation. Brookings Institution and The Rockefeller Foundation.	http://www.brookings.edu/~/media/research/files/papers/2012/1/11%20states%20energy%20funds/0111_states_energy_funds.pdf
C2ES. 2014. Public Benefit Funds. Center for Climate Solutions. Accessed May 2014.	http://www.c2es.org/us-states-regions/policy-maps/public-benefit-funds
CALMAC. 2005. CALMAC Website. California Measurement Advisory Council.	http://www.calmac.org
CEC. 2005. DEER - Database for Energy Efficient Resources. California Energy Commission. Accessed July 2005.	http://www.energy.ca.gov/deer/
CEO. 2014. Mortgage Incentive for Homes. Colorado Energy Office. Accessed September 2014.	http://www.colorado.gov/cs/Satellite/GovEnergyOffice/CBON/1251649995727
Clean Energy Group. 2013. CE+BFI Examines Innovative NYSERDA Energy Efficiency Bond Deal. Accessed March 2015.	http://www.cleanegroup.org/blog/ce-bfi-examines-innovative-nyserda-energy-efficiency-bond-deal
CPUC. 2005. CPUC Self-Generation Incentive Program: Fourth-Year Impact Report, Final Report. California Public Utilities Commission.	ftp://ftp.cpuc.ca.gov/puc/energy/electric/050415_sceitron+sgip2004+impacts+final+report.pdf
DOE. 2014. Michigan Saves Basic Program Information. U.S. Department of Energy. Accessed September 2014.	http://energy.gov/sites/prod/files/2014/01/f6/michigan_saves_program_description.pdf
DOE. 2015. Qualified Energy Conservation Bonds. U.S. Department of Energy. Accessed March 2015.	http://energy.gov/eere/slsc/qualified-energy-conservation-bonds
DSIRE. 2013. Maine: Maine PACE Loans. Database of Incentives for Renewables and Efficiency. Accessed April 2015.	http://programs.dsireusa.org/system/program/detail/4767
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Chapter 4. Energy Efficiency Policies

Saving energy through energy efficiency improvements can cost less than generating, transmitting, and distributing energy from power plants, and it provides multiple economic and environmental benefits. States have adopted many policies that support cost-effective energy efficiency programs by removing key market, regulatory, and institutional barriers that hinder investment in cost-effective energy efficiency. This chapter presents in-depth descriptions of five policies that states have used to support greater investment in and adoption of energy efficiency.

These policies, summarized in Table 4.1, were selected from among a larger universe of energy efficiency strategies because of their proven effectiveness and successful implementation by states. Each policy description is based on the experiences and best practices of states, as well as the following sources: local, regional, and federal agencies and organizations; research foundations and nonprofit organizations; universities; and utilities.

Table 4.1 also lists examples of states that have implemented programs for each policy and where to find more in-depth information on the policy in the *Guide to Action*.

States are also adopting complementary policies to fund and incentivize investment in energy efficiency and allow energy efficiency to be fully integrated into the delivery of and planning for electricity service. These policies are addressed in the following chapters of the *Guide to Action*:

- *Funding and Financial Incentive Policies* describes additional ways states provide funding for energy efficiency through loans, tax incentives, and other mechanisms (see Chapter 3).
- *Policy Considerations for Combined Heat and Power* highlights policy options that help states capture the environmental, energy, economic, and reliability benefits of combined heat and power technologies (see Chapter 6).
- *Electric Utility Policies* presents a number of policies that encourage electric utilities to invest in and encourage greater use of energy efficiency throughout all aspects of their business, including resource planning, ratemaking, offering service to customers, and modernizing electricity delivery (see Chapter 7).

State Policy Options in the *Guide to Action*

Type of Policy	For More Information
Funding	
Funding and Financial Incentive Policies	Chapter 3
Energy Efficiency Policies	
Energy Efficiency Resource Standards	Section 4.1
Energy Efficiency Programs	Section 4.2
Building Codes for Energy Efficiency	Section 4.3
State Appliance Efficiency Standards	Section 4.4
Lead by Example	Section 4.5
Renewable Portfolio Standards	
Renewable Portfolio Standards	Chapter 5
Combined Heat and Power	
Policy Considerations for Combined Heat and Power	Chapter 6
Electric Utility Policies	
Electricity Resource Planning and Procurement	Section 7.1
Policies That Sustain Utility Financial Health	Section 7.2
Interconnection and Net Metering Standards	Section 7.3
Customer Rates and Data Access	Section 7.4
Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration	Section 7.5

Table 4.1: Energy Efficiency Policies and Programs

Policy	Description	State Examples	For More Information
Energy Efficiency Resource Standards (EERSs)	Similar to renewable portfolio standards (see Chapter 5), EERSs direct energy providers to meet a specific portion of their electricity demand through energy efficiency. A total of 27 states have some type of energy efficiency requirement or goal.	AR, AZ, CA, IL, VT	Section 4.1
Energy Efficiency Programs	Energy efficiency programs target a portfolio of related activities, such as energy efficiency investments and reduction of demand during peak periods, to reduce energy costs and meet power system capacity needs and energy savings goals. States rely on a combination of funding sources and authorities to administer and oversee such programs. Most energy efficiency programs are funded by ratepayers through a small charge on every customer's electricity bill. Forty-eight states and Washington, D.C., offer energy efficiency programs.	MA, MO, MS, VT	Section 4.2
Building Codes for Energy Efficiency	Building energy codes establish minimum energy efficiency requirements for new building construction and existing building major renovations. These codes can reduce building life-cycle costs and peak energy demand, as well as greenhouse gas emissions and other air pollutants. More than 40 states have implemented some level of building codes for residential buildings and/or commercial buildings.	AZ, CA, IL, MA, TX	Section 4.3
State Appliance Efficiency Standards	State appliance efficiency standards set minimum energy efficiency standards for appliances and other energy-consuming products. A total of 12 states have adopted appliance standards.	CA, CT, OR	Section 4.4
Lead by Example	Lead by example initiatives advance the use of clean energy within state and local government facilities, fleets, and operations. These programs can help governments achieve energy cost savings while promoting the adoption of energy-efficient technologies. States can adopt specific goals, establish energy efficiency specifications for products, or purchase and use renewable energy.	CA, NH, TX	Section 4.5

4.1 Energy Efficiency Resource Standards

Policy Description and Objective

Summary

Energy efficiency resource standards (EERSs) require obligated parties—usually retail distributors of electricity—to meet a specific portion of their electricity demand through energy efficiency (NCSL 2014). As of March 2015, 27 states have some type of energy efficiency requirement or goal. Twenty-three states have mandatory energy efficiency requirements, two states have voluntary targets, and two states allow energy efficiency as a compliance option for their renewable portfolio standard (RPS)[15] (ACEEE 2014d; DSIRE 2015).

EERS designs vary considerably across the states. They vary in terms of:

- The target type—incremental or annual, relative (percent) or absolute (gigawatt-hour, or GWh), rolling or fixed.
- Responsible entities.
- The portion of load covered.
- The stringency of targets.

EERS programs have been around since 1999. Among existing programs, relative incremental energy savings targets range from as low as 0.1 percent of energy demand for a new program to 2.5 percent for more established programs (ACEEE 2014d).

Depending on the state, EERSs generally apply to retail distributors of either electricity or natural gas, or both. Utilities or third-party program administrators are responsible for meeting multi-year targets for energy savings through energy efficiency programs targeting customer facilities. However, in some states, additional measures or programs, such as peak demand reductions, building code changes, increased onsite generation (e.g., fuel cells and combined heat and power[CHP]), and efficiency improvements to transmission and distribution systems, can also facilitate compliance (Nadel 2006).

Effectively designed and explicit energy efficiency standards can help ensure that energy efficiency opportunities are pursued to meet electricity demand at least cost while reducing peak loads, lowering electricity bills, supporting a reliable grid, reducing air emissions, and providing other non-energy-related benefits such as reduced adverse health impacts. (See Chapter 1, “Introduction and Background,” for more on the benefits of energy efficiency.) The energy, environmental, and economic benefits of EERSs are well documented by retrospective evaluations, like those from the Efficiency Vermont program (Efficiency Vermont 2014a). To avoid double-counting reductions, many programs (including those in Colorado, Massachusetts, and Pennsylvania) report their net savings, which take into account secondary effects and exclude savings that would have occurred without the program (NREL 2014). The American Council for an Energy-Efficient Economy (ACEEE) found that states generally exceeded their savings targets with overall savings of 20 million megawatt-hours (MWh), surpassing combined 2012 targets of 18 million MWh. These savings could power around 2 million homes for a year (ACEEE 2014b).

[15] Delaware and Florida were not included in the totals. Delaware has enacted legislation to create EERSs, but final regulations have not yet been promulgated (DSIRE 2015). Florida has enacted EERSs, but program funding to date is considered to be “…far below what is necessary to meet targets” (ACEEE 2014d). Due to the wide variety of EERS programs with varying levels of stringency and funding, different sources may report different state counts of EERS programs.

Objective

Market barriers, regulatory disincentives, and/or insufficient information about the opportunities for energy efficiency or its benefits limit investment in cost-effective energy efficiency. Many states are overcoming these barriers and stimulating investment in cost-effective energy efficiency with EERSs, helping to realize a large amount of cost-effective efficiency potential available nationwide. Estimates vary, but recent studies show remaining achievable potential on the order of 15 to 20 percent of U.S. electricity demand that could be met through energy efficiency over the next 10 to 15 years (ACEEE 2008, 2014a; Sreedharan 2013). This potential exists in states with newer energy efficiency programs as well as those that have been offering programs for a decade or more.

Benefits

EERSs can result in significant reductions in both electricity and natural gas consumption. In addition, EERS programs are simple to administer and cost-effective, and they complement other energy policies by supporting policy development or compliance. They also reduce the strain on power grids. States have found the merits of these programs include:

- *Electricity savings*. Under an EERS, the amount of electricity savings required depends on the initial target and how quickly the target gets ramped up over time. Market forces affecting electricity demand may also affect targets. Electricity sector EERS targets range widely between programs. On the low end, Texas has an incremental target of 20 percent of forecasted electricity sales *growth* (0.1 percent of total sales); meanwhile, on the upper end, Massachusetts has a target of 2.6 percent of total annual electricity *sales*. See Table 4.1.1 for a summary of current targets.
- *Cost-effectiveness*. Energy efficiency remains one of the most cost-effective resources for addressing electricity system needs (ACEEE 2012). The aggregate EERS targets allow energy providers to combine savings across multiple end-uses and sectors, providing the flexibility to cost-effectively meet the overall savings goals. States have found the design of energy efficiency program portfolios can ensure that all customers who contribute through ratepayer funding have the opportunity to reduce energy bills directly by participating in energy efficiency programming (see Section 4.2, "Energy Efficiency Programs").
- *Long-term rate benefits*. The savings associated with energy efficiency offer long-term bill savings and contribute to stability because they are typically realized on an ongoing basis throughout the measure lifetime. Energy efficiency investment costs may increase energy rates slightly in the initial years of a program; however, states have found reduced energy bills over the program's lifetime provide a rapid payback on these investments and provide price moderation benefits. For example, Vermont's Efficiency Vermont program reports savings of $2.30 for every dollar spent on electricity demand reduction programs (Efficiency Vermont 2014a). Moreover, states have found these costs compare favorably to the ongoing costs of new energy production and delivery infrastructure investments (NAPEE 2006). The levelized cost of electricity for energy efficiency programs has been estimated at three to five cents per kilowatt-hour (kWh) of electricity service demand, in which is lower than all forms of new electricity generation (ACEEE 2012).
- *Reduce the strain on the power grid.* In some regions, energy efficiency has been formally incorporated into the region's forward capacity market (FCM), which procures electricity capacity through an auction a few years before the electricity actually needs to be delivered, lessening the short-term strain on power

grids and reducing the need for new electricity generation capacity.[16] In Independent System Operator (ISO) New England's FCM, energy efficiency efforts submitted by Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont combined to reduce electricity demand by 1,723 GWh and summer peak demand by 223 megawatts (MW) in 2012. ISO New England forecasts that during the 2018–2022 time period, these states will contribute annually an average of 1,563 GWh (about 1 percent) of forecast electricity demand and 212 MW of summer peak demand savings from energy efficiency into the FCM (ISO New England 2014).

- *Simplicity.* EERSs create a straightforward, quantified energy savings target for energy providers that can easily be measured against and modified over time.
- *Complements other energy policies.* EERS policies can also complement other policies, although they often contribute to the same energy efficiency savings. EERSs work in concert with market-based programs, such as emissions cap and trade programs like the Regional Greenhouse Gas Initiative (RGGI), because energy efficiency avoids greenhouse gases (GHGs) and lowers the cost of meeting the cap. EERSs encourage states to consider energy in their integrated resource plans. Other policies may complement and enhance the outcomes of an EERS including, for example, financial incentives in utility ratemaking (see Section 7.2, "Policies That Sustain Utility Financial Health").

States with EERSs

EERSs were first used primarily in restructured states as a policy approach to replace the integrated planning requirements that were often eliminated as part of restructuring.[17] (For more information about restructuring, see Chapter 7, "Electric Utility Policies.") However, they have recently been employed as an effective policy in nine states with a traditional regulatory model, and in six states that have suspended restructuring of their market. See Table 4.1.1 for more details. As shown in Figure 4.1.1, as of March 2015, 23 states have adopted mandatory EERS policies,[18] and another four states have adopted voluntary policies or enabled energy efficiency to count towards the state RPS (ACEEE 2014d; DSIRE 2015). These 27 states represent 64 percent of total electricity sales in the United States (EIA 2013).

[16] FCMs are a mechanism to ensure sufficient supply and demand resources are available when needed and reliability standards are met. Capacity markets reflect the value of electricity supply that is necessary to meet forecasted demand and reserves on a sufficiently forward planning horizon. They also provide a forecasted price signal to show the value and expected revenues that support financing for capital-intensive projects. In many markets, customer-sited resources, including energy efficiency, can participate in FCMs.

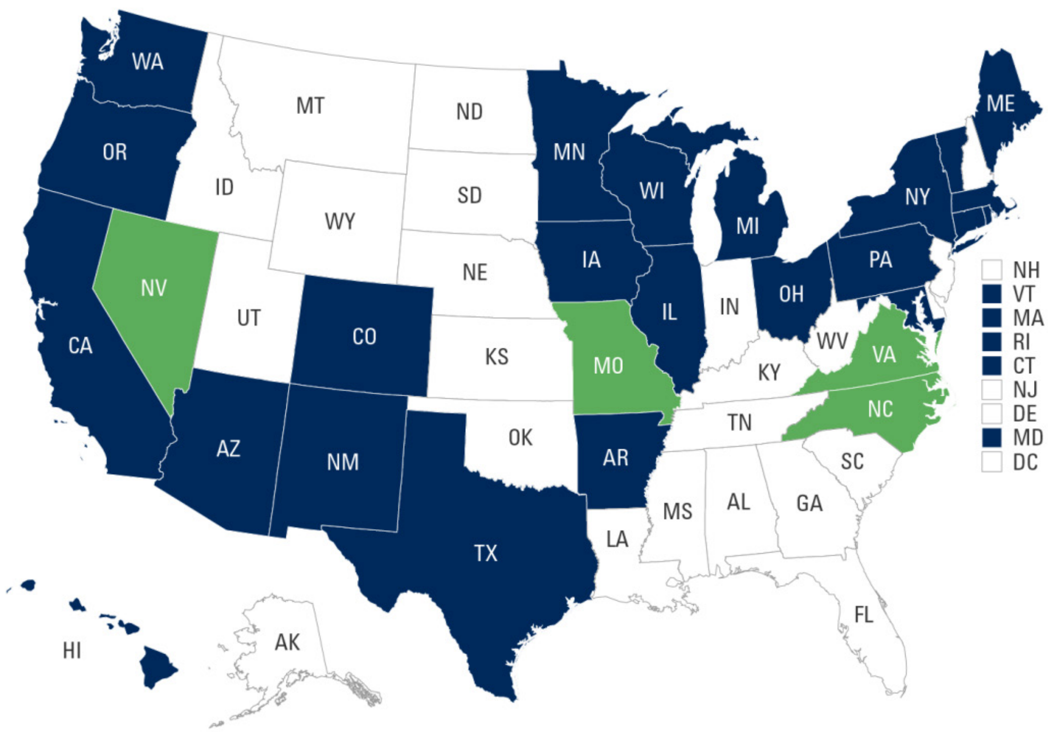
[17] From the 1920s to the 1990s, providers of electricity in the United States were vertically integrated entities providing generation, transmission, distribution, and retail supply services in franchised service territories. These natural monopolies were either state-owned or privately owned and subject to price and entry regulation. Many were subject to integrated resource planning requirements, including required filings to state authorities to demonstrate that all resources, including energy efficiency and renewable resources, were considered in planning for a least-cost resource mix to reliably meet electricity demand over a 20- or 30-year planning horizon. Beginning in the 1990s, a series of state and federal initiatives "restructured" electricity markets to reflect the observation that some of these functions, such as generation and retail service, were potentially competitive, while others, including transmission and distribution, were natural monopoly functions. Market restructuring took many forms, but the underlying concepts involved the divestiture of generation from utilities, the formation of organized wholesale spot energy markets, non-discriminatory mechanisms for rationing transmission resources, the introduction of retail choice programs, and the establishment of oversight and coordination functions.

[18] Included in this count is the Ohio EERS whose targets have been frozen for 2015 and 2016 before continuing, subject to a program review.

In addition, several states with public benefits funds[19] (PBFs) have conducted energy efficiency analyses, potential studies, and goal-setting exercises to explore the adoption of an EERS program.

Overall, states have been meeting or exceeding EERS targets while achieving other benefits. In 2012, overall state energy savings of 20 million megawatt-hours (MWh) surpassed combined energy efficiency targets of 18 million MWh (ACEEE 2015). For example, two of Illinois' electric utilities, the Commonwealth Edison Company (ComEd) and Ameren Illinois, both exceeded their electricity savings goals for each of the first 5 years of that state's EERS. In 2012, ComEd and Ameren Illinois reported net savings of 828 GWh and 331 GWh, respectively, amounting to about 1 percent of electricity sales in their combined service territories (ACEEE 2014b). From 2006 to 2014, California estimates its EERS achieved net savings[20] of $1.8 billion (CPUC 2014a). Cumulative peak electricity demand savings reached 1,300 MW from 2004 to 2009, avoiding the need to build three power plants (CPUC 2014a).

Figure 4.1.1: States That Have Adopted EERSs



Sources: ACEEE 2014d; VA, MO sourced from DSIRE 2015.

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[19] PBFs (also called system benefits charges or Universal Systems Benefits Programs) were established in many states as a mechanism for ensuring continued investment in energy efficiency, renewable energy, and research and development in the face of market restructuring and diminished incentives for the market to provide these resources. The funds are collected either through a small charge on the bill of every electric customer or through specified contributions from utilities. The charge ensures that money is available to fund these investments.

[20] Net savings reflect utility savings above those that would have been achieved in the absence of the EERS program. Total savings are called gross savings.

Table 4.1.1: Current and Pending State EERS Policies

State	State Regulatory Status	EERS	Applies to	Savings Target
Arizona	Restructuring suspended	Mandatory	Electric and gas utilities	Incremental electricity savings starting at 1.25 percent in 2011 and rising to 2.5 percent in 2016. Annual energy savings of 22 percent from electricity and 6 percent from natural gas by 2020.
Arkansas	Restructuring suspended	Mandatory	Electric and gas utilities	Rises to 0.9 percent incremental savings by 2015 for electricity; 0.6 percent by 2015 for gas.
California	Restructuring suspended	Mandatory	Electric and gas utilities	0.85 percent incremental savings by 2020 for electricity.
Colorado	Regulated	Mandatory	Electric and gas utilities	Rises from 0.8 percent incremental savings in 2011 to 1.7 percent in 2020 for electricity. Gas IOUs must target spending at more than 0.5 percent of annual revenues.
Connecticut	Restructured	Mandatory	Electric and gas utilities	Incremental electricity savings targets of about 1.4 percent to 2015; cumulative natural gas savings of 60 million therms through 2015.
Hawaii	Regulated	Mandatory	Electric utilities	About 1.4 percent incremental savings each year through 2030 (about 30 percent of forecast electricity sales).
Illinois	Restructured	Mandatory	Electric and gas utilities	Rises from 0.2 percent incremental savings in 2008 to 2 percent in 2015 for electricity. Utilities with cost cap limitations can average incremental targets of 0.9 percent. Gas targets rise from 0.2 percent in 2011 to 1.5 percent in 2019, reaching 8.5 percent annual savings in 2020.
Iowa	Regulated	Mandatory	Electric and gas utilities	Incremental electricity savings of about 1.4 percent and gas savings of between 0.7 percent and 1.2 percent of retail sales between 2014 and 2018.
Maine	Restructured	Mandatory	Electric and gas utilities	Incremental savings targets of about 1.6 percent for electricity and 0.2 percent for gas; annual 20 percent reduction target for electricity and gas.
Maryland	Restructured	Mandatory	Electric utilities	Per capita electricity savings of 10 percent by 2015 compared to 2007 baseline.
Massachusetts	Restructured	Mandatory	Electric and gas utilities	Incremental savings rise from 1.4 percent in 2010 to 2.6 percent by 2015 for electricity; 0.63 percent in 2010 to 1.14 percent by 2015 for gas.
Michigan	Restructured	Mandatory	Electric and gas utilities	Ramps up to 1 percent incremental electricity savings from 2012; 0.75 percent incremental gas savings from 2012. Targets post-2015 are TBD.
Minnesota	Regulated	Mandatory	Electric and gas utilities	1.5 percent incremental electricity and gas savings from 2010 with flexibility to adjust down to as low as 1 percent.
Missouri	Regulated	Voluntary	Electric utilities	Annual electricity savings of 9.9 percent by 2020, 1.9 percent incremental savings thereafter.

Table 4.1.1: Current and Pending State EERS Policies

State	State Regulatory Status	EERS	Applies to	Savings Target
Nevada	Restructuring suspended	Voluntary (RPS)	Electric utilities	Energy efficiency can meet up to 25 percent of requirements towards Nevada's RPS.
New Mexico	Restructuring suspended	Mandatory	Electric utilities	5 percent annual reduction in electricity sales from 2005 by 2014, 8 percent by 2020.
New York	Restructured	Mandatory	Electric and gas utilities	About 1 percent incremental electricity savings and 0.5 percent incremental gas savings per year through 2015.
North Carolina	Regulated	Voluntary (RPS)	Electric utilities	Energy efficiency can meet up to 25 percent of requirements towards North Carolina RPS to 2018 and 40 percent of the 2021 targets.
Ohio	Restructured	Mandatory	Electric utilities	22 percent annual savings by 2027 (2 percent incrementally by 2021).
Oregon	Restructured	Mandatory	Electric and gas utilities	1.4 percent incremental electricity savings from 2013; 0.4 percent incremental gas savings by 2014.
Pennsylvania	Restructured	Mandatory	Electric utilities	3 percent annual electricity savings by 2013, rising to 5.3 percent by 2016.
Rhode Island	Restructured	Mandatory	Electric and gas utilities	Incremental savings rise to 2.6 percent by 2017 for electricity; 1.1 percent by 2017 for gas.
Texas	Restructured	Mandatory	Electric utilities	Savings of 20 percent of incremental load growth in 2011 (about 0.1 percent incremental savings) and 30 percent from 2013 onwards.
Vermont	Regulated	Mandatory	Electric and gas utilities	2.1 percent incremental savings for electricity each year from 2015 to 2017; 246,000 net MMBtu of incremental thermal efficiency savings each year from 2015 to 2017.
Virginia	Restructuring suspended	Voluntary	Electric utilities	Retail electric energy consumption target of 10 percent from 2006 levels by 2022.
Washington	Regulated	Mandatory	Electric utilities	About 1.4 percent incremental electricity savings from 2010.
Wisconsin	Regulated	Mandatory	Electric and gas utilities	About 1.8 billion kWh incremental electricity savings each year from 2011 to 2014 and about 73 million therms of incremental gas savings each year from 2011 to 2014.

IOUs = Investor-owned utilities

Note: "State regulatory status" refers to the way each state's electricity market is structured. In a regulated state, the public utility commission (PUC) regulates IOUs that generate, transmit, and distribute electricity. In a restructured state, electricity generation may be owned and operated by independent power producers, with the PUC regulating the distribution service that is still provided by IOUs. A few states began to restructure their markets but subsequently suspended this activity, so they are effectively still regulated markets. See the introduction to Chapter 7 for more information about utility regulation and restructuring. Also see *Examples of Legislation/Regulation* for each state at the end of this section.

Sources: ACEEE 2015; DSIRE 2015; EIA 2010

Designing Effective EERS

EERS policies include three basic features: quantitative targets that indicate the required amount of energy savings over a specific period, a designated entity or group of entities that is required to meet the targets and demonstrate compliance, and a set of activities that can be used to meet the targets. A number of key design elements have emerged from EERS efforts to date that influence the policy's flexibility; the balance of benefits, costs, and risks borne by utilities and customers; and the overall policy impact. These design considerations include:

- Participants in different aspects of the process.
- Target setting.
- Coverage.
- Eligible savings measures.
- Funding.
- Interaction with federal policies.
- Interaction with state policies.

States can typically draw from other states' experiences in considering approaches to these considerations. States have also drawn upon their own past experience with designing and administering energy efficiency programs.

Participants

- *State legislatures.* In most states, legislation is required to set EERS targets. Legislatures either set EERS targets in legislative language or direct an executive agency to do so. In either case, states designate an executive agency to administer implementation of the targets.
- *Public utility commissions (PUCs).* In some states, PUCs have the authority to set EERS targets directly. PUCs are often the agencies that administer and evaluate EERSs given their oversight of utilities.
- *Utilities*. Given the direct impact on the utility sector, when designing EERSs and developing accompanying ratemaking and other regulatory policies, legislatures and PUCs typically seek input on the potential impacts on utility profitability and ongoing operations. In most states, utilities are assigned specific energy efficiency goals and administer the ensuing energy efficiency programs. However, several states including Wisconsin, Maine, and Vermont, as well as Washington, D.C., have their own mechanisms for administration and oversight. Alternatively, some states designate third-party entities to serve in this capacity. Regardless of administrator, the program funding required to meet the resource standard typically comes from ratepayers.
- *State energy offices*. State energy offices can play a constructive role in the development of EERSs by collaborating with utilities to propose and implement energy efficiency programs. Since these offices do not rely on electricity sales for revenue, they do not have any inherent disincentive to invest in energy efficiency. The New York State Energy Research and Deployment Authority has been particularly active in the design and roll-out of the state's EERS (ACEEE 2014b).
- *Customers/general public.* States have held public workshops and created public comment processes to help inform topics such as potential economic impacts, costs, and benefits, including health benefits and other reduced emission effects. The Arkansas Public Service Commission (APSC) engaged the community

early on by holding 12 public workshops and filing over 250 testimonies, comments, and legal briefs to collect input and build support for their EERS (APSC 2010).

- *Public interest organizations.* Groups representing consumers, environmental interests, and other public interests have been involved to offer technical expertise as well as public perspectives.

Target Setting

Under EERSs, numerical energy savings targets are established by statute or by a state utility commission.

These targets may be defined in a number of different ways, including:

- Targets based on savings that are incremental, meaning new to that year, or annual (sometimes referred to as cumulative and including both incremental and past year savings).
- Targets measured in relative terms (percent of sales) or in absolute terms (e.g., GWh of savings per year).
- Targets specified as a portion of load growth or base year sales.
- The basis for the relative measure may be a fixed year (e.g., a percentage of 2010 sales) or a rolling period of time (e.g., a percentage of the previous 3 years' sales).
- Targets can address peak electricity demand (e.g., MW capacity).
- Targets may be specified on a "gross" basis or on a "net" basis. Gross savings include those savings that would have occurred in the absence of EERSs, while net savings net away estimates of baseline savings.

When setting targets, many states analyze their specific energy efficiency potential and estimate the benefits of energy efficiency; they then weigh these against the costs and the availability of funding. Analyzing the potential for energy efficiency will help policy-makers understand what may be realistically achieved cost-effectively. States have found that considering the additional benefits of increased energy efficiency provides a broader context for understanding the impacts of EERS policies. The share of state electricity and gas load that is covered by the target will directly affect the overall savings achieved. Timing and duration, as well as funding and related cost recovery issues, are also key considerations in setting the target.[21]

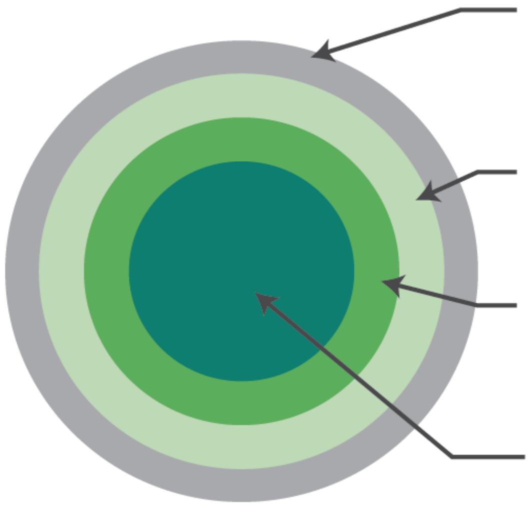
Analysis of Efficiency Potential

States have set EERSs based on analysis and program experience within the state or in states believed to be comparable. Described in Figure 4.1.2, state analysis typically includes a robust study of the technical, economic, and achievable potential for energy efficiency—the latter being the potential most typically considered in target setting—combined with a review of past program experience with energy efficiency measures (EPA 2007).

Energy efficiency potential studies consider what energy-efficient technologies and products are available, the degree to which those technologies and products may be further deployed in the market, and the cost-effectiveness of each. A potential study will help policy-makers understand what kind of electricity demand reductions can be achieved and at what cost (SEE Action 2011). States can also consider the potential for CHP to achieve savings, as described in the text box, "EERS and CHP."

[21] For more information about setting targets, see SEE Action papers by SEE Action (2011) and NREL (2014).

Figure 4.1.2: Energy Efficiency Savings Potential



Technical potential refers to the maximum theoretical amount of energy that could be produced or displaced, given existing limitations.

Economic potential refers to the subset of technical potential that is economically cost-effective.

Achievable potential (or market potential) refers to the energy efficiency savings or renewable energy expansion that can be realistically achieved.

Program potential refers to an even more specific subset of the maximum potential impact of one or more specific programs.

EERS and CHP

Though all EERSs allow end-use energy savings to contribute to compliance, some states allow new CHP projects, a type of supply-side energy efficiency measure, to also contribute (EPA 2015). States that have explicitly identified CHP as a qualifying resource typically assign minimum efficiency requirements for the CHP project and assign separate, distinct targets for CHP. CHP projects in Massachusetts, Michigan, Pennsylvania, and Connecticut have contributed to meeting EERS objectives (SEE Action Network, 2013).

In 2013, California commissioned a report on the technical, economical, and achievable potential for energy efficiency initiatives through 2024. The study found that in 2015 alone, California has an achievable potential of 2,244 GWh for energy efficiency programs, building codes, and equipment standards. This increases to a cumulative 21,844 GWh over the 10-year period (Navigant 2014). In a proposed ruling released in September 2014, the California Public Utilities Commission (CPUC) used this estimate to propose a 2015 statewide goal of 2,203 GWh, of which 1,562 GWh is set to come from energy efficiency programs and the rest from codes and standards (CPUC 2014b). These respective savings total 0.8 percent and 0.6 percent of statewide electricity consumption (EIA 2013).

Analysis of the Benefits of Energy Efficiency

In addition to estimating efficiency resource potential, states have used power sector and economic impact models to estimate the benefits of energy efficiency, including emission reductions, lower long-term power prices and total power costs from avoided energy infrastructure investments, and net benefits to the economy (e.g., increased gross state product and increased jobs and wages). When determining its targets, California estimates multiple benefits associated with avoided electricity use. Benefits from avoided electricity use include the avoided cost of the energy, the avoided costs of building new peak generation capacity, the reduced costs of operating a reliable electricity grid, the avoided costs of expanding transmission and distribution lines, the value of avoided GHG emissions, the public health benefits associated with decreased emissions of air pollutants, and the reduced cost of compliance with the RPS resulting from lower sales (E3 2011).

Timing and Duration

States often determine the timing and duration of EERSs by considering how quickly targets can be ramped up to optimal levels from program initiation, and how long it will take to achieve the final program goal. Generally, only a portion of the total energy savings potential can be realized in a given year because of considerations like the time it takes for a technology or program to penetrate and transform the market, as well as limits on funding. States have found that reviewing regulatory compliance deadlines and developing an analysis of achievable efficiency potentials for specific years can help inform these considerations. To determine a realistic timeframe for ramping up and achieving energy efficiency program goals, states also usually consider their existing experience with energy efficiency programming, and for new types of programs, the experience of similar states.

Coverage

The options for achieving significant load coverage under an EERS depend on the entities under the state's jurisdiction. In the majority of states, PUCs typically do not have the authority to set requirements for municipally owned, federally owned, or rural cooperatively owned utilities. State legislation is often necessary to specify requirements and oversight for these entities. Vermont's EERS achieved 94 percent[22] coverage of its electricity load through a statewide energy efficiency provider rather than coordinating with the state's 22 municipally owned utilities. In 1999, the Vermont Public Service Board (PSB) created a statewide energy efficiency utility (EEU) known as Efficiency Vermont, funded through a per-kWh fee on customers' electricity bills (NREL 2014; Vermont PSB 2014). Arizona established its EERS to target a 22 percent annual savings in retail electricity sales from investor-owned utilities (IOUs) by 2020. Cooperatively owned utilities in Arizona are also subject to the EERS; however, they are obligated to achieve only 75 percent of the annual IOU targets (ACEEE 2015). Some EERSs have established targets for electric utilities alone, while others (e.g., California and Illinois) have set savings goals for both electric and gas utilities. States have sometimes included provisions to ensure that the energy efficiency measures used (and hence the energy bill savings) are distributed among customer classes (e.g., residential, industrial, commercial) and income levels.

Eligible Savings Measures

There are a wide variety of energy efficiency programs with varying levels of certainty that can be implemented. States must decide what types of programs will be eligible in their EERS. More traditional programs that have established measurement and verification methods may take the form of appliance rebate programs or energy audits with follow-up home efficiency improvements. To give states more flexibility in finding cost-effective efficiency savings, eligible programs can be expanded to include CHP, behavior change programs, supply-side efficiency improvements, and credit for advocacy work that promotes stronger building codes and appliance standards. These programs provide a greater challenge for savings verification, but as measurement and verification methods for these programs mature, the uncertainty associated with program savings is reduced (NREL 2014).

Funding

States establish funding sources to pay for utility or public programs that help achieve the efficiency resource goals. Different approaches include one or more of the following: utilizing funds from a state PBF to support energy efficiency investments, allowing utilities to recover program costs through adjusted rates, allowing

[22] The City of Burlington runs its own energy efficiency programs.

utilities to earn a return on investment on energy efficiency analogous to that earned on energy sales, and allocating allowance auction revenues to support energy efficiency.[23]

EERS design may involve defining how funds will be raised, spent, and accounted for in meeting goals. For example, California recognizes an electricity “loading order” where the PUC requires utilities to invest in cost-effective energy efficiency as a procurement resource using funds that would otherwise go to purchasing power; the utilities also use PBFs and efficiency resource acquisition funds to meet the overall goals.

Some states also include cost-containment provisions in their EERS. These provisions can either cap program expenditures as a percentage of electricity sales or limit the increase in electricity rates to recover program costs. Eight states currently have some form of cost-containment provision (NREL 2014).[24]

Interaction with Federal Policies

A variety of federal programs, partnerships, and technical assistance is available to help states achieve their energy efficiency goals. The U.S. Department of Energy (DOE), through the State Energy Program (SEP), provides funding to state energy offices for energy efficiency and renewable energy purposes. The SEP helps states establish and implement energy efficiency and renewable energy plans, policies, and programs to reduce energy costs, increase competitiveness, enhance economic development, improve emergency planning, and improve the environment. SEP provides state energy offices with formula-based grants that allow states and U.S. territories, as well as Washington, D.C., to advance their energy priorities by designing and implementing energy efficiency and renewable energy programs. SEP also provides funding on a competitive basis to state energy offices to create public-private partnerships geared towards addressing critical clean energy challenges. The ENERGY STAR® program offers energy program planning assistance and facilitates best practice exchange among programs. It also defines efficiency criteria for more than 70 product categories, as well as whole-building performance for new homes and commercial and industrial buildings (see Section 4.2, “Energy Efficiency Programs,” for a broader discussion of ENERGY STAR activities). The EPA CHP Partnership and DOE Technical Assistance Programs can offer similar assistance on CHP (see Chapter 6, “Policy Considerations for Combined Heat and Power,” for a broader discussion of CHP).

Federal incentives can also make it easier to comply with an EERS. Federal programs that include tax credits for energy-efficient measures or improved appliance standards can reduce the cost or support compliance with EERSs. EERSs that produce verifiable capacity savings can have favorable short and long-term electricity resource adequacy[25] implications reflected in a variety of organizations. These include federally jurisdictional wholesale markets overseen by the Federal Energy Regulatory Commission, the North American Electric Reliability Council, regional reliability organizations, regional transmission organizations, and transmission-owning companies.

Interaction with State Policies

States have found that EERSs can complement other energy efficiency policies and serve as a framework for a suite of policies and programs. Some of these policies include building codes, lead by example programs, appliance standards, energy savings performance contracting, and financing programs that promote energy efficiency. Moreover, complementary policies can improve the success of EERSs. Policies that address cost

[23] Some of the states participating in the RGGI use the latter funding mechanism.

[24] The eight states are California, Illinois, Maine, New Mexico, Pennsylvania, Rhode Island, Washington, and Wisconsin.

[25] Resource adequacy pertains to both the short-term reliability of the electricity grid and ensuring sufficient generation resources are available to meet longer term reliability concerns.

recovery for the lost sales associated with energy efficiency (such as lost revenue adjustment and decoupling mechanisms) remove the financial disincentive for pursuing energy efficiency, while additional performance incentives tied to EERS targets can provide positive incentives to utilities. All of these help program administrators achieve their targets.

Program Implementation and Evaluation

EERS implementation occurs primarily through designated utilities and other program implementers. However, continued state involvement is important in overseeing the development of implementation rules and may be important in ensuring the necessary funding is available. In Texas, for example, where the electric distribution utilities must meet the EERS goals, the utility commission is actively involved in determining how efficiency goals are met, approving plans submitted by utilities and awarding performance bonuses for energy savings (ACEEE 2015). State energy offices also play an important role, which can include analyzing the benefits of an existing or potential EERS and promoting measures that contribute to compliance. In Illinois, the EERS implementation is split between electric utilities and the Illinois Department of Commerce and Economic Opportunity (DCEO), with DCEO responsible for achieving 25 percent of the program's energy savings by targeting state and local governments, school districts, and low-income households (ACEEE 2014b).

Some utilities design and implement their own customer-funded programs using in-house staff. Others contract with third-party service providers who are responsible for installing energy efficiency measures at residences and businesses. These third-party energy efficiency providers may include air conditioning contractors, insulation installers, lighting contractors, retail electric providers, energy service companies, and other energy efficiency service contractors. The energy efficiency providers receive incentive payments from the utility for installing energy efficiency measures that result in peak demand reductions and electricity savings. Most large utilities contract out to full service, third-party implementers that manage all elements of their energy efficiency portfolios, including policy and planning, technical analysis, and implementation. See Section 4.2, "Energy Efficiency Programs," for more discussion on program implementation.

Best Practices: Implementing EERS

States have found the following best practices helpful when implementing an EERS:

- Use a clear basis for assessing compliance.
- Set a long-term goal with the opportunity to revisit every 5 to 10 years.
- Set strong goals.
- Coordinate EERS with market transformation programs, PBFs, and other programs to facilitate the market changes that are needed to reach EERS goals.
- Ensure that the electricity and natural gas demand forecasts used in supply-side resource filings reflect energy savings goals.
- Distinguish between energy efficiency programs aimed at new construction and equipment replacement upon failure and programs aimed at retrofitting existing, still operational equipment or facilities. Appropriate baselines may be based on building codes, equipment standards or common industry practice for the former, and program participants' pre-program efficiency levels or characteristics of the latter.

States have found that evaluation, measurement, and verification (EM&V) is a key element of a successful EERS. EM&V is used to provide accurate, transparent, and consistent measurements of program impacts, which help to assess the program's costs and benefits, design, and implementation. (See the *Approaches to Evaluation, Measurement, and Verification* section below for more detailed information on the approaches states are using for EM&V.)

As state programs mature, states are able to refine their programs based on past experience. In California, CPUC's 2015 savings targets were largely informed by a stakeholder-vetted report that CPUC commissioned to project the state's future energy efficiency savings potential. In addition to the potential study, CPUC considered the past performance of what utilities had been able to achieve (ex post savings) against the original estimates that went into the targets for that period (ex ante savings) (CPUC 2014b). In Vermont, Efficiency Vermont has refined the operation of its statewide program based on various program evaluation activities. Program refinements include collecting additional customer data to provide a more accurate measurement of savings, allowing more flexible timelines for customers to take up projects while maintaining current incentives, and investing in new software to enhance customer engagement and improve the efficiency of data collection and feedback efforts (Efficiency Vermont 2014).

Oversight

States have found that some form of oversight is needed while implementing EERSs. For IOUs, the oversight organization is usually the PUC. PUCs may require that independent third-party evaluators conduct impact evaluations. Some PUCs have hired evaluators to guide the PUC. Some states have decided to establish official oversight or advisory bodies, typically composed of stakeholders who periodically review the EERS program to determine whether its goals are being met, whether its goals should be renewed or adjusted, and whether other aspects of implementation need modification. For example, the Massachusetts Energy Efficiency Advisory Council (EEAC) is a body that guides the development, implementation, and long-term direction of the state's efficiency programs. The EEAC is made up of representatives from a variety of stakeholder organizations, including residential consumers, energy efficiency experts, realtors, small businesses, nonprofits, non-voting utility representatives, and key government agency staff (ACEEE 2014b).

Approaches to Evaluation, Measurement, and Verification

The two principal approaches for evaluating, measuring, and verifying the energy efficiency measures that states use to meet their EERS targets are the "deemed savings" approach and the measurement-based approach. State PUCs are the entities typically charged with approving, overseeing, and verifying the application of these approaches by the independent companies hired to perform the evaluation work.

The deemed savings approach involves estimating energy savings by combining verification that the energy efficiency measure has been installed and can at least be partially attributed to the program with the pre-calculated or "deemed" savings from using that measure. Although this approach is not as accurate as the measurement-based approach, it can provide a defensible estimate of avoided consumption while minimizing the complexity and cost of EM&V by drawing on the extensive field experience from other states. The use of deemed savings is most appropriate for simpler measures, such as a residential refrigerator or other plug-in appliance, whose performance characteristics are well established and not highly interactive with other building characteristics.

Deemed savings are calculated by subtracting the energy-efficient measure's energy use from the energy use of a conventional measure. These savings estimates often take into account other key characteristics such as hours of use or local climate (i.e., heating and cooling degree days). It is also possible to adjust deemed savings methods to account for the following:

- *Persistence of savings*. How long the savings from measures should be counted. Persistence includes both the expected lifetime and the performance degradation of the measure. It also includes failure rates.
- *Free ridership*. Savings that program participants would have achieved regardless of program intervention. These savings would be netted out from gross deemed savings estimates.
- *Spillover effects*. Increased savings from indirect effects not directly covered in the deemed savings calculation. This could include additional measures by program participants not directly captured by the program, or measures from non-program participants who are influenced by the program.

- *Interactive effects with other measures.* For example, efficient lighting reduces waste heat and therefore interacts with heating and cooling systems.

While deemed savings approaches can provide greater certainty in program planning because the estimates are readily available, assumptions need to be reviewed periodically and programs need to invest in studies related to usage, persistence, and other key parameters. States often prioritize these evaluations to target measures that represent a large portion of program savings or where key uncertainties have arisen. Technical resource manuals are often used as a credible source for deemed savings methodologies and measurements. Deemed savings should be specific to recent state or regional technical resource manuals, as factors such as climate, behavioral, and equipment assumptions may vary by region and over time. At least 11 states have developed technical reference manuals to estimate savings from energy efficiency measures (ACEEE 2014c).

The other EM&V approach used to ensure that EERS targets are being achieved is a measurement-based approach. It is most widely used for larger and more complex energy efficiency projects. The most well-known and referenced example is the International Performance Measurement and Verification Protocol (IPMVP). The IPMVP provides an overview of current best practice techniques available for estimating results of energy efficiency, water efficiency, and renewable energy projects in commercial and industrial facilities. The IPMVP was developed with DOE sponsorship and is currently managed by a nonprofit organization that continually publishes new materials available to the public (EVO 2014).

Best Practices: Evaluating, Measuring, and Verifying EERS Policies

States have found the following best practices helpful when evaluating, measuring, and verifying an EERS:

- Establish key baseline, tracking system, and reporting practices for affected markets and technologies prior to program implementation.
- Draw on other states' experiences and technical reference manuals to establish rigorous and workable measurement, verification, and reporting protocols.
- In addition to quantitative impact evaluation, provide for a qualitative evaluation process that enables program administrators to obtain useful feedback and improve program effectiveness over time.
- Evaluate programs operated under an EERS policy at appropriate intervals, so that agency overseers can gauge compliance with energy savings goals.
- Utilize an independent, third-party verifier to help build confidence in results. (See *Approaches to Evaluation, Measurement, and Verification* section.)
- Provide evaluation results to oversight agencies, program administrators, and other participants. Adjust future energy savings goals, as needed.

The DOE Uniform Methods Project (UMP) is another example of a measurement-based EM&V approach. It provides a framework and set of protocols to assist in determining energy efficiency program savings. These protocols are targeted towards individual measures as well as entire energy efficiency programs. The UMP is designed to streamline the EM&V process by providing program administrators and policy-makers with a single, straightforward, and credible resource to use (DOE 2014).

In addition to the IPMVP and UMP, some states have developed their own EM&V resources to support the achievement of EERS targets and related goals. For example, California maintains a robust set of protocols that is maintained on the California Measurement Advisory Council (CALMAC) website (CALMAC 2014).

State Examples

Arizona

Arizona's EERS experience highlights the flexible options utilities can use to meet targets. In 2010, Arizona established their EERS at a cumulative 22 percent savings in retail electricity sales from IOUs by 2020. Incremental targets are also specified, starting with savings of 1.25 percent in 2011. Cooperatively owned utilities are also subject to the EERS; however, they are obligated to achieve only 75 percent of the annual IOU targets. Arizona also has a cumulative natural gas savings target of 6 percent by 2020 (ACEEE 2015).

While some states cap EERS expenditures as a percentage of electricity sales, Arizona's EERS does not have any cost caps for IOUs. To offer flexibility, savings in peak demand can count for up to 10 percent of the energy target annually and up to 2 percent of the overall 22 percent target. Peak savings are converted to estimated energy savings assuming a 50 percent annual load factor.[26] Energy efficiency from building codes where the affected utility has undertaken an EM&V study can provide additional sources of savings for utilities. CHP equipment that is not eligible for Arizona's Renewable Energy Standard can also be counted towards Arizona's EERS (ACC 2009). Utilities can meet savings requirements through a number of methods including demand-side management incentives, peak demand reductions, building codes, CHP systems, self-direction, and existing demand-side management programs that achieved energy savings between 2004 and 2011. To accommodate large industrial users with established energy efficiency programs, facilities may direct up to 85 percent of their program payments towards cost-effective onsite energy efficiency measures (ACEEE 2015).

The Arizona Public Service Company, the largest utility in Arizona, has been successful in the first years of the program. Arizona Public Service has reported cumulative energy savings equivalent to 3.2 percent of retail sales from 2011 to 2012, exceeding the 3 percent savings target. These savings have resulted in a net benefit to consumers of more than $200 million in 2012 alone (APS 2013). In 2012, Arizona electric utilities saved 693 GWh, or 1.66 percent of retail sales (ACEEE 2014d, 2015).

Website: http://www.azcc.gov/Divisions/Utilities/default.htm

Arkansas

Arkansas' EERS experience highlights the process the state went through to develop its program. Arkansas undertook a multiple-year development and engagement process before establishing their EERS in 2010. In October 2008, the APSC opened the Sustainability Energy Resources Docket (No. 08-144-U). This docket directed the APSC to explore the current status and potential for Arkansas' sustainable energy resources and technologies by looking at existing efforts within the state as well as nationwide. The APSC also established the Innovative Ratemaking Docket (No. 08-137-U) to explore how the utilization of new technologies and innovative regulatory frameworks can support energy efficiency efforts. From 2008 to 2010, the APSC engaged the community by holding 12 public workshops and filing over 250 testimonies, comments, and legal briefs in order to work towards the objectives put forward in the dockets (APSC 2010). During this time, APSC also directed electric and gas utilities to pilot a wide range of energy efficiency programs (ACEEE 2011).

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[26] Load factors describes the relationship between annual peak end-use demand in MW (or peak output) and annual electricity sales (or generation) in MWh. The formula is *Annual Electricity Sales (MWh) / (Peak Demand (MW) * 8760 Hours per year).*

In December 2010, the APSC published the APSC Sustainable Energy Resources Action Plan for Arkansas (APSC 2010). The Action Plan established the EERS by including them in 10 orders designed to increase energy efficiency in Arkansas. The APSC issued orders to complement the EERS by:

- Aligning incentives of customers and utilities, accomplished by introducing utility performance incentives and a lost revenue adjustment mechanism to make up for decreased sales.
- Promoting a high standard for EM&V of energy efficiency programs.
- Promoting customized energy efficiency projects at large commercial and industrial facilities, enabling facilities to self-direct energy efficiency funds to which they are contributing (ACEEE 2011).

The Arkansas Action Plan established EERS incremental savings targets for utilities, rising from 0.25 percent of electricity sales in 2011 to 0.75 percent in 2013 and from 0.2 percent of gas sales in 2011 to 0.4 percent in 2013. Since then, targets have been scaled up to 0.9 percent of electricity sales and 0.6 percent of gas sales by 2015. The APSC is currently conducting an evaluation of the EERS to see how they can be improved before setting targets for 2016 and beyond (ACEEE 2015).[27]

Website: http://www.apscservices.info/ee.aspx

California

California's EERS experience highlights the state's reforms to align utility and other stakeholder incentives with EERS objectives. Since 2004, the California EERS programs have set ambitious energy savings goals for both electric and gas utilities. Following the passage of Assembly Bill 2021 in 2006, the California Energy Commission (CEC), CPUC, and other stakeholders were required to develop a statewide estimate of all cost-effective electricity and gas savings and to develop annual energy savings and demand reduction goals for the state's four largest IOUs. This study must be updated every 3 years (DSIRE 2014). Each IOU acts both as a portfolio manager and program administrator and seeks approval from CPUC (CPUC 2013). The energy efficiency program portfolio must meet California's cost-effectiveness tests, and CPUC must set energy savings goals for IOUs to achieve all cost-effective reductions identified by the IOUs. In addition, energy efficiency programs must align with CPUC strategic plan objectives, and 20 percent of the budget must be competitively bid on by third-party implementers (CPUC 2014a).

California found that the following mechanisms have led to the success of their EERS:

- A "loading order" for investing in energy resources, through which cost-effective energy efficiency and conservation resources are to be selected first, followed by onsite generation, then renewable generation. The cleanest available fossil fuel generation resources are acquired to meet any remaining resource needs (CPUC 2014a).
- Utilities are required to reduce their demand forecasts to reflect the adopted energy efficiency savings goals, and are therefore further motivated to ensure that reductions are achieved. The utilities' achievements are subject to rigorous EM&V, overseen by CPUC.

[27] In 2013, Arkansas was awarded $500,000 in competitive funding from DOE to help ensure that robust savings goals continue to be pursued during the second 3-year phase of the EERS rollout.

- CPUC also adopted decoupling ratemaking mechanisms that break the link between the utilities' revenues and sales, removing disincentives for utility investments in energy efficiency. (See Section 7.2, "Policies That Sustain Utility Financial Health.")
- The Energy Savings Performance Indicator provides financial incentives for achieving energy efficiency savings, setting strong goals, advocating for stronger building codes and appliance standards, and establishing "non-resource" programs that support the goals of cost-effective energy conservation but do not directly result in savings (DSIRE 2014).

The rules that govern all aspects of portfolio management and program administration are found in the CPUC energy efficiency policy manual (CPUC 2013). The energy savings goals were adopted by CPUC and established through a collaborative effort between the CEC and key stakeholders (CPUC 2004).

California has met its program targets and achieved considerable savings (ACEEE 2014b). In 2009, California IOUs invested $786 million in the state's EERS through ratepayer funds. This investment saved Californians 3,000 GWh of electricity (1.2 percent), 28 million therms of gas (0.2 percent), and over 540 MW of electricity demand (0.9 percent). Throughout the life of these measures, Californians are expected to save 30,000 GWh and 530 million therms. An estimated 60 percent of these savings and net savings would not have occurred without EERS program intervention (CPUC 2011; CEC 2015). From 2006 to 2014, accounting for program and customer costs, California's EERS program has resulted in overall savings of $1.8 billion (CPUC 2014a).

Websites:
http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm
http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/40212.pdf
http://www.cpuc.ca.gov/PUBLISHED/REPORT/28715.htm
http://www.cpuc.ca.gov/NR/rdonlyres/1E2FFBF2-E93D-4FEA-BD38-00D83576BB2E/0/CPUCEEPrimer_.pdf

Illinois

Illinois' EERS experience highlights a hybrid implementation approach between utilities and a state agency. The Illinois Power Agency Act of 2007 sets incremental electric and gas savings, ramping up from 0.2 percent electricity savings in 2008 to 2 percent in 2015 and thereafter. Gas savings of 0.2 percent start in 2011 and ramp up to 1.5 percent by 2019, with the goal of 8.5 percent cumulative savings for natural gas by 2020 (ACEEE 2015). This Act also divides the role of implementing the EERS between the electric utilities and the Illinois DCEO, with DCEO responsible for achieving 25 percent of the program's energy savings by targeting state and local governments, school districts, and low-income households. While targets have been set for each year of the program, expenditures are also now capped at 2 percent of the price per kWh, up from 0.5 percent at the start of the program. Due to the expenditure cap, the energy savings targets were revised downward for 2011–2013.

Illinois electric utilities ComEd and Ameren both exceeded their electricity savings goal for each of the first 5 years of the EERS. In 2012, ComEd and Ameren reported net savings of 828 GWh and 331 GWh respectively, amounting to around 1 percent of electricity use. In addition, gas utilities saved 24.5 million therms in 2012, just shy of their collective savings goal of 25.9 million therms (ACEEE 2014b).

The Illinois EERSs are part of a broader effort that includes an RPS requirement, and are intended to gain the combined benefits of reduced demand growth and increased clean generation. This twin approach has broad support from utilities, environmental and consumer groups, and other stakeholders.

Website: http://www.icc.illinois.gov/en/ecenergy.aspx

Vermont

Vermont's EERS experience highlights its program implementation through a single statewide administrator. Most EERS programs are created at the state level but implemented through state utilities. However, since Vermont has 22 municipally owned utilities, the state decided it was more efficient to implement its EERS through a single statewide administrator. In 1999, the Vermont PSB created a statewide EEU known as Efficiency Vermont, funded through a per-kWh fee on customers' electricity bills (Vermont PSB 2014). The state periodically issues a request for proposals to determine the statewide administrator for Efficiency Vermont. It also uses a performance-based contract to ensure performance against goals.

While Efficiency Vermont administers statewide energy efficiency programs, in 2000, the Vermont PSB allowed the City of Burlington Electric Department to implement these services in Burlington (BED 2014a). Each year, the Burlington Electric Department releases a plan coordinated with Efficiency Vermont to increase program efficacy and both EEUs are responsible for implementing energy efficiency measures for their respective areas.

Efficiency Vermont works with municipalities to improve energy efficiency by producing outreach and informational efficiency materials, such as the *Municipal Guide to Vermont Energy Codes and Above-Code Programs*. Efficiency Vermont also runs targeted programs, including:

- The Municipal Street Lighting Program, which offers financial incentives and guidance on switching to efficient LED technologies.
- The Light Meter Loan Program, which allows municipalities to borrow meters to determine appropriate street lighting levels and eliminate unnecessary lights (Efficiency Vermont 2014c).
- Energy competitions in schools and homes. For instance, the Whole School Energy Challenge reduced electricity consumption in 13 participating schools by 7 percent, while the Vermont Home Energy Challenge enlisted 79 communities in a competition to weatherize 3 percent of local homes in one year (Efficiency Vermont 2014a).

Efficiency Vermont has a 3-year electricity reduction target from 2012 to 2014 of 274,000 net MWh, equal to about 6.6 percent of total generation (ACEEE 2015). Through the end of 2013, savings totaled 198,150 kWh, or 72 percent of the target. Relative to a target of 41,920 kilowatts (kW) of saved peak summer demand, Vermont has achieved 25,724 kW (61 percent) of reductions. The program has also been cost-effective, with $2.30 of total electric benefits being generated for every dollar spent on the electricity demand programs. Efficiency Vermont is also 93 percent and 125 percent of the way towards meeting respective spending goals on programs geared towards low-income communities and the residential sector (Efficiency Vermont 2014a). As for regional targets, in 2013 the Burlington Electric Department reported electricity savings of 7,006 MWh, 95 percent of the way towards its goal of 7,334 MWh (BED 2014b). Efficiency Vermont has also set goals for specific towns with large peak demands to avoid the need for expensive new infrastructure that would raise rates statewide. For example, the St. Albans and Susie Wilson localities have achieved 71 percent and 104 percent of their respective goals to date (Efficiency Vermont 2014d).

Website: https://www.efficiencyvermont.com/About-Us

What States Can Do

States can look to other states for best practices, as both restructured and traditional utility markets have set EERS goals for utilities. For instance, in 2011, the District Department of Energy contracted with the Vermont Energy Investment Corporation to form the DC Sustainable Energy Partnership (DCSEU 2015). EERS goals can be administered in association with PBFs or regulated utility efficiency programs. Because an EERS can support multiple purposes, including Clean Air Act compliance plans, utility-sector resource plans, and climate action plans, states can set EERS goals within the context of broad energy and environmental policy goals. States with existing EERSs can continue to assess and refine the standards as new information about potential opportunities and successful approaches becomes available.

Action Steps for States

States have found that the key steps to establishing EERSs are:

- Conduct a robust analysis of energy efficiency potential, an economic assessment of potential benefits and costs, and a determination of the range of savings targets that would be realistic for the EERS.
- Establish a stakeholder engagement process to gather input and build support for the program.
- Design and develop the EERS program by determining appropriate goals and timeframes, the sectors covered by the goals, the way the program will be funded, the kinds of programs that can be implemented, and the interaction with other state and federal programs.
- Define an implementation and evaluation process that sets rules and procedures for identifying efficiency programs, funding sources, EM&V requirements and procedures, and general oversight.
- Provide for periodic evaluation and program review at specified intervals.
- Consider complementary policies that incentivize utilities to invest in energy efficiency.

Information Resources

Information about States

Title/Description	URL Address
ACEEE State and Local Policy Database. This database includes information on energy efficiency policies currently implemented at the state and local level. It tracks policy activity across multiple sectors, including government, utilities, transportation, buildings, and alternative approaches such as CHP and appliance standards.	http://database.aceee.org/
Arizona Corporation Commission (AZCC). The AZCC website contains information on Arizona's electric utilities, including an electronic docket for regulations, calendars, and current issues.	http://www.azcc.gov/Divisions/Utilities/default.htm
Energy Efficiency. This APSC website contains information on current energy efficiency rules, a Technical Reference Manual, and annual utility reports.	http://www.apscservices.info/ee.aspx
State of California Energy Action Plan. This website contains the text of the California Energy Action Plan.	http://docs.cpuc.ca.gov/published//REPORT/28715.htm
Energy Efficiency Potential and Goals Studies. This CPUC site has compiled information on the potential and goals set for energy efficiency in California, including the 2013 Navigant study.	http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm
CPUC Energy Efficiency Primer. This document provides an overview of CPUC regulation and goals for energy efficiency.	http://www.cpuc.ca.gov/NR/rdonlyres/1E2FFBF2-E93D-4FEA-BD38-00D83576BB2E/0/CPUCEEPrimer_.pdf
Illinois Commerce Commission. This site contains information on programs, services, hearings, workshops, and regulations related to electric utilities.	http://www.icc.illinois.gov/en/ecenergy.aspx
About Efficiency Vermont. This website provides resources to residences and businesses, including initiatives, plans, reports, and white papers.	https://www.efficiencyvermont.com/About-Us
Focus on Energy Program: Partnering with Wisconsin Utilities. This website provides resources for finding out about and participating in Wisconsin's energy efficiency programs.	https://focusonenergy.com/

EERS Policy Resources

Title/Description	URL Address
Measurement and Verification Portal. This website provides numerous resources, ranging from implementation guidelines to checklists and other resources, to help organizations implement an EM&V program.	http://ateam.lbl.gov/mv/
Guideline 14-2002 – Measurement of Energy and Demand Savings. This document provides guidelines for reliably measuring energy and demand savings of commercial equipment.	http://www.techstreet.com/ashrae/products/1645226
CALMAC. California's statewide CALMAC evaluation clearinghouse website contains resources for deemed savings and project-specific EM&V techniques.	http://www.calmac.org
The Efficiency Vermont Technical Reference Manual. Vermont provides a set of deemed-savings methods in this manual.	https://www.veic.org/resource-library/the-efficiency-vermont-technical-reference-manual-%28excerpts-from%29

Title/Description	URL Address
2005/2006 Biennial Plan: Minnesota Natural Gas and Electric Conservation Improvement Program. This plan was submitted to the Minnesota Department of Commerce by Xcel Energy on June 1, 2004.	http://pbadupws.nrc.gov/docs/ML0520/ML052010211.pdf
Interim Opinion: Updated Policy Rules for Post-2005 Energy Efficiency and Threshold Issues Related to Evaluation, Measurement and Verification of Energy Efficiency Programs. CPUC held several workshops on EM&V to discuss the performance basis, metrics, and protocols for energy efficiency program EM&V, including incentive, training, education, marketing, and outreach programs.	http://www.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/45783.htm
IPMVP Public Library of Documents. IPMVP Inc. is a nonprofit organization that develops products and services to aid in the EM&V of energy and water savings resulting from energy/water efficiency projects—both retrofits and new construction. The site contains the IPMVP, a series of documents for use in developing an EM&V strategy, monitoring indoor environmental quality, and quantifying emission reductions.	http://www.evo-world.org/index.php?option=com_content&view=article&id=272&Itemid=379&lang=en
Energy Performance Contracts for Local Governments: Industry Standards and Best Practices Guide. EM&V guidelines are included in the New York State Energy Research and Development Authority's request for applications for performance contracting.	http://www.dec.ny.gov/docs/administration_pdf/epcguide.pdf
Sixth Northwest Conservation and Electric Power Plan. This document presents the 2010–2014 targeted conservation measures and economics.	http://www.nwcouncil.org/energy/powerplan/6/plan/
PA Knowledge Limited 2003: Standardized Methods for Free-Ridership and Spillover Evaluation-Task 5 Final Report. This 2003 report is used by Massachusetts utilities to estimate free ridership and spillover effects.	Contact PA Consulting at: http://www.paconsulting.com
Setting Energy Savings Targets for Utilities. This report reviews how states have set EERS targets, discusses the issues involved, and provides recommendations.	https://www4.eere.energy.gov/seeaction/system/files/documents/ratepayer_efficiency_targets.pdf
Southern California Edison's 2012 Demand Response Load Impact Evaluations Portfolio Summary. This report summarizes the load reduction capability from Southern California Edison's (SCE) portfolio of Demand Response (DR) programs.	http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/62A8F5E44C447F0688257B410052EC7B/$FILE/R.07-01-041_DR+OIR-SCE+DR+Portfolio+Summary+2012+-+Final.pdf
State Energy Efficiency Resource Standards: Design, Status, and Impacts. This 2014 report reviews the key design features of EERSs for electricity, explores state-level design variations in EERSs, and provides an estimate of the savings required by currently-specified EERSs in each state.	http://www.nrel.gov/docs/fy14osti/61023.pdf
Putting a Floor on Energy Savings: Comparing State Energy Efficiency Resource Standards. This study aggregates information about the requirements of existing EERS policies for electricity sales in the United States by converting quantitative goals into comparable terms across states and comparing U.S. policies to those of the European Union.	http://www.rff.org/RFF/Documents/RFF-DP-12-11.pdf

Examples of Legislation/Regulation

State	Title/Description	URL Address
Arizona	Arizona Administrative Code R14-2-2401. This code established an EERS target of 22 percent by 2020.	http://www.azsos.gov/public_services/Title_14/14-02.htm
Arkansas	Order Establishing a Collaborative to Develop an Evaluation, Measurement, and Verification Protocol and Propose EM&V Amendments to the Commission's Rules for Conservation and Energy Efficiency Programs. This document is part of a series of orders to update and further define energy efficiency programs.	http://www.apscservices.info/pdf/08/08-144-u_155_1.pdf
	APSC Sustainable Energy Resources (SER) Action Guide. This document established an initial EERS.	http://www.apscservices.info/pdf/08/08-144-U_153_1.pdf
California	California Interim Opinion: Administrative Structure for Energy Efficiency (Decision 05-01-055). This CPUC rule sets the administrative structure and process for energy efficiency programs.	http://docs.cpuc.ca.gov/published//FINAL_DECISION/43628.htm
	Decision establishing energy efficiency savings goals and approving 2015 energy efficiency programs and budgets. This decision, an EERS update, was released for public comment in September 2014.	http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M107/K150/107150165.PDF
Illinois	Interim Opinion on the Administrative Structure for Energy Efficiency: Threshold Issues. This act, also known as the Illinois Power Agency Act, established EERSs that require incremental annual electric and savings.	http://www.ilga.gov/legislation/ilcs/ilcs4.asp?DocName=002038550HArt%2E+1&ActID=2934&ChapterID=5&SeqStart=100000&SeqEnd=3700000
Vermont	Triennial Plan: 2015–2017. This Efficiency Vermont document outlines the triennial plan for reduction goals in Vermont.	https://www.efficiencyvermont.com/docs/about_efficiency_vermont/annual_plans/evt-triennial-plan-2015-2017.pdf

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ACEEE. 2014d. State Energy Efficiency Resource Standards (EERS) April 2014. American Council for an Energy-Efficient Economy. Accessed July 23, 2014.	http://www.aceee.org/files/pdf/policy-brief/eers-04-2014.pdf
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4.2 Energy Efficiency Programs

Policy Description and Objective

Summary

States have found that well-designed and administered energy efficiency programs increase public and private sector investments in cost-effective energy efficiency, resulting in reduced energy costs for electricity customers, emission reductions, and enhanced reliability. Programs can be used in conjunction with other strategies to achieve market transformation, causing lasting change in the availability and demand for energy-efficient goods and services.

> Energy efficiency programs provide a range of financial and other incentives to encourage investments in energy-efficient technologies, related services, and/or behavior change. These incentives range from simple cash rebates for the purchase of efficient products to bundled customized financial incentives and technical assistance.

State executive and legislative branches rely on a combination of authorities and funding sources to administer and oversee successful energy efficiency programs. State policy makers may allow state energy offices, utility companies and/or third-party administrators to deliver energy efficiency programs. In recent years, state funding for electricity energy efficiency programs has increased significantly from $1.6 billion in 2006 to $6.3 billion in 2013, with program administrators in all 50 states reporting savings. As a result, individual states have saved up to 2.1 percent of total electricity demand due to energy efficiency programs (ACEEE 2014b).

The majority of funding for energy efficiency programs comes directly from utility customers, also referred to as ratepayers.[28] State legislators and state utility commissions play a lead role in establishing public benefits funds (PBFs), also known as system benefits charges, to fund energy efficiency programs. PBFs are typically created by levying a small charge on every customer's electricity bill. Alternatively, some state utility commissions allow the utility to provide an annual revenue stream to fund energy efficiency programs by expensing or capitalizing the funds from the utility company's total revenue without itemizing a charge on the customer bills. According to a study by Lawrence Berkeley National Laboratory, ratepayer-funded electricity efficiency program spending is projected to continue growing at a substantial rate, reaching between $6.5 billion and $15.6 billion in 2025 (LBNL 2013).[29] Where there are comprehensive statewide programs in place, funding levels range from 2.83 to 8.55 percent of total utility revenues (ACEEE 2014b).

Objective

The objectives of energy efficiency programs include:

- Reducing customers' energy costs.
- Meeting customers' demand for electricity services without generating electricity at power plants.
- Meeting energy savings goals (see Section 4.1, "Energy Efficiency Resource Standards").
- Stimulating local economic development and new jobs.
- Reducing the environmental impacts of meeting electricity service needs.
- Supporting electricity system reliability by decreasing electricity demand.

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[28] As discussed later in this section, in addition to ratepayer-funded programs, energy efficiency programs may also be funded through other sources, such as state budgets and proceeds from related auctions.

[29] Values for both electricity and natural gas programs provided in nominal dollars from LBNL (2013).

Most states use energy efficiency programs to reduce total overall energy consumption in buildings and homes. Energy efficiency programs also reduce energy waste in agricultural and industrial facilities, support efficiency by taking advantage of thermal energy applications (including combined heat and power [CHP]), reduce peak demand, support consumer education, and demonstrate new energy efficiency technologies and practices. Some of these objectives are also discussed in Chapter 6, "Policy Considerations for Combined Heat and Power," and Section 7.5, "Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration."

Benefits

Well-designed and administered energy efficiency programs can reduce energy demand at a lower cost than supply options (see Figure 4.2.1) and deliver a variety of benefits. They lower energy costs for utility customers by reducing average bills and limiting future energy price increases. By reducing demand, they improve the reliability of the electricity grid and avoid emissions.

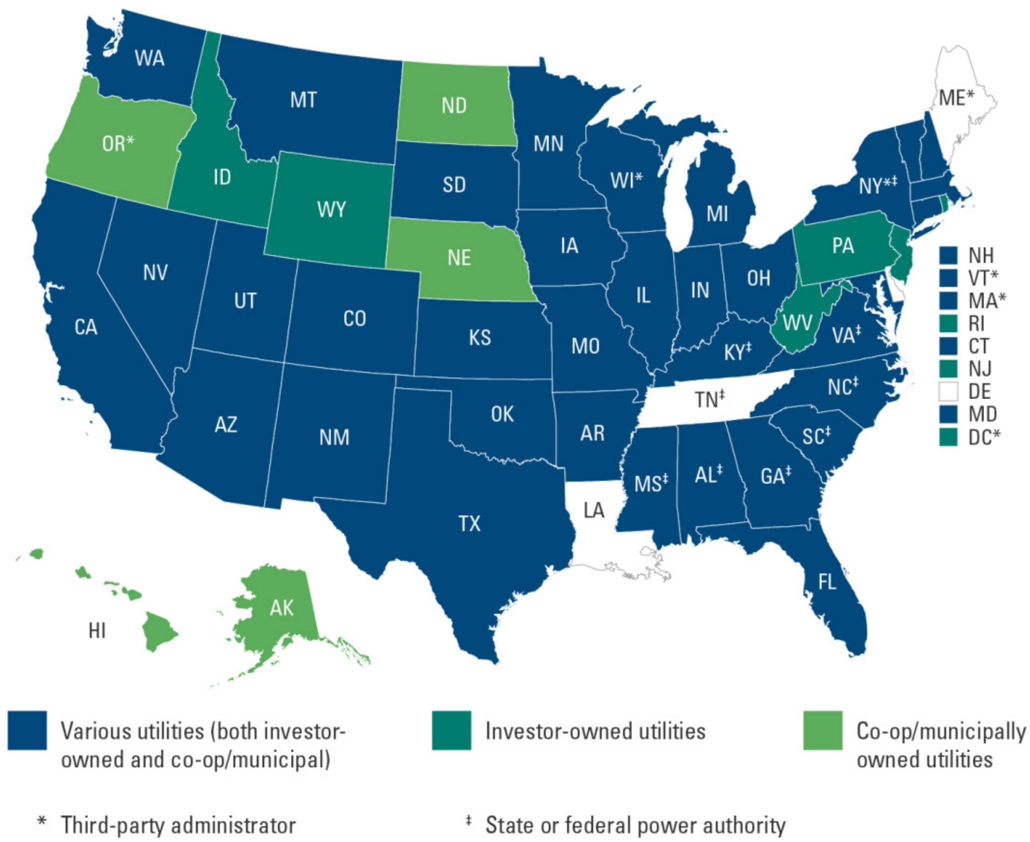
Energy efficiency programs play an important role in correcting market failures and addressing barriers to investment in cost-effective, beneficial energy efficiency opportunities.

Energy efficiency programs also help create local jobs by lowering energy costs and stimulating new public and private sector investments: initial investments in energy efficiency generated about 11 jobs per million dollars of investment (PNNL 2014).

States with Energy Efficiency Programs

Forty-eight states, as well as Washington, D.C., offer energy efficiency programs. These states have one or more entities administering programs in the state, such as statewide third-party program administrators, utility companies, and state energy offices. Figure 4.2.1 illustrates which entity in each state reported energy savings from programs during 2012. Investor-owned utilities reported approximately 75 percent of electricity savings, while third-party administrators and publicly owned utilities reported the majority of additional savings. Annual electricity savings were also reported by cooperatively owned utilities, as well as state and federal power authorities who administer energy efficiency programs (EIA 2012). States have found that coordination across entities administering programs can support greater energy savings and broader market transformation.

Figure 4.2.1: Entities Reporting Energy Savings from Energy Efficiency Programs by State, 2012



Source: Derived from EIA 2012 data, using annual electricity savings from energy efficiency programs for 2012.

Designing an Effective Policy for Energy Efficiency Programs

There are several key issues that states consider when establishing policies that support delivery of energy efficiency programs. These issues include identifying key participants and their roles, calculating appropriate funding levels, determining timing and duration, developing a portfolio of activities, and interacting with other state and federal policies.

Participants

- *State legislatures.* Legislation may be required to establish or expand energy efficiency programs, particularly if statewide program administrator and/or funding mechanisms, such as PBFs, are to be used. The state legislatures may also need to authorize and ensure periodic reviews of energy efficiency programs implemented by utilities and third-party administrators that are not otherwise under the jurisdiction of the state public utility commission (PUC). Legislation may also determine energy efficiency goals and objectives, establish funding, specify implementing and oversight organizations, and review program authorization at specified intervals.

- *State energy offices.* State energy officials, often on behalf of the state governor, play an important role in developing policies to support energy efficiency programs and in reporting on results of policies and programs. State energy offices may also administer energy efficiency programs, particularly those funded through state budgets and/or federal grants.
- *PUCs.* PUCs play a key role in authorizing, reviewing, and approving ratepayer-funded energy efficiency program plans, approving utility cost recovery and related ratemaking considerations (also see Section 7.2), approving methodologies used to evaluate savings, and ensuring that programs are achieving anticipated results. PUCs advance these roles through regulatory processes that allow for stakeholder participation. In some states, PUCs also have authority over specific aspects of cooperatively and publicly owned utilities that give them jurisdiction over energy efficiency programs. State PUCs that require ratepayer-funded energy efficiency programs to be administered by third-party entities, instead of the utility companies, may enter into the contractual arrangement with the third-party program administrators.
- *Other state agencies.* State environmental offices may play a role in supporting policy, establishing funding, and implementing energy efficiency programs. This is particularly true when these programs support environmental policy, such as greenhouse gas (GHG) markets (see more information on Regional Greenhouse Gas Initiative [RGGI] energy efficiency set-asides in Chapter 3, "Funding and Financial Incentive Policies") or Climate Action Plans. State agencies that deliver assistance from the Low-Income Home Energy Assistance Program (LIHEAP) also help implement energy efficiency programs to improve energy affordability. State energy offices may also administer all or part of the energy efficiency programs, including those that weatherize low-income homes.
- *Utilities.* In most states, utilities serve as program administrators for the energy efficiency programs. For those programs in which the utility does not directly serve as program administrator, the utility may still be involved in funding, such as processing PBF charges on customer bills and providing data sources for reporting results. Utilities may also coordinate with other energy efficiency program administrators, including the state energy office, LIHEAP office, and third-party administrators, during program design and implementation.
- *Customers.* Industrial customers and consumer advocates are typically active participants in energy efficiency program proceedings at state PUCs. They help determine the distribution of charges to customers to fund programs as well as which customer classes will be offered programs, such as low-income, residential, commercial and industrial customers.
- *Public and private sector organizations*. Businesses and other non-governmental organizations, including environmental groups, will also participate in policy design, adoption, and implementation.

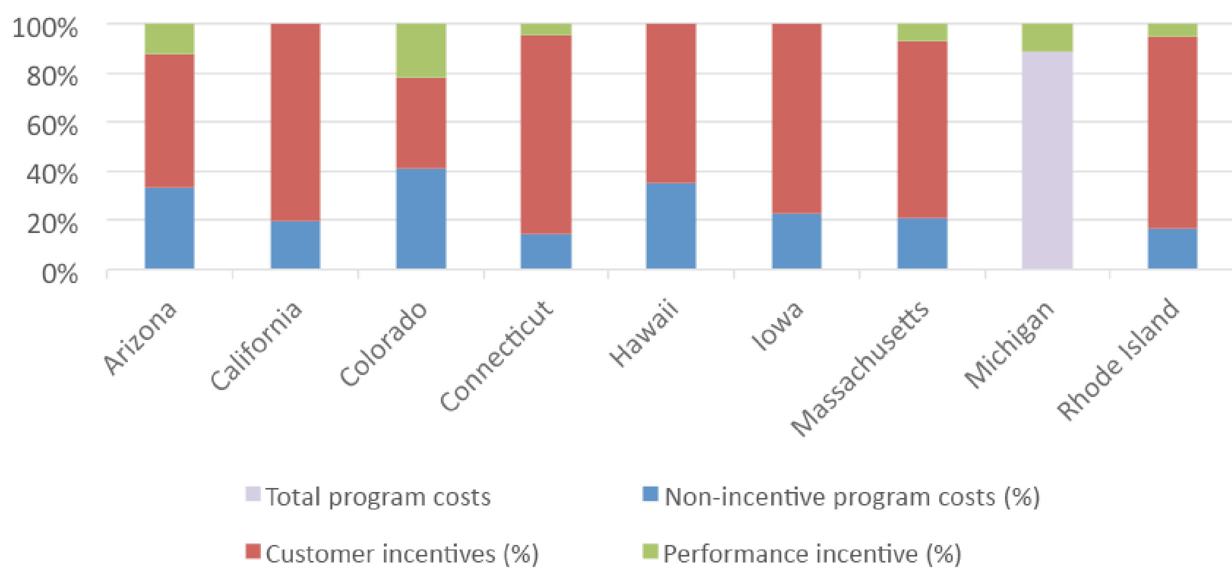
Responsibility and Coverage

States provide policy direction on which customer classes are to be offered programs (i.e., low-income, residential, commercial, and industrial). Policy direction is often provided at a portfolio level, leaving flexibility for program administrators to design and modify specific program offerings to meet policy goals. Energy efficiency program coverage may also in part be affected by the jurisdiction of the agency establishing and implementing the policy. For example, the PUCs in the majority of states do not have authority over cooperatively or municipally owned utilities, hence limiting state PUC implementation of energy efficiency program policies administered by investor-owned utilities. The board of directors or municipal agency overseeing the utility will typically determine energy efficiency program coverage for a cooperatively or municipally owned utility.

Funding

Energy efficiency program funding covers the costs incurred by the program administrators and the incentives paid to customers. Administrative costs are distributed across several activities, including marketing, design and planning, and measurement and verification. Cost distribution across activities varies, with some states setting policy direction on the level of funding directed to administration versus direct incentives. Figure 4.2.2 provides an illustrative overview of how the distribution of program costs varies across key activities.

Figure 4.2.2: Electricity Energy Efficiency Program Costs by Type



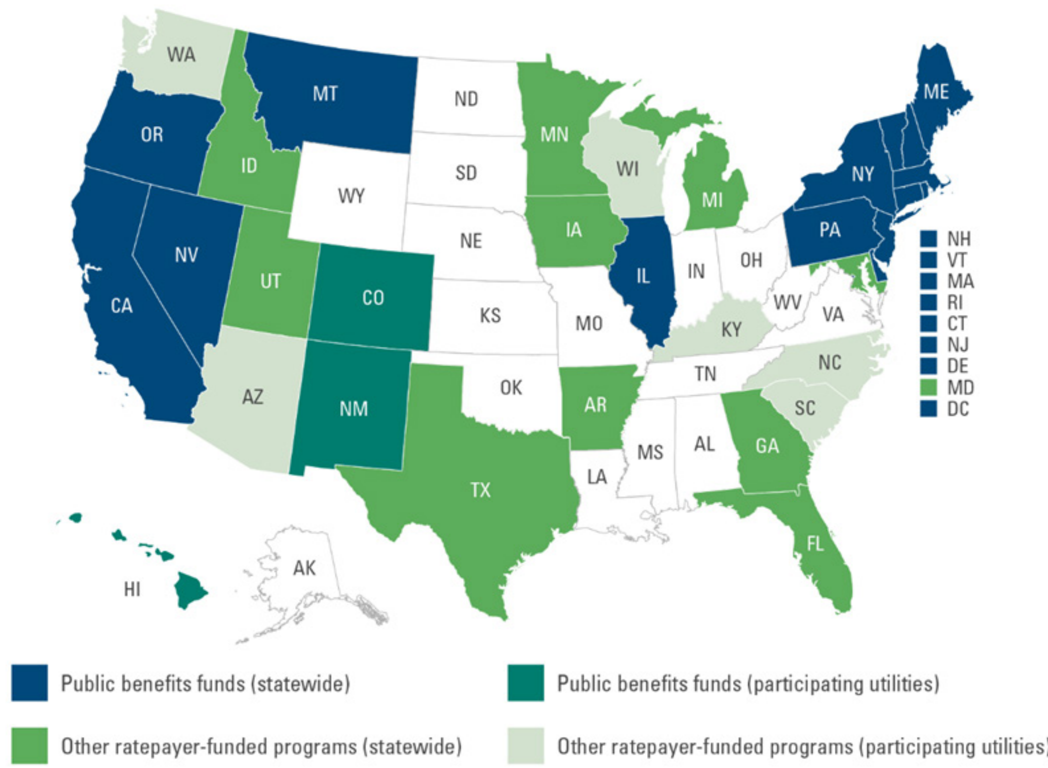
Note: "Customer incentives" refers to rebates, discounts, and other forms of financial incentives received by customers that participate in the energy efficiency program. "Performance incentives" refer to financial rewards that may be provided to the program administrator for reaching or exceeding pre-established performance targets, as further discussed in Section 7.2, "Policies That Sustain Utility Financial Health."

Source: ACEEE 2014c

There are two basic approaches for administering the energy efficiency program funds, both of which can affect how costs are recovered. Under the first and most common approach, money is collected and spent during the current year in an expenses-based mode. If there is an under- or over-collection, it floats in an account and is adjusted in the following year. This account may be controlled by a utility or a third-party administrator, depending upon the type of administering body. (See also "Administering Body" later in this section.) The second approach, which is less common, is to use the energy efficiency program funds to capitalize a revolving fund for grants and loans, which is replenished or expanded when new funds are available.

Funding sources for energy efficiency programs vary, but most states use money collected through customer utility bills. PBFs are a common funding approach; they apply surcharges on customer bills that typically range from $1 to $4 per megawatt-hour (MWh), which translates to well under a half-cent increase on each kilowatt-hour (kWh) of electricity usage (ACEEE 2013). As of March 2015, PBFs are used to fund energy efficiency programs in Washington D.C. and 18 states. In 15 of these states (plus D.C.), energy efficiency PBFs are required statewide, while in the other three, only certain participating utilities use PBFs. An additional 16 states offer energy efficiency programs through other ratepayer-funded mechanisms, but not through a PBF policy. Figure 4.2.3 summarizes these program funding approaches by state.

Figure 4.2.3: Energy Efficiency Incentive Mechanisms by State



Note: States with energy efficiency load funds supported by surcharges, tariffs, or riders were not included. Other ratepayer-funded programs include surcharges, tariffs, riders, and modified base rates that contribute to energy efficiency funds that are not considered PBFs.

Sources: ACEEE 2014a; DSIRE 2015

Utilities that run energy efficiency programs may also recover program costs from their operating budgets, with funding levels and cost distribution across customers determined as part of the broader ratemaking process. Other energy efficiency program funding sources include proceeds from emissions allowance auctions, such as in RGGI states;[30] from energy efficiency programs bidding into electricity capacity markets operated by the New England Independent System Operator and the PJM Interconnection; and from U.S. Department of Agriculture (USDA) grants and loans for energy efficiency programs in rural communities. State budgets and grants from foundations and the federal government (including formula grants and competitive awards from the U.S. Department of Energy [DOE]) fund programs administered by state energy offices. State energy efficiency programs can also coordinate with weatherization assistance programs to leverage an additional funding source while also ensuring complementary energy efficiency program design and implementation for low-income residential customers.

[30] Three states—Connecticut, Massachusetts, and New Hampshire—provide some funding for energy efficiency programs through proceeds from the RGGI auction (ACEEE 2014b).

Providing adequate, consistent, and stable funding is critical for the program's success and for ensuring the private sector's continued participation. There have been market interruptions in cases where some states facing budget shortfalls deferred resources from ratepayer energy efficiency funding sources for other purposes. Some states have developed legislative language to guard against this. For example, Vermont legislation states, "Funds collected through an energy efficiency charge shall not be funds of the state, shall not be available to meet the general obligations of the government, and shall not be included in the financial reports of the state" (State of Vermont 1999).

Best Practices: Developing and Adopting State Energy Efficiency Programs

The best practices identified below will help states develop effective energy efficiency programs. These best practices are based on the experiences of states that have longstanding, highly effective energy efficiency portfolios.

- Determine the cost-effective, achievable potential for energy efficiency in the state. A growing number of states consider non-energy benefits of energy efficiency programs when reviewing cost-effectiveness.
- Start with low-cost, well-established programs and efficiency investments, and build the program over time.
- Assess the level and diversity of support for energy efficiency programs. Engage key stakeholders (i.e., utilities; residential, commercial, and industrial customers; municipalities; trade allies; and environmental groups) and experts collaboratively to help design the program—including its administering organization, funding, duration, and evaluation methods.
- Establish long-term policy direction and funding approach. Consider specific provisions to prevent the energy efficiency program funds from being used for other purposes or to be comingled with general state budget funds. Make funding a minimum level, not a cap, on investment in energy efficiency.
- Ensure that the energy efficiency programs serve the needs of diverse customer classes and stakeholder groups. Managing efficiency programs through portfolios allows program administrators to match incentive types and program features to different customer types and market needs. Portfolios can evolve over time, from simpler and fewer incentive types early on to more feature-rich and diverse incentives and services later on.
- Determine the administering organization(s). The options include utilities, state agencies, or independent organizations. If utilities are selected to administer programs, it is advisable to develop policies that align the utility business model with the goal of achieving energy efficiency. (For more information and examples of these policies, see Section 7.2, "Policies That Sustain Utility Financial Health.")
- Establish effective evaluation methods that build on proven approaches and are appropriate given the chosen program design. Evaluation methods should be rigorous enough to estimate program impacts and other benefits and simple enough to minimize administrative costs.

Timing and Duration

Depending on the resources available to them, such as their ability to consult with outside experts, program administrators that do not already have programs can engage external stakeholders, design energy efficiency programs, and compile necessary documentation for state approval (e.g., through a PUC docket) within a 1 to 2 year timeframe. In reality, most states have some sort of ratepayer-funded energy efficiency programming, and those that have been offering programs for several years continuously evaluate their program offerings and performance as they plan for the next program cycle. Designing new programs may require 90 to 120 days, with a filing made to their PUC within 6 months for approval.

Because ratepayer-funded programs, including those funded by PBFs, require state PUC approval, many states approve multi-year program plans to reduce administrative costs and allow programs to operate more effectively in the market. Typically, states approve programs for 1 to 3 years, with most states conducting reviews at least annually to ensure costs and savings are on track.

To maintain funding and support for energy efficiency programs, it is also valuable for states to collect and share information on program performance and to educate stakeholders about the energy, economic, and environmental benefits of energy efficiency programs.

Developing a Portfolio of Activities

Targeting Efficiency Investments

Most program portfolios are informed by energy efficiency potential studies that identify cost-effective energy efficiency program opportunities. Usually some expert judgment is required to determine how much of that potential is achievable and at what cost. Depending on the program type, once program administrators have received regulatory approval, turnkey programs such as lighting and appliance programs can launch and begin to achieve results within a 6 to 12 month timeframe. Programs that require infrastructure development such as whole-home or whole-building programs will be slower to ramp up. Depending on market conditions, they may be best introduced as pilot programs that are scaled up once the program administrator has gained operational experience and developed relationships with critical trade allies.

State agencies, particularly PUCs, often provide policy direction on energy efficiency programming to meet short and longer term resource needs, maintain cost-effectiveness, and ensure equitable ratepayer treatment. Where state PUCs lack jurisdiction over energy efficiency programs administered by municipally and cooperatively owned utilities, the utility’s board of directors or local government may provide similar direction. Key considerations for energy efficiency include the following:

- Customer classes that need to be served, including hard-to-reach customer classes. States may also distinguish between new and existing equipment and buildings within customer classes.
- Distribution of benefits across customer classes and service territories.
- Whether cost-effectiveness should be assessed at the portfolio level, program customer sector, or measure level, and what cost-effectiveness tests should be used to screen programs (see additional information on cost-effectiveness below).
- Other social and environmental benefits (e.g., serving low-income customers, reducing air pollutants, reducing water consumption, and improving reliability of the electricity grid).
- Supporting technology research, development, and demonstration by identifying and verifying the performance of emerging technologies, practices, or innovative program models.

States may also use energy efficiency programs to reduce electricity consumption during peak demand periods, thereby supporting greater system reliability. Since utilities incur higher costs to provide electricity during periods of high usage, peak hour reductions can also improve the program’s cost-effectiveness. Programs that target energy use during peak periods may include rebates for high-efficiency air conditioners.

In addition, program administrators also invest in demand response programs that involve users curtailing or shifting consumption during specific times of the day (also see Section 7.5, “Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration”). Though demand response programs may result in net reductions in total energy use, the magnitude is typically less than energy efficiency programs because load changes occur in more limited hours throughout the year.

Furthermore, some states target a portion of their efficiency investments to heavily populated areas or business districts; this helps alleviate transmission congestion and offsets or postpones transmission infrastructure investments. By linking program savings to constrained areas, the cost-effectiveness of the energy efficiency program may improve, while all electricity customers benefit when reliable energy supply is provided without incurring costly capital investments in the system.

Cost-Effectiveness

Many states incorporate cost-effectiveness analysis into the design and evaluation of their programs to determine whether the benefits exceed the costs. This helps ensure the effective use of program funds and can be used to compare program and technology performance in developing effective future programs. Table 4.2.1 shows cost-effectiveness tests commonly used by states. These are often applied at the portfolio level, though individual measures and programs can be further screened based on both the extent to which benefits exceed costs and on other aforementioned portfolio considerations.

Table 4.2.1: Primary Cost-Effectiveness Test by State

All tests	TRC/SCT Primary Threshold	UCT Primary Threshold	Combined TRC/UCT threshold
IA, IN, NC	CO, DE, FL, IL, MA, ME, MN, MO, NH, NV, OH, OR, PA, RI, VT, WA, WI	CT, MI, NM, TX, UT	CA, OR

Sources: Cadmus and Hedman 2012; SWEEP 2014

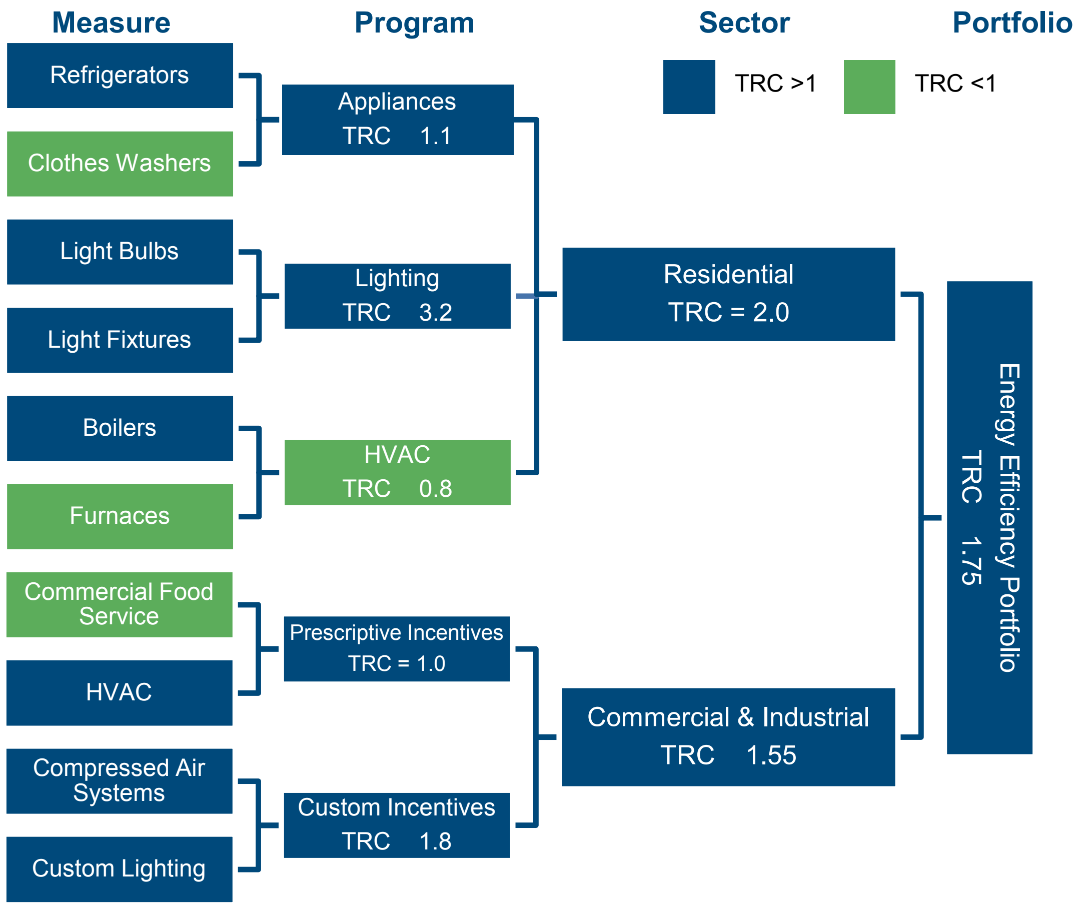
According to the American Council for an Energy-Efficient Economy (ACEEE), most states use multiple tests, although 29 states primarily use the Total Resource Cost (TRC) Test (ACEEE 2012). The TRC, as well as the Societal Cost Test (SCT), assess the net lifetime benefits and costs of a measure or program, accounting for both the utility and program participant perspectives. The SCT differs from the TRC in that it includes some non-energy benefits. As with other cost-effectiveness tests, if the benefit-cost ratio is greater than one, it is deemed to be cost-effective. In many cases, states require programs to assess cost-effectiveness from multiple perspectives, mainly because they provide useful insights into the range of issues a program might raise (ACEEE 2010). For example, the Participant Cost Test and the Program Administrator Cost Test, also known as the Utility Cost Test (UCT), are sometimes used to help design programs and incentive levels.

A longer term trend has been the movement away from the Ratepayer Impact Measure (RIM) test because it does not account for the interactive effect of reduced energy demand from efficiency investments on longer term rates and customer bills. Under the RIM test, any program that increases rates would not pass, even if total bills to customers are reduced.

Cost-effectiveness test results are typically reported in terms of the benefit-cost ratio. A larger benefit-cost ratio means that the program is more cost-effective. States may also express program costs and benefits in terms of $/kWh since such a metric may be effective when communicating to consumers and legislators. This metric also allows utilities and their regulators can compare energy efficiency to other resources, such as new generation.

As illustrated in Figure 4.2.4, cost-effectiveness is generally evaluated at the following four levels: measure, program, sector, and portfolio. Evaluation at the portfolio level is the most flexible; programs can be viewed together for cost-effectiveness purposes, allowing program planners to consider all customer classes, even though some measures and programs may not pass cost-effectiveness tests when looking at them discretely.

Figure 4.2.4: Illustrative Example of Cost-Effectiveness at Measure, Program, Sector, and Portfolio Levels



Source: NAPEE 2008

Interaction with Federal Programs

State energy efficiency programs interact with several federal programs, such as federal energy efficiency standards for equipment, appliances, and lighting. State programs complement federal standards by supporting broader adoption of newer, more efficient products and help bring down the costs for more efficient technologies. However, program administrators can only take credit for the energy savings above the minimum federal standards. Therefore, once a new federal standard advances, program administrators modify their programs to continue achieving cost-effective energy savings. For example, due to recent changes to lighting efficiency standards, state energy efficiency programs were modified to promote new lighting technologies such as LEDs (EPA 2011).

State policy-makers and energy efficiency program administrators should also be aware of other federal programs to avoid duplication and to help properly design programs that complement existing federal financial incentives and assistance. For example, if a federal tax credit is available in a given year, the magnitude of the program rebate or incentives should be recalculated to reflect the additional funding stream. Also, state energy efficiency program administrators may be able to leverage federal technical assistance and tools in their own program design to help reduce costs while also supporting a robust market for energy efficiency products and services. Federal programs providing such technical assistance, tools, and guidance include, but are not limited to:

ENERGY STAR Industrial

Industrial plants can be large consumers of electricity. Therefore, many tools and resources exist to help states develop and deliver strong programs for industrial energy improvements. For example, ENERGY STAR for Industry provides industry, states, and utilities proven energy efficiency strategies and tools that are adoptable within any manufacturing sector. These cost-effective resources (such as sector energy guides, plant energy benchmarks, and the ENERGY STAR Guidelines for Energy Management) help states and utilities 1) evaluate, identify, and understand potential energy savings at specific types of manufacturing plants, 2) build strategic energy management capability at manufacturing plants, and 3) develop cost-effective programs that promote continuous energy-efficient improvements for sustained savings at manufacturing plants.

- *ENERGY STAR®*. EPA's ENERGY STAR program is the simple choice for energy efficiency. For more than 20 years, people across America have looked to ENERGY STAR for guidance on saving energy, saving money, and protecting the environment. Behind each blue label is a product, building, home, or facility that is independently certified to use less energy and cause fewer of the emissions that contribute to climate change. EPA offers technical assistance, tools, and resources to energy efficiency program administrators who leverage ENERGY STAR in their residential, commercial, and industrial efficiency programs.[31] Numerous tools and others resources are available free of charge to ENERGY STAR partners (ENERGY STAR 2014a, 2014b). Approximately 700 energy efficiency program administrators formally partner with ENERGY STAR to reduce program costs and implementation timelines while increasing program effectiveness. Implementation costs can be reduced because the ENERGY STAR program:
    - Defines efficiency through voluntary requirements adopted by more than 1,800 manufacturing partners and more than 4,800 home builders.
    - Develops standardized metrics to measure efficiency of commercial buildings and manufacturing plants, and recognizes the top performers through the EPA ENERGY STAR Portfolio Manager® tool32 for buildings and the ENERGY STAR Energy Performance Indicators for plants. 33
    - Ensures integrity through third-party certification and verification for products, homes, and buildings.
    - Makes it easy for consumers and businesses to identify and ask for efficient products, services, homes, and buildings.
    - Spurs supply and demand through channel marketing and consumer outreach.
    - Allows state and local energy efficiency programs to focus resources on other persistent barriers.
    - Facilitates energy efficiency program best practices and partner networking.
- *State and Local Energy Efficiency Action Network (SEE Action)*. SEE Action is a state- and local-led effort facilitated by DOE and EPA to achieve all cost-effective energy efficiency by 2020. SEE Action offers resources, discussion forums, and technical assistance to state and local decision-makers. State policy-makers and program administrators use SEE Action tools and resources to learn about policies and best practices from other states when adopting and implementing energy efficiency programs.

[31] www.energystar.gov.

[32] For more information on ENERGY STAR Portfolio Manager, see http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/learn-how-portfolio-manager.

[33] For more information on ENERGY STAR Energy Performance Indicators for plants, see www.energystar.gov/epis.

- *Better Buildings and Better Plants Programs.* Through the Better Buildings and Better Plants Programs, DOE is advancing several strategies designed to make state, local, commercial, industrial, and residential buildings 20 percent more energy-efficient over the next 10 years and accelerate private sector investment in energy efficiency (DOE 2014). State policy-makers and energy efficiency program administrators can take advantage of training, tools, and technical assistance, as well as demonstrate their leadership on energy efficiency through the Better Buildings Challenge. As of February 2015, eight states have committed to the goals of the Challenge. Better Buildings has also launched Accelerators to promote increased use of energy savings performance contracts with 14 state partners, as well as high-performance outdoor lighting with two state partners.

The federal government also provides direct financial support to states, local governments, and utilities which may be used to support energy efficiency programs. Financial support is available via loan, grant, and cooperative agreement programs, each with their own unique eligibility and funding requirements. Federal funding sources include, but are not limited to:

- *State Energy Program (SEP)*. The SEP helps states establish and implement energy efficiency and renewable energy plans, policies, and programs to reduce energy costs, increase competitiveness, enhance economic development, improve emergency planning, and improve the environment. SEP provides state energy offices with formula-based grants that allow states and U.S. territories, as well as Washington, D.C., to advance their energy priorities by designing and implementing energy efficiency and renewable energy programs. SEP also provides funding on a competitive basis to states, targeting transformational projects within state energy offices that create more public-private partnerships initiated by states within and outside of their borders to address critical clean energy challenges. In addition, the American Recovery and Reinvestment Act (ARRA) of 2009 supported an increase in energy efficiency and other energy programming via state energy offices. Many of these programs still exist and leverage ratepayer-funded energy efficiency programs, such as those funded by PBFs, by coordinating activities with utilities and other energy efficiency program administrators.
- *Rural Utilities Service Loans.* In December 2013, the USDA Rural Utilities Service finalized a rulemaking that established a new Energy Efficiency and Loan Conservation Program (USDA 2013). Through this program, utilities in rural areas may apply for financing support to administer customer programs for energy efficiency and renewable energy. These include, but not limited to, community awareness and outreach programs, energy audits, energy efficiency measures on a consumer premises, and re-lamping to more efficient lighting. States may look to leverage these loans to help fund energy efficiency programs run by cooperatively and municipally owned utilities serving rural communities.
- *Rural Energy for America Program (REAP).* Through REAP, USDA provides grants and loan guarantees to agricultural producers and rural businesses for energy efficiency and renewable energy. These funds are used to make direct energy efficiency improvements, install onsite renewable generation and CHP, and conduct energy audits and feasibility studies. State energy efficiency programs offered to rural communities and the agricultural sector may look to leverage and complement REAP funding opportunities.

As part of their efforts to reduce costs and comply with Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” federal facilities across the country may consider taking advantage of energy efficiency and demand response programs offered to them by the utility or state in which they are located.[34] Energy efficiency program administrators offering programs to the federal sector may need to consider the unique ownership and fiscal characteristics of the sector.

Interaction with Local and State Policies

State energy efficiency programs can also support several of the local and state policies discussed in this report, including energy codes (see Section 4.3), standards (see Section 4.4), tax incentives and financing (see Chapter 3), and electric utility policy actions (see Chapter 7). Similar to the interactions with federal policies discussed above, program administrators can leverage existing state policies and programs to support broader market transformation and avoid duplicative efforts. For example, energy efficiency programs can support energy code implementation, encourage voluntary stretch codes that offer additional savings, and help document code compliance.

Even if the utility does not administer the energy efficiency program, the energy and peak demand savings from programs are typically reflected in utility integrated resource plans. Program savings and costs must be projected and measured in order to incorporate energy efficiency for least cost service (see Section 7.1). States are also adopting policies such as decoupling and performance incentives to address the utility's inherent financial disincentive to maximize energy savings. Successful energy efficiency programs will reduce sales, making it difficult for the utility to recover their fixed costs under traditional utility regulation (see Section 7.2). Some states have required that utilities offer customers programs to take advantage of data from new electricity grid technologies, such as advanced meters and distribution automation systems. Offering energy efficiency and/or demand response programs can help make the business case for infrastructure investments and support customer acceptance of modern grid investments (see Section 7.5 for more information).

Over the last several years, more than 10 local jurisdictions and the states of California and Washington have adopted policies requiring building owners to measure and share their energy use. These policies can benefit other state energy efficiency programs and may also provide direct efficiency improvements (EPA 2012). They increase customer awareness of the opportunity to make energy efficiency investments in their facilities, priming the marketplace for customers to actively participate in energy efficiency programs. In many jurisdictions, the building energy use is to be disclosed publicly, providing energy efficiency program administrators with a new dataset to inform program design and delivery.

[34] See http://sustainability.performance.gov/.

Benchmarking/Disclosure Policies Example

In 2010, the Seattle City Council unanimously passed an ordinance requiring owners of commercial and multifamily buildings with four or more units to benchmark energy performance in the EPA ENERGY STAR Portfolio Manager tool. They were also required to disclose current benchmarking to the city, as well as prospective tenants, buyers, and financers (note that similar mandates in Washington, D.C., New York City, and other jurisdictions require annual public disclosure of benchmarking results). Compliance and reporting are being phased in over time based on building square footage.

The benchmarking policy was developed with guidance from local industry leaders and enacted as part of the 2009–2013 Climate Action Plan. By 2030, the policy aims to reduce commercial buildings energy use by 10 percent, residential building energy use (including multifamily) by 20 percent, and GHG intensity of all fuels by 25 percent (http://www.seattle.gov/Documents/Departments/OSE/EBR-2011-2012-report.pdf).

As of January 2014, the compliance rate was an astounding 93 percent of all affected buildings, and the city has found that performance data use by building owners is spurring local competition. The city estimates that if the worst performing buildings improved energy performance to median performance levels, total annual bill savings would surpass $55 million and annual energy use would decline 25 percent.

In 2014, DOE awarded an SEP competitive grant to Washington State in order to develop uniform, mandatory statewide benchmarking and disclosure policies.

Program Implementation and Evaluation

Energy efficiency program implementation and evaluation involves several key elements. Additional guidance and other resources for program implementation and evaluation are summarized at the end of this section. Given the long history of energy efficiency program offerings across the country, several program best practices have emerged, as well as existing networks and organizations for sharing model practices and lessons learned at the regional and national level, as listed in the Resources tables at the end of this chapter.

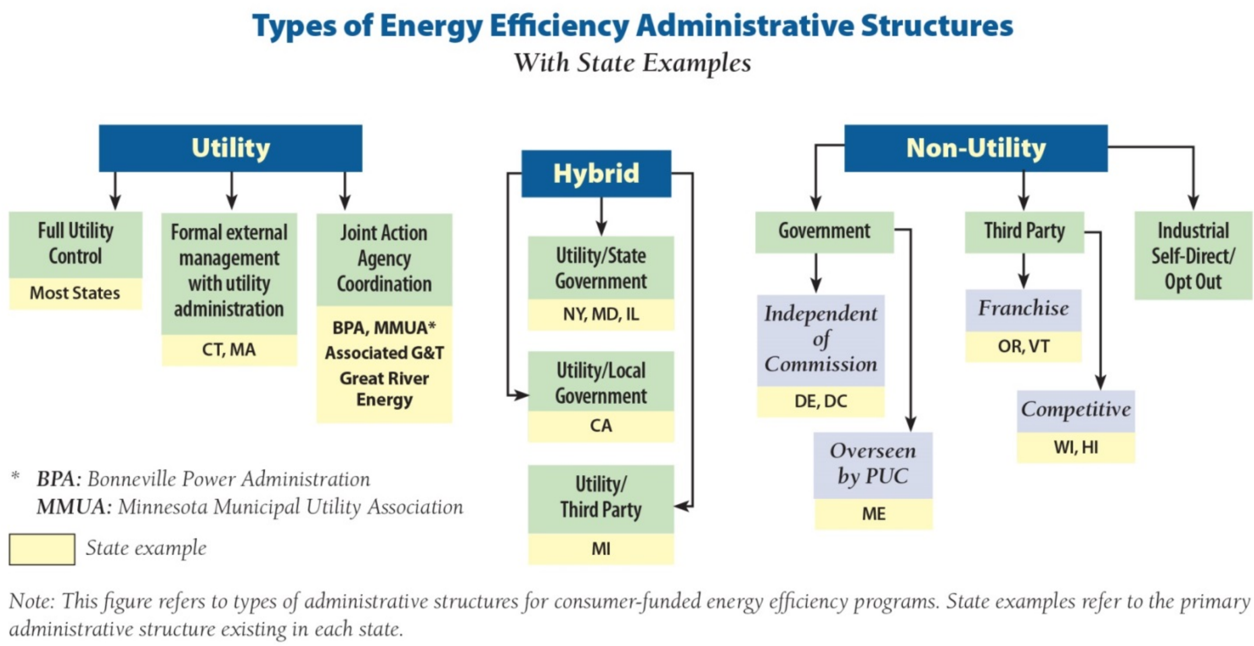
Administering Body

The administrative structure for energy efficiency programs varies by the type of funding source and state. For programs run by the state government, either a state energy office or energy efficiency program-specific state entity serves as program administrator. For programs funded by customers via their utility rates or PBFs, also referred to as ratepayer-funded programs, the utility or a state-designated third-party administrator typically administers programs under the oversight of the state utility commission or utility board of directors. Figure 4.2.5 provides an overview of different administrator options for ratepayer-funded programs.

States have developed effective programs using each administrative model; institutional history typically determines the entities best suited to administer programs. In many states, utilities have the capital, personnel, and customer relations channels that enable them to reach broad customer markets effectively. Thus, they are the most common administering entity.

However, in some states, particularly those served by numerous smaller utilities, a statewide effort may enable programs to develop a strong management capacity for designing and implementing programs and to more cost-effectively engage trade allies and educate consumers.

Figure 4.2.5: Types of Ratepayer-Funded Energy Efficiency Administrative Structures with State Examples



Source: Adapted from RAP 2011.

Energy Efficiency Program Planning and Design

Developing Program Plans

The program oversight authority typically requires program administrators to submit detailed program plans for approval before beginning program implementation. At a minimum, good program plans include the following information for the overall program and for the individual programs that comprise the overall approach:

- Program descriptions, including target market(s), eligible participants and technologies, and financial incentives.
- Program goals and objectives.
- Budgets.
- Kilowatt and kWh goals, including anticipated annual energy savings and lifetime energy savings.
- Benefits and costs.
- Marketing and implementation strategies.
- Major milestones.
- Evaluation plans, including identification of metrics for program success (EPA 2006).

Program administrators usually have about 3 months to develop and submit their program plans. Similarly, oversight authorities typically need about 3 months to review and approve or suggest modifications to plans. In order to ensure programs are implemented as quickly as possible once approved, program administrators issue requests for proposals during this time period (if they did not do so earlier) and contract decisions are made contingent upon approval by the oversight authority.

Designing Programs to Overcome Barriers to Energy Efficiency

The ability to help address persistent barriers to the investment and adoption of socially and cost-beneficial energy efficiency opportunities is key to successful energy efficiency program design. Programs often offer the following strategies to address market failures and other barriers that lead to inefficient energy use:

- *Provide better information*. Energy users often lack accurate information about energy savings and other characteristics of energy-efficient products or practices, which would allow them to understand the costs and benefits of energy efficiency investments. Market failure due to information imperfection leads to underinvestment in energy efficiency by consumers.
- *Address split incentives (also referred to as addressing the "principal-agent problem")*. The incentives of individuals who make energy efficiency investment decisions are not always aligned with the incentives of those who use and pay for energy. Examples include misalignment between landlords and tenants and between builders and homeowners. Split incentives also persist within organizations and institutions that lead to underinvestment in energy efficiency in both the public and private sectors.
- *Reduce risk and uncertainty*. Adopting an unfamiliar, typically more expensive energy efficiency technology can be an uncertain undertaking. This is due to the lack of credible information on product performance and future energy prices, and the irreversibility of the investment. Imperfect or asymmetric information can exacerbate the perceived risk of energy efficiency investments and help explain why consumers and firms do not always invest in energy efficiency measures. Suppliers also face risk and uncertainty because they lack perfect information on consumer preferences for energy efficiency. In the presence of risk and uncertainties, consumers and suppliers alike will underinvest in energy efficiency.
- *Lower transaction costs*. Consumers face transaction costs in searching, assessing, and acquiring energy-efficient technologies and services. It can be time-consuming and difficult for consumers to estimate a product's lifetime operating costs. The complexity of the search process puts many efficient products at a disadvantage relative to less-efficient products with lower upfront costs.
- *Provide access to low-cost financing*. Consumers sometimes face higher interest rates to finance energy efficiency investments compared to other investments. Lenders can be reluctant to invest in energy efficiency loan portfolios in part because energy efficiency loans may lack standardization and financial markets have difficulty ascertaining the likely payoff from such investments. Limited access to credit may prevent some consumers, especially low-income consumers, from making cost-effective energy efficiency improvement decisions due to the higher upfront cost of energy-efficient products or practices.
- *Reduce environmental externalities that are not reflected in energy prices*. Bill savings that do not reflect environmental externalities lead to investments in energy efficiency below socially optimal levels.
- *Influence behavior*. Behavioral economics and psychology have identified potential behavioral impediments preventing individuals and organizations from always making cost-effective energy efficiency

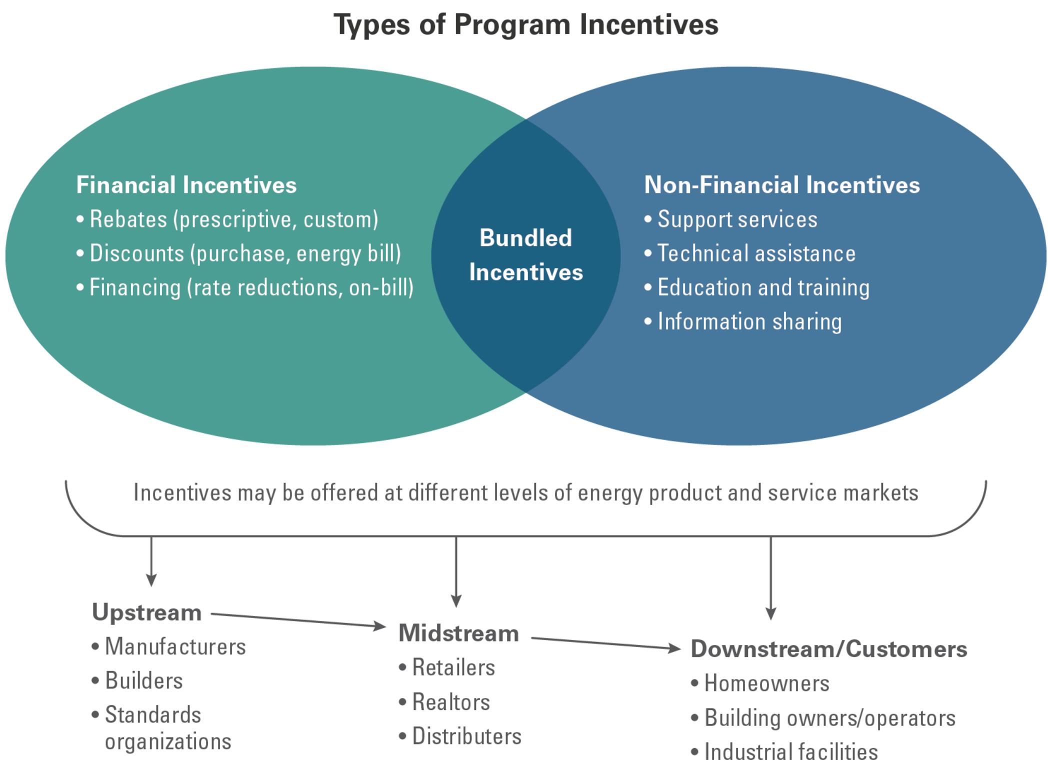
Best Practices: Implementing Energy Efficiency Programs

- Learn from other states' experiences to identify most cost-effective ways to achieve energy savings through programs.
- Consider a range of potential organization(s) for program delivery and select the most appropriate.
- Approve long-term funding cycles (5 to 10 years) to let programs build market experience and capture return on investment.
- Involve key stakeholders and experts in a program design.
- Base program designs on market characteristics and customer needs.
- Keep program designs simple and clear.

investments. Behavioral economics posits possible explanations, including bounded rationality, heuristic decision-making, and non-standard preference and belief.

Program administrators may offer a range of financial and other incentives to help address information, financial, and behavioral barriers. These incentives range from simple cash rebates for the purchase of efficient products to bundled customized financial incentives and technical assistance. Incentives can be targeted to individual customers and purchase transactions, or can be directed further upstream in market supply chains to encourage manufacturers, retailers, or contractors to affect how customers choose products, building designs, or building operating methods. Figure 4.2.6 provides an overview of the types of incentives in energy efficiency programs.

Figure 4.2.6: Overview of Energy Efficiency Incentive Types



Source: EPA 2010

Evaluation, Measurement, and Verification

Energy efficiency program evaluation includes conducting a wide range of assessment studies and other activities to determine a program's effects and to understand or document program performance, program or program-related markets and market operations, program-induced changes in energy efficiency markets, levels of demand or energy savings, or program cost-effectiveness. Market assessment, monitoring and evaluation, and measurement and verification are aspects of evaluation (SEE Action 2012).

States require robust evaluation, measurement, and verification (EM&V) in order to:

- Document a program's energy savings and other benefits, and determine whether the program (or portfolio of programs) met its goals.
- Inform ongoing decision-making and improve program delivery. In particular, evaluation during the early stages of program development can save time and money by identifying program inefficiencies and suggesting how to optimize program funding.
- Support energy demand forecasting and resources planning by understanding the contributions and costs of energy efficiency programs as compared to other energy resources. (See Section 7.1 for more information on electricity resource planning.)
- Ensure policy and public support for energy efficiency programs continues.
- Enable the calculation of other benefits, such as reductions in GHGs and other air pollutants.

When evaluating an energy efficiency program's impact, the key metric of interest is energy savings, which is often evaluated in terms of both total reduction and peak reduction. Savings cannot be directly measured. Instead, efficiency program impacts are estimated by calculating the difference between actual energy consumption after program implementation and energy consumption that would have occurred during the same period without the program (i.e., the baseline). Figure 4.2.7 provides an example of this comparison.

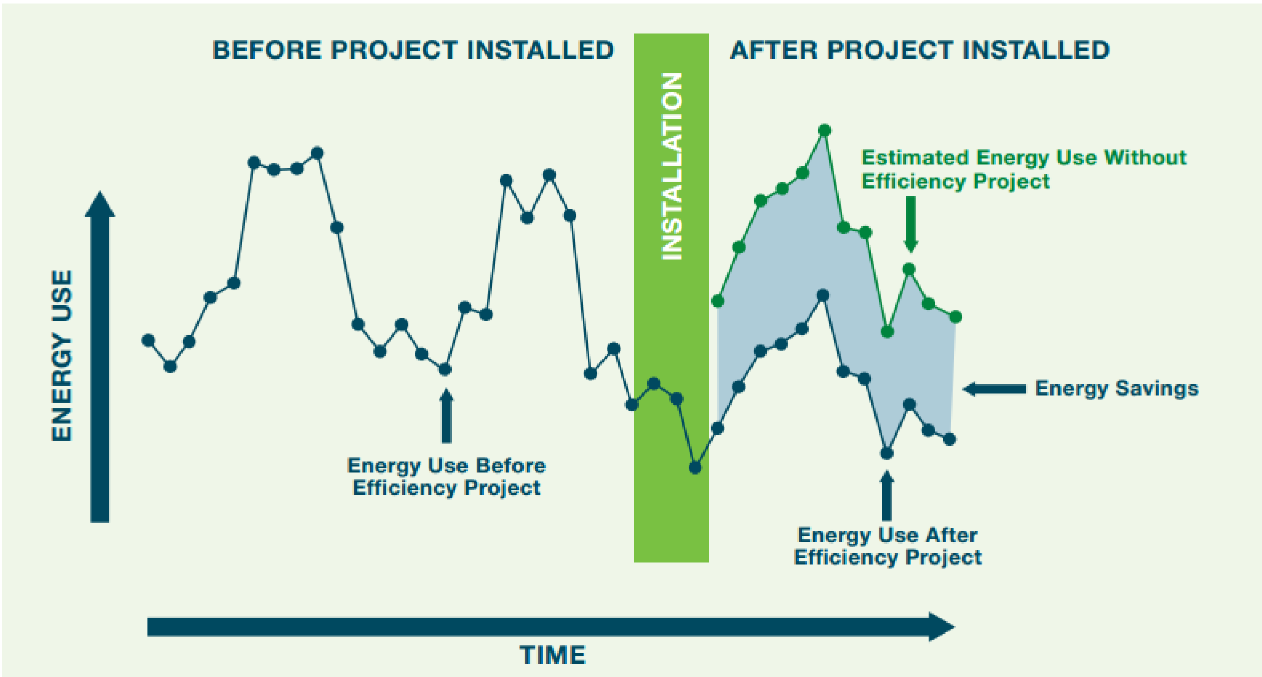
Best Practices: Evaluating Energy Efficiency Programs

State policy-makers are promoting evaluation requirements both during program development and after program implementation. EM&V requirements in states with the most experience implementing and overseeing energy efficiency programs are typically based upon the following industry best practices:

- Use one or more of the industry-standard EM&V protocols or guidelines, and use deemed savings values for well-understood energy efficiency programs and measures.
- Consider local factors, such as climate, building type, and occupancy.
- Involve stakeholders and solicit expert advice regarding EM&V processes and resulting energy savings impacts.
- Conduct EM&V activities (e.g., direct equipment measurements, application of deemed savings, and reporting of impacts) on a regular basis.
- Provide interim and annual reporting of achieved energy savings.
- Update protocols and deemed savings to reflect new developments and improved information.

States are measuring their energy efficiency savings using strategies and protocols that are increasingly credible, transparent, and consistently applied, as further discussed in this section. Because different types of evaluation are needed at various states of program design and implementation, states may establish a process for obtaining expert advice on EM&V, such as by forming a separate evaluation advisory group or hiring a professional advisor to guide evaluation investments. These entities can help assess available resources, identify and help prioritize evaluation activities, determine areas of uncertainty in a program or portfolio, and assess a program's maturity. Such processes may also address key methodological issues related to impact evaluation as described below.

Figure 4.2.7: Energy Consumption Before, During, and After Project Implementation



Source: SEE Action 2012

Determining the Baseline

During the program planning process, program administrators should develop a baseline forecast of efficient technology or service adoption absent the program and with the program. This baseline will allow program managers to set realistic savings goals and design programs that are well-suited for the target market. Understanding market potential and the market penetration of energy-efficient equipment and practices also provides valuable insights into how the program should be delivered, and what incentive levels would be cost-effective and successful at moving the market. Depending on the technology or service, evaluating baselines by market subsector can be valuable. Some market assessments employ a survey process to develop baseline assumptions. Baselines should be revisited as needed to account for changes in program design or changes to state or federal standards.

Establishing a Program Tracking System

A program tracking system is used to collect detailed information needed for program evaluation and implementation. Data collection can vary by program type, technologies and systems addressed, and customer segment. Well-designed program tracking systems include:

- *Participating customer information.* At a minimum, create a unique customer identifier that can be linked to other customer information systems. Other customer or site specific information might be valuable.
- *Measure specific information.* Record equipment type, equipment size or quantity, efficiency level, and estimated savings. Table 4.2.2 provides an overview of information typically tracked for each measure in a commercial facility.

- *Program tracking information.* Track rebates or other program services provided (for each participant) and key program dates.
- *All program cost information.* Include internal staffing and marketing costs, subcontractor and vendor costs, and program incentives.

Table 4.2.2: Typical Energy Efficiency Program Tracking Information for a Commercial Product Program

Measure Level Information	Power Consumption Information	UCT Primary Threshold Combined TRC/UCT threshold
o Measure type – Brand – Model number – Description – Capacity o Percent of load on measure o Quantity of measure o Level of incentive o Installation date	o Power draw of installed equipment o Power draw of typical equipment Installed at time of purchase o Power draw of old equipment description	o Energy savings o Summer demand savings o Winter demand savings o Years of useful life remaining on old equipment o Years of useful life for installed equipment

Ensuring Transparency and Documentation

Many states with active energy efficiency programs rely on accepted practices and methods approved by their respective regulatory commissions as the basis for measuring and verifying energy efficiency savings. Some states have gone further and documented the key assumptions used to calculate energy and demand savings in a technical reference manual (TRM), providing transparency.

Many technical reference manuals include predetermined estimated (or deemed) savings, derived from historical evaluations, to estimate energy and demand savings. Deemed savings are appropriate for evaluating programs that focus on relatively straightforward efficiency measures with well-known and consistent performance characteristics—for example, duct sealing or replacing standard incandescent light bulbs with compact fluorescent bulbs. Though there may be consistency across state deemed savings values due to common sources, the values are typically calculated by state PUCs. For instance, the PUC of Texas' EM&V contractor develops and maintains deemed savings values in a statewide TRM.

Adopting Standard Protocols for EM&V

Several national and regional efforts have focused on developing standard EM&V definitions and protocols. By adopting these approaches, states and other stakeholders can improve the consistency and accuracy of their evaluations and make it possible to compare efficiency initiatives across states. These initiatives also promote transparency in reporting. Examples of standard protocol efforts include:

- *The International Performance Measurement and Verification Protocol (IPMVP).* The IPMVP is an accepted industry standard that provides an overview of best practice techniques for verifying energy savings from facility-level and other efficiency initiatives. The objectives of the IPMVP are to:
  - Increase certainty, reliability, and savings level (with a focus on the persistence of savings several years after installation).

- Reduce transaction costs by providing an international, industry consensus approach and methodology.
- Reduce financing costs by providing project EM&V standardization, thereby allowing project bundling and pooled project financing.
- Provide a basis for demonstrating emissions reduction and delivering enhanced environmental quality.
- Provide a basis for negotiating contractual terms to ensure that energy efficiency projects achieve or exceed program goals of saving money and improving energy efficiency (Seattle 2006).

Northeast Energy Efficiency Partnerships (NEEP) EM&V Forum

NEEP works across the Northeast and Mid-Atlantic to accelerate energy efficiency in the building sector and improve transparency and consistency in EM&V reporting. NEEP's Regional Evaluation, Measurement, and Verification Forum develops and supports the use of consistent savings assumptions and standardized, transparent guidelines and tools to evaluate, measure, verify, and report the energy demand savings, costs, and avoided emission impacts of energy efficiency. The Forum has developed the Regional Energy Efficiency Database, which includes electric and gas energy efficiency program data for 10 jurisdictions and can be used to analyze program and policy design, air quality reporting and planning, system planning, and comparisons of state energy efficiency impacts to promote cross-state consistency.

The IPMVP provides a flexible set of EM&V approaches for evaluating energy savings in buildings. Several states—including California, Texas, and New York—have adopted the IPMVP to support system planning needs, clean energy portfolio standards, and carbon reduction programs (SEE Action 2011).

- *DOE Uniform Methods.* Technical experts developed the Uniform Methods Project to provide a straightforward method for evaluating gross energy savings for common residential and commercial measures offered in ratepayer-funded initiatives in the United States. The first set of protocols for determining energy savings from energy efficiency measures and programs was published in April 2013.

State Examples

Massachusetts

Massachusetts' long, successful track record of implementing energy efficiency programs across customer sectors has been funded by a combination of utility programs, PBFs, and the RGGI. Utility programs, dating back to the 1980s, have evolved with utility regulation and other policies. Most recently, the Green Communities Act of 2008 established a process through which all electric and gas utilities work collaboratively to design and implement statewide energy efficiency programs. The program administrators across the state develop program designs that are reviewed and approved by an oversight committee called the Massachusetts Energy Efficiency Advisory Council. Once statewide program designs are approved, the individual utility companies submit annual energy savings goals and annual budgets based on service territory size. Programs are designed for 3-year cycles and allow for annual modifications as needed. Marketing and evaluation are conducted jointly to support statewide consistency. Utility program administrators manage and implement efficiency programs, with the exception of low-income programs. The state's low-income weatherization and fuel assistance program implements low-income residential demand-side management and education programs.

In January 2013, the Department of Public Utilities approved the second 3-year (2013–2015) electric and gas energy efficiency plans under the Green Communities Act, continuing the state's progress toward ambitious energy savings targets in the country. The first electric efficiency procurement plan called for savings of 1.0 percent in 2009, 1.4 percent in 2010, 2.0 percent in 2011, and 2.4 percent in 2012. The state's second 3-year plan calls for savings to increase to 2.6 percent in 2015. The energy efficiency investments from 2013 to 2015 are expected to save 3,703 gigawatt-hours of electricity in 2015.

The state's natural gas plan will save 24.75 million therms in 2015, equivalent to 1.14 percent of retail natural gas sales in 2015. Overall, the fully funded 2013–2015 electric and natural gas efficiency procurement plans will yield net consumer savings of more than $6.2 billion. The energy savings proposed in the current 3-year plan represent a 55 percent increase compared to the energy savings achieved in previous 3-year plans.

These efforts have placed the state among the nation's leaders in energy efficiency. The 2014 ACEEE State Energy Efficiency Scorecard placed Massachusetts first in its annual rankings. The Energy Efficiency Advisory Council won ACEEE's Champion of Energy Efficiency in Buildings Award in 2014 in public recognition of the continued accomplishments and leadership provided by the Council.

Vermont

Vermont is another example of a state that has been a pioneer of energy efficiency programs for several decades, and is also the pioneer of the energy efficiency utility concept known as Efficiency Vermont. Efficiency Vermont was created in 1999 by the Vermont Public Service Board and the Vermont Legislature in response to a request for statewide energy programs from the Vermont Department of Public Service, the state's 22 electric utilities, and a dozen consumer and environmental groups. Under the efficiency utility concept, a third-party organization is responsible for designing the efficiency program and is under contract to deliver results for the entire state. Efficiency Vermont's funding comes from a public benefit charge as a fixed amount per kWh sold on all electric utility customers' bills. Beginning in 2008, RGGI carbon allowance auction proceeds were combined with established funding sources to offer a wider range of services and incentives.

Efficiency Vermont currently operates primarily as an electricity efficiency utility to deliver energy efficiency services throughout most of the state; the City of Burlington Electric Department operates as an energy efficiency utility in its service territory. In 2014, the Board is considering whether to appoint an energy efficiency utility to deliver natural gas efficiency services, as gas efficiency programs have been operated by gas utilities since 1993.

In 2007, the Board initiated a yearlong workshop process to consider changing the energy efficiency utility. As a result, the structure of an Order of Appointment model was changed in 2009. This moved Efficiency Vermont to a 12-year rolling program model that provides additional stability. Additionally, the state conducts a demand resources plan, which is a statewide plan that identifies short- and long-term energy efficiency budgets and savings goals, as well as other compensation matters related to delivering energy efficiency services.

In 2013, Vermont's budget for electricity efficiency programs was over $35 million with projected savings of 92,520 MWh. The budget for thermal efficiency programs was nearly $5 million.

Missouri

Missouri is a good example of a state in the early processes of funding and delivering energy efficiency programs. Missouri began a major transformation in the scope and role of utility-sector energy efficiency programs in 2009 when it enacted SB 376, the Missouri Energy Efficiency Investment Act (MEEIA). Among its many provisions, MEEIA requires Missouri's investor-owned electric utilities to capture all cost-effective energy efficiency opportunities and allows them to recover costs. The Missouri Department of Economic Development's Division of Energy reviews and intervenes in dockets and utility regulatory cases for demand-side management programs, integrated resource planning, and incentive mechanisms pursuant to the MEEIA.

The Missouri Public Service Commission's (MPSC's) implementation of MEEIA sets out voluntary goals for electric utilities to achieve. These include 0.3 percent annual savings in 2012, ramping up annually to 0.9 percent in 2015, and 1.7 percent in 2019 for cumulative annual savings of 9.9 percent by 2020. Ameren Missouri was the first large investor-owned utility to win approval from the MPSC for a comprehensive energy efficiency portfolio to recover costs and lost revenue. Its programs launched in late 2012. Kansas City Power and Light ran limited programs in its Greater Kansas City service territory and plans to expand programs to its entire service territory in 2015.

In 2012, Missouri's budget for electricity efficiency programs was more than $35 million, making up 0.38 percent of statewide utility revenues; their budget for natural gas efficiency programs was $9.2 million. The state's 2011 efforts resulted in savings of 369,000 MWh.

Utility ratepayer-funded efficiency programs are working alongside other energy efficiency policies, including state government lead-by-example, financing, and local government programs. Governor Nixon signed Executive Order 09-18 in 2009, which mandated that all state agencies adopt policies designed to reduce energy consumption by 2 percent each year for the following 10 years. The Missouri Department of Economic Development's Division of Energy has provided energy efficiency loans since 1989. In 2010, an additional $14.3 million in ARRA SEP revolving loan funds were added to the loan portfolio to specifically address energy efficiency in public and institutional facilities. Since the program's inception, loans totaling over $89 million have been made through this program, resulting in an estimated cumulative savings of $167 million.

On April 18, 2014, Governor Nixon announced that the Missouri Department of Economic Development's Division of Energy will lead a statewide initiative to develop a comprehensive energy plan for Missouri. In public meetings across the state, the initiative solicited input from energy stakeholders including consumers, businesses, publicly owned utilities, renewable energy companies, academic researchers, and environmental advocates. The comprehensive energy plan is targeted for release in summer 2015.

At the local level, Kansas City is currently crafting plans, through the City Energy Project,[35] to benchmark buildings' energy consumption, provide building operator training and certification, recognize building owners/managers who implement energy efficiency improvements, and help building owners/managers identify local, technical, and financial resources to implement energy efficiency measures. Kansas City's participation will focus on reducing energy use in large buildings, saving money on utility bills, putting local people to work making energy efficiency improvements to local buildings, and reducing GHG emissions in order to achieve the goals of the Kansas City Manager's Office climate protection plan. Kansas City Power and Light has supported the city's efforts.

Mississippi

In 2013, ACEEE recognized Mississippi as one of the country's most improved states with regard to energy efficiency. Previously falling at the bottom of the ACEEE State Energy Efficiency Scorecard rankings based on policy actions and program efforts, Mississippi has become more active in promoting energy efficiency as a state policy priority. In addition to its Scorecard, ACEEE released a report stating that Mississippi could create 32,000 jobs and free up $4.3 billion over the next decade from energy efficiency policy and program action. Such economic development arguments appear to have been persuasive. As summarized in Energy Works: Mississippi's Energy Roadmap, Governor Phil Bryant has prioritized energy efficiency in the state's energy

[35] For more information on the City Energy Project, see http://kcmo.gov/city-energy-project/; http://www.cityenergyproject.org/.

strategy, and is working with other state officials to leverage energy efficiency as an economic development opportunity.

The Mississippi Public Service Commission initiated an energy efficiency collaborative process, supported by federal stimulus funds, through which Energy Efficiency and Conservation Rule 29 was established. Rule 29 requires utilities to implement energy efficiency programs and standards. The collaboration included a range of stakeholders and interested parties, as well as jurisdictional electric and natural gas utilities and electric power associations. This resulted in comprehensive utility filings, which included such program elements as customer education, energy audits, rebates for home retrofits, and business and industrial technical assistance. The Commission approved the program filings in 2014 for a 3-year period, and programs are in the early stages of implementation. The Mississippi State Energy Office also received a competitive SEP grant award from DOE in 2013 to build and expand upon its energy efficiency success to date.

Additional state actions related to energy efficiency programs are also expected to be taken in the future. Such actions may include evolving more comprehensive program portfolio plans, developing more detailed guidelines for EM&V, and developing stakeholder working group processes that facilitate program improvements outside the formal regulatory process.

What States Can Do

Experience from the states with energy efficiency programs demonstrates that the policy is an effective mechanism for securing investment in cost-effective energy efficiency and meeting important state energy objectives. States can use the best practices and information resources in this guide to establish new energy efficiency programs or strengthen existing programs to deliver even greater benefits.

Action Steps for States

The following four steps can be used both by states interested in developing a new PBF program or those interested in strengthening an existing program:

- Assess energy efficiency potential. States can begin the process by assessing current levels of energy efficiency spending within their state, analyzing all of their options for achieving greater levels of efficiency, and analyzing the energy and cost savings that energy efficiency programs would offer.
- Determine program funding needed to capture cost-effective energy efficiency. Consider appropriate program funding levels and establish funding mechanisms that can avoid the potential for funds to be diverted to other purposes. Studies show energy efficiency spending could be increased significantly and still be used cost-effectively. Conduct an efficiency potential analysis and economic screening process to identify the most cost-effective mix of new program targets. Include consideration of energy efficiency's role as a potential reliability tool and how its costs in that context compare to other options.
- Leverage federal, state, and local programs. Explore opportunities to leverage federal and state grant funds, as well as technical assistance and tools available from federal programs such as ENERGY STAR. States should also coordinate with other federal, state, and local energy efficiency policies and programs for effective program implementation and design.
- Measure and communicate results. Measure results, evaluate the effectiveness of energy efficiency programs, and report progress annually. Communicate the benefits of energy efficiency programs to state legislatures, PUCs, and other stakeholders. Document lessons learned and opportunities to enhance the program's effectiveness.

Information Resources

Funding, Administration, and Cost-Effectiveness

Title/Description	URL Address
Who Should Deliver Ratepayer-Funded Energy Efficiency? A 2011 Update. This report, updating a 2003 report for the Colorado Public Utilities Commission by the Regulatory Assistance Project, offers guidance to state legislators and utility regulators as they consider ways to make the administration and delivery of energy efficiency more effective.	https://www4.eere.energy.gov/seeaction/system/files/documents/rap_sedano_whoshoulddeliverratepayerfundedee_2011__11_15.pdf
Whose Perspective? The Impact of the Utility Cost Test. This study for the 2012 International Energy Program Evaluation Conference examines the theory behind different utility cost test perspectives, the rationale for adopting each test, and key outcomes.	http://www.cadmusgroup.com/wp-content/uploads/2012/11/TRC_UCT-Paper_12DEC11.pdf
ACEEE State and Local Policy Database. This ACEEE database includes comprehensive information on energy efficiency policies and programs currently implemented at the state and local level. The database tracks policy activity across multiple sectors, including government, transportation, buildings, CHP, and appliance standards.	http://database.aceee.org/
Energy Efficiency Cost-Effectiveness Screening in the Northeast and Mid-Atlantic States. This survey, prepared for NEEP's Regional EM&V Forum, describes key issues and differences related to current cost-effectiveness testing practices, and it identifies areas where guidance can on cost-effectiveness testing can be improved.	http://www.neep.org/sites/default/files/resources/EMV_Forum_C-E-Testing_Report_Synapse_2013%2010%2002%20Final.pdf

Program Design

Title/Description	URL Address
ENERGY STAR Utility and Regional Energy Efficiency Program Sponsors (EEPS) Resources. This website provides resources for EEPS on home improvement, residential and commercial products and programs, residential new construction, and commercial and industrial programs.	http://www.energystar.gov/index.cfm?c=reps.pt_reps
Regional Energy Efficiency Organizations (REEOs). REEOs provide technical assistance to states and municipalities to support efficiency policy development and adoption, along with program design and implementation. This policy brief provides an overview on and Web links to the six REEOs.	http://www.seealliance.org/wp-content/uploads/REEO-GeneralEEPolicyBrief-2014.pdf
Database for Energy Efficiency Resources. This California Public Utilities Commission (CPUC) database contains information on selected energy-efficient technologies and measures, including estimates of the energy-savings potential for these technologies in residential and nonresidential applications and data on the costs and benefits of energy-efficient measures.	http://www.deeresources.com/
Demonstration of Energy and Efficiency Developments (DEED) Program. The American Public Power Association's DEED Program is a research demonstration program dedicated to improving the operations and services of public power utilities by supporting and demonstrating innovative developments.	http://www.publicpower.org/Programs/Landing.cfm?ItemNumber=31245&navItemNumber=37529

Title/Description	URL Address
Leaders of the Pack: ACEEE's Third National Review of Exemplary Energy Efficiency Programs This 2013 presents the results of ACEEE's third national review of exemplary programs. The report identifies and profiles 63 leading programs that span the wide array of program types offered to utility customers.	http://aceee.org/research-report/u132
ENERGY STAR Industrial Energy Efficiency Resources for State and Utility Programs. This website contains tools and resources to help states and utilities understand energy use in the industrial sector and learn how to work with manufacturers to improve energy efficiency, develop stronger energy efficiency programs, and promote industrial energy performance improvement.	https://www.energystar.gov/buildings/industrial-energy-effiicency-resources-state-utility-programs
ENERGY STAR Partner of the Year Awards Winners. This website contains descriptions of energy efficiency programs which have received ENERGY STAR awards for promotion of ENERGY STAR products, homes and tools to support broader market transformation for energy efficiency.	www.energystar.gov/awards
California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects. CPUC's 2001 Standard Practice Manual provides guidelines for utility-sponsored energy efficiency programs. This report is an updated version of CPUC's *Standard Practice for Cost-Benefit Analysis of Conservation and Load Management Programs*, first written in 1983.	http://www.cpuc.ca.gov/NR/rdonlyres/004ABF9D-027C-4BE1-9AE1-CE56ADF8DADC/0/CPUC_STANDARD_PRACTICE_MANUAL.pdf
Consortium for Energy Efficiency (CEE) Program Resources. CEE releases resources that are the result of CEE members analyzing business prospects, identifying energy efficient products and services, and engaging manufacturers and other market stakeholders to develop credible approaches for encouraging market uptake and achieving verifiable energy savings.	http://www.cee1.org/content/cee-program-resources
Energy Efficiency Policy and Program Resources. This SEE Action website offers resources and discussion forums for the design and implementation of policies and programs that can drive investment in energy efficiency.	https://www4.eere.energy.gov/seeaction/resources
Regional Energy Efficiency Database (REED). NEEP's REED is a public resource that contains electric and natural gas energy efficiency program data for 10 jurisdictions in the Northeast. NEEP has also developed annual reports to provide an overview of the high-level impacts of energy efficiency programs at the state and regional level.	http://www.neep.org/initiatives/emv-forum/regional-energy-efficiency-database
Energy Efficiency Quick Start Programs: A Guide to Best Practices. The Southeast Energy Efficiency Alliance, the REEO serving the Southeastern states, released this guide to share best practices for designing and implementing energy efficiency programs quickly. This information can also be helpful to other regions as well.	http://www.seealliance.org/wp-content/uploads/Quick-Start-Best-Practices-041414-FINAL.pdf
Midwest Energy Efficiency Alliance (MEEA) Program Best Practices Information. MEEA, the REEO serving the Midwestern states, shares case studies and best practices information with energy efficiency program administrators. This information can also be helpful to other regions as well.	http://www.mwalliance.org/newsletter/meea-minute-monthly-newsletter-january-2014 http://www.mwalliance.org/resources/case-studies-best-practices
Association of Energy Service Professionals (AESP). AESP is a member-based association dedicated to improving the delivery and implementation of energy efficiency, energy management and distributed renewable resources. AESP also recognizes outstanding achievement in program design.	http://www.aesp.org/ https://c.ymcdn.com/sites/aesp.site-ym.com/resource/resmgr/Awards/AESP_Energy_Awards_POSTERS.pdf

Evaluation

Title/Description	URL Address
The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Under the Uniform Methods Project, DOE is developing a framework and a set of protocols for determining the energy savings from specific energy efficiency measures and programs. In 2013, DOE published the first set of protocols.	http://energy.gov/eere/downloads/uniform-methods-project-methods-determining-energy-efficiency-savings-specific
ENERGY STAR Unit Shipment Data. This website collects information on qualified product unit shipment data to determine the market penetration of ENERGY STAR products and evaluate the overall performance of the program.	http://www.energystar.gov/index.cfm?c=partners.unit_shipment_data
FedStats. FedStats provides data and trend information for more than 100 federal agencies that are engaged in production and dissemination of official federal statistics, including the Energy Information Administration (EIA) and EPA.	http://fedstats.sites.usa.gov/
A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs. This ACEEE report provides the results of a comprehensive survey and assessment of the current state of the practice of utility-sector energy efficiency program evaluation across the 50 states and the District of Columbia.	http://www.aceee.org/sites/default/files/publications/researchreports/u122.pdf
Efficiency Valuation Organization (EVO). EVO is a non-profit organization that develops and promotes the use of standardized protocols, methods and tools to quantify and manage the performance risks and benefits associated with end-use energy efficiency, renewable-energy, and water-efficiency business transaction.	http://www.evo-world.org
Proceedings of the International Energy Program Evaluation Conference (IEPEC). The IEPEC is an annual professional conference for energy program implementers; evaluators of those programs; local, state, national, and international representatives; and academic researchers involved in evaluation. This website contains proceedings from past conferences, beginning with the 1997 IEPEC.	http://www.iepec.org/?page_id=26
State Energy Efficiency Program Evaluation Inventory. The U.S. Energy Information Administration released this 2013 inventory of state program evaluations to support their long-term energy forecasts, though the summary of information may also be helpful to states designing their own energy efficiency program evaluations.	http://www.eia.gov/efficiency/programs/inventory/
EM&V. This SEE Action website provides policy and program resources for EM&V, including the EM&V Resource Portal, which serves as a compendium for energy efficiency program administrators and project managers.	https://www4.eere.energy.gov/seeaction/topic-category/evaluation-measurement-and-verification
Energy Efficiency Program Impact Evaluation Guide. This 2012 guide, prepared by SEE Action's EM&V Working Group, describes and provides guidance on approaches for determining and documenting energy and non-energy benefits resulting from end-use energy efficiency programs.	https://www4.eere.energy.gov/seeaction/publication/energy-efficiency-program-impact-evaluation-guide

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ACEEE. 2014c. The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs. American Council for an Energy-Efficient Economy.	http://www.aceee.org/research-report/u1402
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PNNL. 2014. Assessing National Employment Impacts of Investment in Residential and Commercial Sector Energy Efficiency: Review and Example Analysis. Pacific Northwest National Laboratory.	www.pnnl.gov/main/publications/external/technical_reports/PNNL-23402.pdf
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4.3 Building Codes for Energy Efficiency

Policy Description and Objective

Summary

Building energy codes require new construction and major renovations in existing buildings to meet minimum energy efficiency requirements. Well-designed and enforced codes can institute construction practices that reduce building life-cycle costs and occupants' total housing or commercial costs. Building energy code requirements can also help reduce peak energy demand, as well as greenhouse gas (GHG) emissions and other air pollutants. Recognizing these benefits, a majority of states have adopted building energy codes for residential and commercial buildings.

> Building energy codes improve energy efficiency in new building construction and major renovations by setting thermal performance standards for building envelope components and efficiency criteria for building systems and equipment. Developed at the national level through model code and standards processes, energy codes are typically adopted at the state level and enforced by code officials at the local level.

Broadly speaking, building codes include an array of specifications and standards that address safety and functionality. In 1978, California became the first state to include energy requirements in its code. As of March 1 2015, 40 states plus Washington, D.C., have state-level residential building energy codes equal to or better than the 2006 International Energy Conservation Code (IECC), and 41 states plus D.C. have state-level commercial building energy codes equal to or better than ASHRAE 90.1-2004 (BCAP 2015a).

To be successful with codes, state and local governments have found they must ensure that the most efficient model energy codes are adopted and that compliance is rigorous. States and localities are taking steps in this direction by adopting updated versions of energy codes and are improving compliance by monitoring, evaluating, and enforcing their codes. States and localities without building energy codes can leverage these existing best practices when adopting energy codes in their jurisdictions.

The potential energy savings from further state action can be significant. If the most recent commercial and residential model energy codes—i.e., the 2012 IECC—are adopted, states can reduce their energy usage by 30 percent compared to the 2006 IECC (DOE 2013). If states comply with existing codes, the projected national savings from bringing a year's worth of new residential and commercial construction in the U.S. up to full compliance is 2.8–7.9 quadrillion British thermal units annually, or $63–$174 million in annual energy cost savings (IMT 2013).

> **Why Building Energy Codes Matter**
>
> Incorporating efficiency at the time of construction is typically the most cost-effective way to improve building energy performance. However, market barriers result in underinvestment, leading to "lost opportunities" in inefficient structures that are expensive or impractical to improve later in the building life cycle. Two such barriers are:
>
> - *Split incentives*. Whereas builders are motivated to minimize capital costs, homeowners and building tenants are motivated to minimize total occupancy costs, including energy bills. When builders invest in energy efficiency, the benefits in lower energy bills flow to occupants and not to them.
> - *Customer preferences*. Most home purchase decisions and feature choices are driven by non-energy factors. In selecting optional features for the home, buyers often focus on amenities like kitchen upgrades, extra bathrooms, and new flooring. Efficiency competes with these priorities.
>
> In the face of multiple barriers, energy codes can ensure that new buildings achieve a basic level of energy efficiency performance that is cost-effective and delivers related benefits.

Objective

Building energy codes establish legal requirements for a minimum level of energy efficiency for residential and commercial buildings.

Benefits

State and local governments see a range of benefits from building codes, including lower energy use, reduced energy costs, reduced pollutant emissions, stronger local economies, improved energy resource reliability and improved health. For example, the U.S. Department of Energy (DOE) estimates that upgrading from the 2006 to the 2012 IECC would reduce the energy costs to the homeowner by an average of 32.1 percent (DOE 2012).

The DOE analysis also estimates that cumulative energy savings from 1992–2012 were approximately 4.2 quads and cost savings to consumers have been more than $44 billion. These savings resulted primarily from DOE-supported activities that help upgrade model energy codes; accelerate their adoption by states and localities; and improve code compliance via software tools, training, and technical support. At an estimated 20-year federal budget cost of some $110 million, energy codes have realized more than $400 in cost savings for each DOE program dollar spent (DOE 2014).

Looking forward, the estimated cumulative benefits from DOE program support total nearly 46 quads of full-fuel-cycle energy—or 44 quads of primary energy—through 2040, equivalent to almost an entire year's worth of current U.S. residential and commercial primary energy consumption. These energy savings correspond with consumer dollar savings of up to $230 billion on utility bills through 2040. In terms of emission prevention benefits, annual carbon savings are estimated at 36 million tons through 2012, with expected cumulative savings through 2040 of 3,478 million tons (DOE 2014f).

Building energy codes can also strengthen state and local economies by increasing investment in energy-efficient capital equipment and increasing employment for technical experts, duct and air leakage professionals, quality control assessors, building and system commissioning agents, energy auditors, and compliance officers (DOE 2014f).

Other key benefits of building energy codes include improved regional energy reliability and energy self-reliance. Codes reduce energy usage and therefore decrease peak loads, which increases grid reliability. They also help reduce our nation's dependency on foreign energy sources (DOE 2014f).

States and municipalities may also see benefits from building energy codes ability to reduce energy use and reduce pollutants. Energy-efficient buildings reduce GHG emissions and other air pollution and thus lower the risk of related health issues (DOE 2014f). In addition to improved outdoor air quality, building energy codes help improve indoor air quality—which can be more polluted than outdoor air—by reducing particulate matter, radon, carbon monoxide and other harmful pollutants (CPSC 2014).

States with Building Energy Codes

Because new construction is a key driver of energy demand growth in the buildings sector, states often use energy codes as a key energy and environmental strategy. Some states and utilities are promoting "beyond code" building programs to achieve additional cost-effective energy efficiency.

For residential buildings, as of March 2015, 40 states plus Washington, D.C., use a version of the 2006 IECC or better building energy code. Eleven of these states (plus D.C.) are using the 2012 IECC version that DOE has determined would improve the energy efficiency of residential buildings by approximately 30 percent compared to the 2006 IECC. Only 10 states have not adopted a statewide code, although many jurisdictions in these states have adopted the 2009 IECC (BCAP 2015a).

For commercial buildings, as of June 2014, 41 states plus Washington, D.C., use a version of ASHRAE 90.1-2004 or a more stringent building energy code. Seventeen of these states (plus D.C.) are using the ASHRAE 90.1-2010 version that DOE has determined would improve energy efficiency in commercial buildings compared to ASHRAE 90.1-2004. Nine states have not adopted commercial building codes, although many jurisdictions within these states have adopted ASHRAE 90.1-2010 (BCAP 2015a).

Residential and Commercial Building Energy Codes

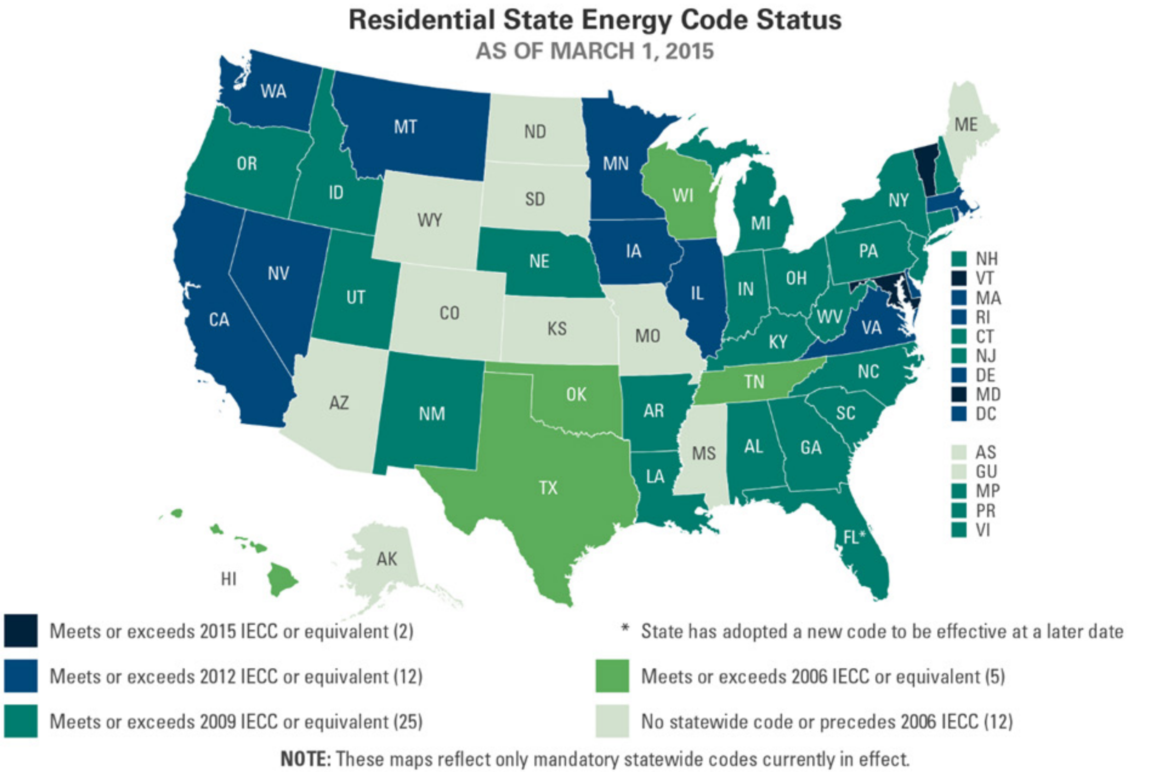
The energy code that applies to most *residential* buildings is the applicable version of the IECC, which supersedes the Model Energy Code. The 2012 IECC is the most recent version for which DOE has issued a positive determination. However, different versions of the IECC have been adopted by states, creating a patchwork of residential codes across the country. The federal Energy Conservation and Production Act (ECPA) was amended in 1992 to require states to review and adopt the most recent model code, or submit to the Secretary of Energy its reasons for not doing so.

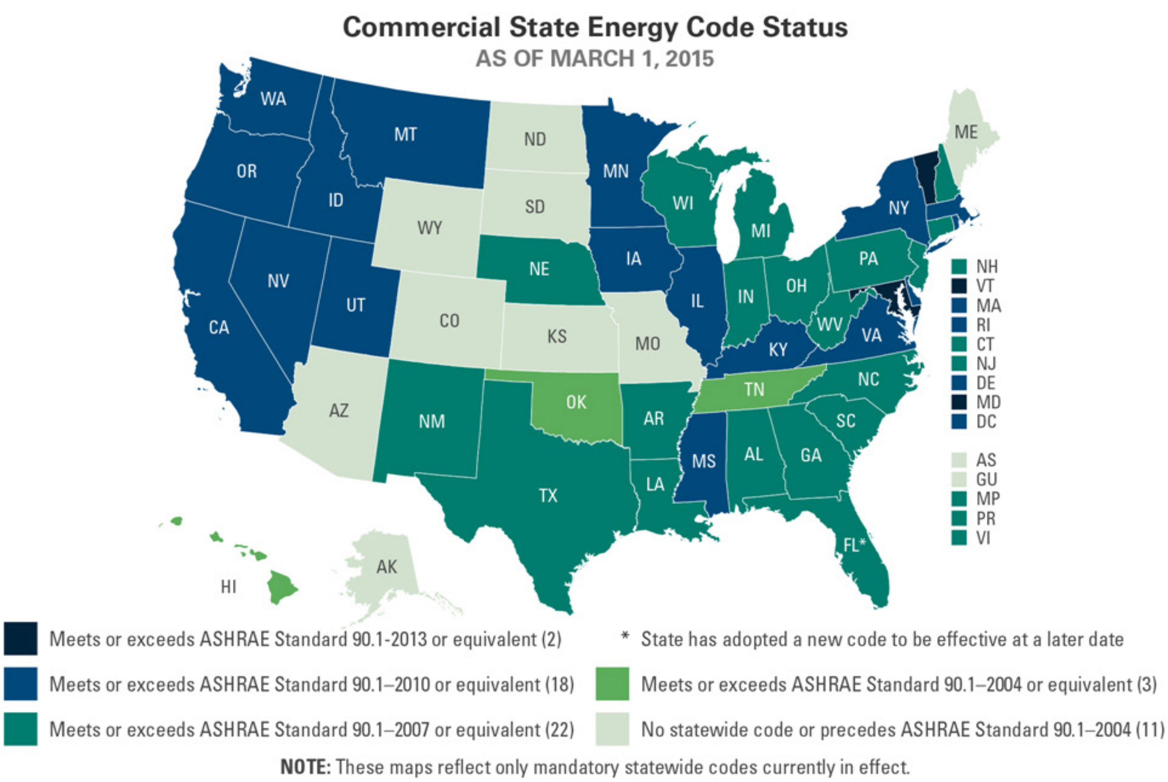
Most *commercial* building energy codes are based on ANSI/ASHRAE/IES Standard 90.1, jointly developed through the American National Standards Institute, ASHRAE, and the Illuminating Engineering Society, and commonly referred to as ASHRAE 90.1. ECPA requires states to adopt the most recent version of ASHRAE Standard 90.1 for which DOE has made a positive determination for energy savings, currently 90.1-2013. The IECC also contains prescriptive and performance commercial building provisions. By referencing Standard 90.1 for commercial buildings, IECC offers designers alternate compliance paths.

State and local experience has shown that a code must be properly implemented, evaluated, and enforced after being adopted to achieve energy savings. In states where these components are missing, compliance rates can fall short. But recent studies, including a 2011 Illinois study (IEE 2011) and a 2013 Minnesota study, show that improved enforcement is leading to increased compliance—more than 80 percent compliance in the new homes and new commercial building markets (BCAP 2015b). Leading states are not only monitoring and evaluating their energy codes, but also using the findings from these analyses to take corrective action.

Most states and municipalities periodically update their building energy codes to ensure that they incorporate improvements in technology and design that offer increased energy efficiency and cost-effectiveness. Code reviews are often triggered by DOE's Congressionally mandated determination as to whether each new code version saves energy relative to the previous version (ASHRAE 90.1 or IECC). For residential codes, federal law requires states to consider adoption of each new IECC version for which DOE issues a positive determination.

Figure 4.3.1: States with Residential and Commercial Building Energy Codes





Source: BCAP 2015a

Establishing Effective Building Energy Codes

When adopting, implementing, enforcing, or updating energy codes, states identify key participants, review code implementation costs, analyze building life-cycle costs, determine a timeframe for action, and evaluate interactions with federal and state policies.

Participants

- *Government officials*. Some states and local jurisdiction government officials have been active participants in updating the national model energy codes. State and local governments are the front-line actors in code implementation and enforcement (DOE 2005). States and local jurisdictions often modify the national model codes during the state/local adoption process to account for their specific needs and opportunities.

  In national model code development processes conducted by the International Code Council (ICC) and ASHRAE, federal government officials from DOE and many other stakeholders participate in the multi-year code development cycles. Each time a new version of the IECC or ASHRAE 90.1 is issued, DOE makes a determination on whether the new version saves energy compared to the previous version. If DOE makes a positive determination on a new residential code, federal law gives states 2 years to consider adopting it. If they elect not to adopt the code, state officials are required to submit their reasoning to the U.S. Secretary of Energy. State adoption of the ASHRAE 90.1 commercial building energy code, by contrast, is not optional. If DOE makes a positive determination on a new commercial building energy code, states are required to update their current code with either the applicable ASHRAE 90.1 version or an equally stringent code within 2 years. DOE also provides technical assistance to states to support building code adoption and implementation. More information is available at http://www.energycodes.gov.

- *Code development organizations.* The ICC, ASHRAE, and the National Fire Protection Association (NFPA) develop model energy codes and standards. The ICC develops the IECC for residential and commercial buildings, while ASHRAE maintains the 90.1 standards for commercial buildings and 90.2 for residential buildings. Both ICC and NFPA provide a reference to ASHRAE Standard 90.1 as an alternate compliance path for commercial buildings. The ICC also provides training and technical support to code officials to assist with interpretation and implementation of codes.

- *Nongovernmental organizations (NGOs).* NGOs support building energy code adoption and implementation by fostering peer exchange, serving as information sources, and providing expert assistance. For example, the Building Codes Assistance Project (BCAP) offers tailored technical assistance to states and municipalities. In states seeking to adopt the IECC or ASHRAE 90.1, BCAP provides services such as educational support and implementation assistance for code officials and legislators. BCAP was founded as a joint initiative of the Alliance to Save Energy, the American Council for an Energy-Efficient Economy, and the Natural Resources Defense Council. Other active NGOs in the building codes arena include the regional energy efficiency organizations (comprising six regional groups), the New Buildings Institute (NBI), and the Institute for Market Transformation (IMT).

- *Utilities and utility regulators.* Utilities and regulators can also be key participants in improving building energy code implementation and compliance (EPA 2009). IMT, the Institute for Electric Efficiency, and the Northeast Energy Efficiency Partnership list five recommended roles for utilities: 1) advancing measurement and translation of baseline compliance levels to target education and training efforts, 2) developing a mechanism for evaluating and attributing the energy savings impacts, 3) promoting the inclusion of energy codes into integrated resource planning, 4) securing regulatory approval for expenditures on code activities, and 5) advancing knowledge on the interaction of codes with existing energy efficiency programs (Stellberg et al. 2012).

- *Builders, developers, and building owners.* Builders, developers, owners, and managers are becoming more involved with the development of the national model energy codes as they are responsible for implementing provisions in the code. States and municipalities are also finding that active collaboration with these groups improves understanding, creates buy-in, and can lead to greater levels of compliance.
- *Industry professionals.* Building scientists, manufacturer representatives, and other industry experts are involved in the code development and implementation process to ensure that the code language and requirements are in coordination with available technologies and building science. The Residential Energy Services Network (RESNET) promotes codes by fostering national markets for home energy rating systems, accrediting home energy raters and providers, promoting residential energy efficiency financing products, and conducting educational programs. To encourage consistency across rating systems, the organization works to harmonize its standards with the IECC.

Building Life-Cycle Costs

Incorporating efficiency into building design and construction is more cost-effective than trying to upgrade efficiency after the building is in operation. Decisions made during design and construction often cannot be remedied later or can only be improved at significant cost. Moreover, because building components and systems can last 15, 20, 50 years, or longer, inefficient technologies can waste energy for decades until a replacement or upgrade occurs.

For example, a recent study estimated that upgrading the energy efficiency of a typical new home in Arizona from the 2006 IECC would save homeowners an average of $3,245 over 30 years with the 2009 IECC and $6,550 over 30 years with the 2012 IECC (DOE 2012). The cost to install the measures in the 2012 IECC, including improved ducts, air sealing, and insulation, makes it very difficult to upgrade after the home construction is complete.

Code Implementation Costs

National code development processes can spare a state the full cost of developing its own codes. While ICC, ASHRAE, and NFPA offer model energy codes that can be adopted in their entirety, it is common for states to initiate an adoption and modification process that amends the model codes to reflect state-specific considerations. However, some states (e.g., California) and municipalities maintain their own code development processes. State and local governments can also lower development, adoption, and enforcement costs by taking advantage of resources offered by DOE.

When adopting a model code, some states provide resources to municipalities to support implementation and enforcement. In some cases local funds are available to help code officials and builders understand and comply with the code’s requirements. However, even when such resources are available, localities are finding that staff resources for code enforcement are often stretched thin. To overcome this barrier, some local governments collaborate with state officials, utilities, or third-party technical experts such as energy raters to help meet resource and assistance needs.

Timing and Duration

States are finding that a periodic review of energy code requirements helps ensure that new efficiency opportunities are realized in their jurisdictions. States often conduct their code reviews following national-level model codes updates or the issuance of a DOE determination. Other states call for updates on their own regular schedules. For example, some states take action if the code is more than 5 years old, if there is no evidence of consistent enforcement, or if there is no state energy code.

When DOE makes a positive determination on a new version of a model code, states are required by federal law to complete an adoption consideration process within 2 years. State adoption is not required for the IECC residential building energy code (though states choosing not to update their codes must publicly submit their reasoning to DOE), which has recently been updated and is released every 3 years (e.g., 2009, 2012, 2015). State adoption is mandatory for the ASHRAE 90.1 commercial building energy code, which has recently been updated and is also on a 3-year cycle (e.g., 2007, 2010, 2013).

State experience with the review and update process demonstrates that it is important to anticipate and plan for the education and training needs of code officials, builders, contractors, and other affected parties. Each participant requires time to understand new requirements. Code changes also affect product manufacturers and suppliers, who need lead-time to clear current inventories and ensure that compliant products are available when the revised code takes effect.

Best Practices for Developing and Adopting Building Codes

- *Do your homework.* Evaluate current building energy code laws and options for implementation and enforcement. If there is no state energy code, if it is more than 5 years old, or if there is no evidence of consistent enforcement, it may be time to act:
  - Analyze the benefits and costs of code adoption and implementation.
  - Talk with key stakeholders, including local officials and builders, to gauge their perspectives.
  - Assess resources for training and technical support for code officials, builders, designers, and installers.
  - Contact suppliers about availability of products.
- *Get outside help*. Tap building expertise and other resources from organizations such as DOE's Pacific Northwest National Laboratory, BCAP, Regional Energy Efficiency Organizations (REEOs), state energy offices, the National Association of State Energy Officials (NASEO), and the NBI. Resources might include quantitative assessments of potential benefits, baseline building practice studies, legislative and regulatory assessments, training, and technical assistance for builders and code officials.
- *Create a stakeholder process*. Involve key stakeholders early and regularly. Include them in reviews of studies, proposed regulations, and other aspects of the process. This process increases the chances of code adoption and minimizes enforcement problems.

Interaction with Federal Programs

State and local governments are finding that voluntary programs such as ENERGY STAR can advance building performance beyond code minimum requirements and can field test potential design and building practices that can become future energy code requirements. ENERGY STAR-certified new homes are designed and built to standards well above code and market performance levels, and have undergone inspections, testing, and verification to ensure strict requirements are met.

In some states, ENERGY STAR certification may be recognized under certain conditions as “deemed to comply” with energy codes, helping state and local governments address the technical and resource issues they face in code implementation. This can be especially helpful where utilities fund such voluntary programs. Specific state and local conditions should be carefully reviewed when considering options of this type.

Interaction with State Policies

State and local policy-makers are leveraging other state clean energy policies to support building energy codes. For example, some states are using public benefits funds to support code implementation and enforcement. The New York State Energy Research and Development Authority is committed to ensuring that at least 90 percent of residential and commercial buildings comply with the 2010 Energy Conservation Code of New York State by 2017 through its Energy Codes Training and Support Initiative to transition to a more energy-efficient built environment (NYSERDA 2014).

Some state and local governments are investigating the extent to which building codes can be incorporated into their air quality planning processes. Codes improve air quality by reducing energy consumption in buildings, thereby lowering direct fuel use and electricity generation and the resulting pollution from power plants. Some jurisdictions have examined the role of energy codes in State Implementation Plans for regulated air pollutants. S.B.5 in Texas is an example of legislation mandating building energy efficiency for the purpose of improving the state's ozone air quality through the state's Health and Safety Code (SECO 2010). As states explore their options for developing plans under the proposed EPA Clean Power rule, energy codes are garnering focus as part of the rule's allowed use of energy efficiency in compliance.

Program Implementation and Evaluation

Implementation

States and municipalities are finding innovative ways to implement building codes.

These efforts are needed to address the following commonly encountered barriers to implementation:

- *Building industry technology advancement is slow*. While there are fewer than a dozen U.S. manufacturers of automobiles, home appliances, and light bulbs, there are thousands of home building companies in the United States, even with substantial consolidation in the wake of recent construction downturn. In contrast to highly automated sectors of the U.S. economy, the building sector remains largely a local craft industry dependent on onsite crews and subcontractors integrating hundreds of components from various manufacturers. While some advanced building systems, including those used by modular home builders, are beginning to shift the industry, this barrier still requires training and education services to address such issues.
- *Energy codes can be complex and difficult to understand*. Responding to feedback from code officials and industry groups, code-development organizations have worked to simplify new versions

Best Practices for Energy Code Implementation

States and municipalities have identified the following best practices for energy code implementation:

- Educate and train key audiences:
- Build strong working relationships with local building officials, homebuilders, designers, building supply companies, and contractors for insulation, heating, and cooling equipment.
- Hold regular education and training sessions before and after the effective date of the new energy code requirements. Maintain an ongoing relationship with homebuilders and building officials associations, even between code change cycles. This encourages both understanding and trust and is an opportunity to share concerns.
- Provide the right resources, including:
  - An overview of energy code requirements, opportunities, and related costs and benefits.
  - Basic building science concepts. Practical compliance aids can range from laminated information cards for simple prescriptive methods to software packages for performance-based codes.
  - Information on how to inspect plans and site features for compliance.
  - Whom to contact and resources for more information and technical assistance.
- Provide budget and staff for the program. Assign staff personnel with appropriate training and experience to support the code adoption and implementation processes. Give them enough of a budget to do the necessary homework, involve stakeholders, and support implementation.

of the ASHRAE 90.1 and IECC model codes. Some states have had success with simplified prescriptive codes, as in Oregon and Washington, written in plain English with easy-to-read tables and other user-friendly features. Code officials are also pursuing a range of best practices (see text box, "Best Practices for Energy Code Implementation") that minimize the additional education and time requirements imposed on code officials.

- *Many states do not have the resources to monitor, evaluate, and enforce their energy codes*. Many jurisdictions do not have staff dedicated to training, technical assistance, or enforcement, and thus do not pursue monitoring and evaluation. As a result, self-enforcement of building energy code provisions is the norm in many states. New York accomplishes this by requiring a licensed design professional to complete an official form attesting to code compliance. In the face of resource shortages, other states rely on self-enforcement mechanisms such as home energy rating systems and the ENERGY STAR program.

Evaluation

State and municipal experience demonstrates that evaluating energy savings, conducting compliance surveys, and assessing the process by which program information is distributed are key elements of a successful building energy code. Evaluation of energy and peak demand savings data helps ensure that requirements are followed and that stated goals are achieved. Code officials use information about the "co-benefits" of energy savings (e.g., financial savings and reductions in air pollution), implementation levels, and code awareness to evaluate progress, suggest strategies for improvement, and enhance overall program effectiveness. Another major benefit of compliance evaluation is the identification of code provisions that show the greatest energy savings impacts, as well as low compliance, or reveal significant market confusion. Revealing such issues can help code officials develop targeted corrective actions for training and enforcement.

Similarly, states are conducting studies of prospective energy savings from codes prior to adoption and implementation. Measuring the range of potential benefits, energy, economic, and environmental, can build the case for energy codes by assessing both positive and negative costs. If results show promise, studies of prospective benefits can also broaden stakeholder support for energy codes.

Texas Energy Code Evaluation

In Texas, the South-central Partnership for Energy Efficiency as a Resource developed a *2014 Energy Code Adoption Report* (SPEER 2014) that identifies the code adoption status of 217 cities and describes enforcement and adoption activities. Key findings include:

- In 2013, just over half of the jurisdictions required certification of their enforcement staff.
- Conversations with building industry leaders indicated that the industry tends to support the "leveling of the [playing] field" to the extent that codes can help eliminate low-cost, low-efficiency, low-quality construction that undercuts mainstream builders' market prices and reputations. These discussions indicate support for adoption and enforcement of the current (2009) state energy code.
- Through 2013, 20 cities in Texas had adopted the 2012 IECC energy codes or stronger amendments. This number had almost tripled by 2014.

State and local officials are finding value from the following kinds of evaluation tools:

- *Energy savings evaluation*. Even though theoretical energy savings from building codes can be estimated with computer software, it is important to evaluate whether codes are actually saving energy and meeting goals. Information from energy savings evaluations can indicate if certain portions of the code perform better than others or if overall savings are meeting expectations. With this insight, states can focus their implementation and enforcement efforts on addressing priority concerns. For example, a 2002 study in Fort Collins, Colorado, found that measured energy savings from a code change in 1996 were approximately half of pre-implementation estimates. By conducting a code evaluation, the city was able to identify problem areas and focus its resources accordingly (City of Fort Collins 2002). In the context of

EPA's proposed Clean Power Plan, state plans that include codes need to consider best practices for energy savings evaluation.

- *Compliance surveys*. While there are few comprehensive code compliance studies, DOE has created a series of compliance evaluation tools that can be used to determine whether buildings are being built in compliance with code. Another purpose of compliance studies is to assess the overall state of building technology and practice. Results might show, for example, that certain beyond-code energy features are gaining wide acceptance in the market. In states and municipalities where data exist, they frequently indicate compliance rates between 40 and 60 percent, although much lower levels of performance have been documented (NEEP 2009). Because the methodologies used in compliance studies can vary significantly, DOE's evaluation tools can help provide greater consistency in assessing compliance rates. Regardless of which methods are used, the gap between targeted and measured compliance highlights the challenges state and local governments face in reaching compliance goals and puts a premium on innovation and effort aimed at forging new compliance strategies.
- *Process evaluation.* State programs that offer technical assistance and related services benefit from a process evaluation to assess and suggest improvements to these offerings. These evaluations look less at what is being built than at the ways information is delivered to key stakeholders such as builders and code officials. Improving service delivery can help improve code compliance and overall stakeholder acceptance of the code. Process evaluation is also used to determine the effectiveness of a state's enforcement efforts.

State Examples

The following states have implemented successful building code programs using varying approaches.

California

California's Title 24 standards for residential and commercial buildings constitute a mandatory, statewide building energy code that is more efficient than the 2012 IECC and ASHRAE 90.1-2010. California's building energy code differs from other state codes in that it impacts the process of building design and construction verification more thoroughly. For building designs, all building plans must be reviewed for energy code compliance prior to the release of building permits. For construction verification, California requires energy inspections (envelope, infiltration) and has unique inspection certificates that are required for insulation and mechanical equipment and devices that fall under the Building Energy Efficiency Standards.

Website: http://www.energy.ca.gov/title24/

Massachusetts

The first state to adopt an above-code appendix to its state building energy code, Massachusetts implemented a version of the 2009 IECC that was designed to achieve 20 percent greater savings than the base 2009 IECC. By the end of 2012, 122 communities in Massachusetts adopted the voluntary stretch code—an impressive rate of participation for voluntary code. The Massachusetts state government has since adopted the 2012 IECC and ASHRAE 90.1-2010 building energy codes, with an effective date of July 1, 2014. As a result, DOE estimates, the state will save $144 million annually by 2030.

Website: http://www.mass.gov/eea/energy-utilities-clean-tech/energy-efficiency/policies-regs-for-ee/building-energy-codes.html

Texas

Texas, a state with a “home rule” constitution, passed legislation in 2001 requiring local governments to follow a single statewide building energy code.

While Texas has not adopted the 2012 IECC or ASHRAE 90.1-2013, numerous municipalities in the state have moved forward with more progressive building energy codes than are recommended by the state. Notably, the city of Houston has adopted a stretch code for residential buildings equivalent to 10 percent above the 2009 IECC. It is estimated that 2012 IECC and ASHRAE 90.1-2010 adoption in Texas would save close to $1 billion annually by 2030.

Website: http://seco.cpa.state.tx.us/tbec/

Arizona

Arizona is another home rule state, where energy codes are adopted and enforced at the local level. As such, several communities, including Pima County, Peoria, and Phoenix, have emerged as local leaders in building code adoption. These jurisdictions now have codes based on the 2012 IECC. The successful experience of these municipalities has encouraged other local governments in Arizona to consider adopting an energy code. However, despite the continued success, only half of the cities researched by the Phoenix Chapter’s Technical Committee have adopted energy codes. It is estimated that adopting the 2012 IECC and ASHRAE 90.1-2010 energy codes statewide could save Arizona about $270 million annually by 2030.

Website: http://www.azenergy.gov/government/state+energy+codes.aspx

Illinois

Illinois is notable as a state that adopted the 2012 IECC on January 1, 2013, and has set up an aggressive system for implementing future updates to energy building codes. A provision in past legislation to adopt 2009 IECC and ASHRAE 90.1-2007 directed the state’s Capital Development Board to adopt subsequent versions of the IECC within 9 months of publication. DOE expects Illinois’ energy cost savings to reach $270 million annually by 2030.

Website: http://www.illinois.gov/dceo/whyillinois/KeyIndustries/Energy/Pages/IECC.aspx

What States Can Do

States with energy codes can consider updates and improvements to the implementation process to increase energy efficiency. States with no energy code in place can examine the costs and benefits of implementing a code and consider initiating a code adoption process.

Action Steps for States

States that already have an energy code can:

- Implement a rigorous enforcement program that ensures that local building code departments have proper training and resources, including adequate staff coverage.
- Review the version of the document currently in force. If it is more than 5 years old, consider an updated version. The latest available IECC code is the 2015 version, and the most recent ASHRAE Standard 90.1 is the 2013 version.
- Conduct analysis on the effect of potential code updates on energy and cost savings for building owners, on the effect on energy generation and distribution, and on GHG emissions and other criteria air pollutant levels. Balance these benefits against any added construction costs.
- Initiate a stakeholder process to review the data, obtain participant input, and decide whether to adopt a new code.
- If a new version of the energy code is adopted, initiate administrative and educational processes. Implementation tools and other resources are available at no charge from DOE.
- If a state-specific energy code training program exists, review it and consider an update that describes new codes not currently covered.

A state that does not have an energy code can:

- Review available model codes and standards and learn about other states' experiences. Conduct research and analysis to determine which model codes best match the needs of the area under consideration.
- Establish a construction market baseline against which to assess the benefits of an energy code. This may require a field survey of homebuilders, suppliers, and contractors, including onsite inspections and interviews.
- Conduct an analysis of the effect of the new code on energy and cost savings for building owners, power system reliability, and reduced GHG emissions and other criteria air pollutants. Balance these benefits against any added construction codes.
- Initiate a stakeholder process to review the data, obtain stakeholder input, and decide whether to adopt the energy code under consideration.
- After a decision to adopt an energy code, initiate administrative and educational processes, as appropriate.
- Develop a code implementation process that includes training and technical assistance. Reach out to affected industries and audiences across the state. Tap federal, NGO, and industry sources for expertise and resources to support these efforts.

Information Resources

Resources for Building Code Information

Title/Description	URL Address
ASHRAE. ASHRAE provides technical standards, publications, education, and hosting for industry events.	http://www.ashrae.org
BCAP. A nonprofit organization, BCAP is dedicated to helping states adopt and implement up-to-date building energy codes.	http://energycodesocean.org
DOE Building Energy Codes Program. Program provides compliance tools, technical assistance, and other code information and support.	http://www.energycodes.gov
DOE. Building energy code determinations issues by the U.S. Department of Energy.	http://www.energycodes.gov/determinations
ICC. The ICC provides code documents, technical assistance, training, and other services, including the IECC residential code.	http://www.iccsafe.org
ICC Code Library. Online library for each of the ICC model codes.	http://publicecodes.cyberregs.com/icod/
ICC State Codes. Online library of code language for various states that have IECC-based building code language.	http://publicecodes.cyberregs.com/st/
Midwest Energy Efficiency Alliance (MEEA). MEEA works on code development and adoption in the Midwest states.	http://www.mwalliance.org/policy/building-energy-codes
NASEO. The association of state energy offices.	http://www.naseo.org/building-energy-codes
NBI. A nonprofit organization, NBI develops leading-edge commercial building standards and related research and technical information.	http://www.newbuildings.org
Northeast Energy Efficiency Partnerships (NEEP). NEEP works on code development and adoption in the Northeast states.	http://www.neep.org/initiatives/energy-efficient-buildings/building-energy-codes
Northwest Energy Efficiency Alliance (NEEA). NEEA works on code development and adoption in the Pacific Northwest states.	http://neea.org/initiatives/codes-standards/codes
RESNET. RESNET accredits home energy rating organizations and provides a variety of technical information on home energy ratings and home energy performance.	http://www.resnet.us
Southwest Energy Efficiency Project (SWEEP). SWEEP works on code development and adoption in the Southwest region and Rocky Mountain states.	http://www.swenergy.org/programs/buildings/codes/index.html
South-central Partnership for Energy Efficiency as a Resource (SPEER). SPEER works to accelerate the adoption of energy codes in Texas and Oklahoma.	http://eepartnership.org/energy-codes-2/

Compliance and Analytical Tools

Title/Description	URL Address
DOE Building Energy Software Tools Directory. This is the DOE directory of building energy analysis tools available from numerous organizations.	http://www.eere.energy.gov/buildings/tools_directory/
DOE COMcheck and REScheck. DOE-developed tools that offer an easy way to check whether building designs meet energy code requirements.	https://www.energycodes.gov/compliance/tools
DOE Compliance Evaluation Tools. DOE-developed tools to help states and jurisdictions measure and report their rate of compliance.	https://www.energycodes.gov/compliance/evaluation
DOE EnergyPlus. This public-domain software is a whole-building energy simulation program that engineers, architects, and researchers use to model energy and water use in buildings.	http://www.eere.energy.gov/buildings/energyplus/
ENERGY STAR Portfolio Manager. This tool allows users to track energy use of a portfolio of existing buildings online. It includes functions for benchmarking, managing a single building or group of buildings, assessing investment priorities, and verifying building performance.	https://portfoliomanager.energystar.gov/
ENERGY STAR Target Finder. This tool rates the energy performance of a new building design using information about energy use per square foot derived from building design simulation tools. EPA's energy performance rating system uses a 1 to 100 scale, where an ENERGY STAR target rating is 75 or higher.	http://www.energystar.gov/buildings/tools-and-resources/target-finder https://portfoliomanager.energystar.gov/pm/targetFinder
NEEA Energy Code Compliance Studies. These studies document energy code compliance results in the Pacific Northwest states.	http://neea.org/initiatives/codes-standards/codes

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DOE. 2012b. National Energy and Cost Savings for New Single- and Multifamily Homes: A Comparison of the 2006, 2009, and 2012 Editions of the IECC. U.S. Department of Energy, Building Technology Program.	http://energy.maryland.gov/codes/documents/NationalResidentialCostEffectiveness.pdf

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IMT. 2013. Assessment of Energy Efficiency Achievable from Improved Compliance with U.S. Building Energy Codes: 2013–2030. Institute for Market Transformation.	http://www.imt.org/resources/detail/assessment-of-energy-efficiency-achievable-from-improved-compliance-with-u
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Stellberg, S., A. Cooper, C. Sarno, and D. Lis. 2012. Role for Utilities in Enhancing Building Energy Code Compliance. Institute for Market Transformation, Institute for Electric Efficiency, and Northeast Energy Efficiency Partnership.	http://www.aceee.org/files/proceedings/2012/data/papers/0193-000174.pdf

4.4 State Appliance Efficiency Standards

Policy Description and Objective

Summary

Appliance standards save energy and generate net benefits for homes, businesses, and industry by reducing the cost of operating equipment and appliances.

State appliance efficiency standards establish minimum energy efficiency levels for appliances and other energy-consuming products. These standards typically prohibit the sale of less efficient models within a state. Many states are implementing appliance and equipment efficiency standards, where cost-effective, for products that are not already covered by federal government standards.[36] States are finding that appliance standards offer a cost-effective strategy for improving energy efficiency and lowering energy costs for businesses and consumers.

As of February 2014, 12 states (Arizona, California, Connecticut, Georgia, Maryland, Nevada, New Hampshire, New York, Oregon, Rhode Island, Texas, Washington, and the District of Columbia) have adopted one or more appliance efficiency standards for products not covered by federal standards (ASAP 2014).

Appliance efficiency standards have been an effective tool for improving energy efficiency. At the federal level, the U.S. Department of Energy (DOE) has been responsible for setting minimum appliance standards and test procedures for an array of residential and commercial appliances and equipment since 1987. As of 2000, federal appliance efficiency standards had reduced U.S. electricity use by 2.5 percent and carbon emissions by nearly 2 percent (ACEEE 2001). Due to new standards contained in the Energy Policy Act of 2005 (or EPAct 2005), the Energy Independence and Security Act of 2007 (or EISA 2007), and additional DOE rules, total electricity savings from already adopted federal standards are projected to increase 682 billion kilowatt-hours (kWh) per year or 14 percent of the projected total U.S. electricity use in 2025 (ASAP 2012).

Efficiency standards can play a significant role in helping states meet energy savings goals. California's standards program has saved consumers over $75 billion on electricity bills since its inception (CEC 2013).

Objective

The key objectives of appliance efficiency standards are to:

- Raise the efficiency of a range of residential and commercial energy-consuming products, where cost-effective.
- Overcome market barriers, such as split incentives between homebuilders and homebuyers and between landlords and tenants, and panic-purchase situations in which appliances break and must be replaced on an emergency basis. In a panic purchase, customers usually do not have the time to consider a range of models, features, and efficiency levels, and the full range may not be available from all suppliers.
- Reduce energy use to lower criteria air pollution and greenhouse emissions, improve electric system reliability, and cut consumer energy bills.

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[36] Under certain conditions, a state may exceed a federal standard for a federally covered product; overall, however, federal law is preemptive. For example, in the case of building codes, a state can create a building code compliance path in which a furnace is at a higher efficiency than the federal standard. However, the state must also provide a compliance path under which the higher efficiency furnace is not required. Thus, the option to exceed federal standards is indirect and is typically only possible in the case of building codes. In addition, states may not ban lower efficiency products.

Benefits

In addition to saving energy, appliance and equipment standards help reduce greenhouse gas (GHG) emissions and other air pollution, improve electric system reliability, and save consumers and businesses significant amounts of money over the life of the equipment. Federal standards completed through 2014 are expected to have reduced U.S. energy use by a cumulative 70 quadrillion British thermal units (quads) by 2020 and result in energy bill savings of $960 billion (DOE 2015a). In 2012, an analysis showing 34 new or updated standards that could be pursued in the near future had potential annual savings of 212 terawatt-hours (TWh)[37] of electricity, 126 trillion British thermal units (Tbtu) of natural gas, and 42,000 megawatts (MW) of peak demand savings in 2025 if implemented nationally. These standards are also cost-effective, with purchases of these appliances through 2035 expecting to result in net present value savings of over $167 billion if the standards are implemented (ASAP 2012).

In addition to appliance standards that set minimum energy efficiency performance levels that all equipment must meet, states can go further by adopting ENERGY STAR specifications that set higher efficiency levels. ENERGY STAR identifies the top performers in the marketplace, and supports even greater levels of energy savings.

The direct economic and environmental benefits of state standards are also substantial. California draft regulations for 15 new appliance standards are expected to save 50 billion gallons of water, 1,400 MW of peak electricity, 9,800 gigawatt-hours (GWh) of electricity, and 162 million therms of natural gas per year. This is expected to result in annual savings of $2 billion (CEC 2014).

While federal appliance standards have been expanding in recent years, there is still great potential for states to move into product areas not yet covered by federal standards. Table 4.4.1 looks at energy savings from some of the products with the largest potential for savings in each sector, then gives a total for each sector for all 34 products considered by an Appliance Standards Awareness Project (ASAP) study into future appliance standards.

[37] One TWh is a billion kWh.

Table 4.4.1: Estimated Energy Savings of Appliance Standards Not Covered by Federal Law

Products	Annual Savings in 2025			Annual Savings in 2035		
	Electricity Savings (TWh)	Peak Demand (GW)	Natural Gas (Tbtu)	Electricity Savings (TWh)	Peak Demand (GW)	Natural Gas (Tbtu)
Residential Standards						
Water heaters	18.2	2.5	—	43.0	5.9	—
Set top boxes and digital communication equipment	14.7	2.0	—	14.7	2.0	—
Air handlers	13.7	5.6	—	29.1	11.9	—
Total (14 products)	**98.5**	**16.8**	**51.6**	**142.3**	**27.0**	**51.6**
Commercial And Industrial Standards						
Walk-in coolers and freezers	14.7	3.4	—	14.7	3.4	—
Distribution transformers	10.9	1.5	—	22.4	3.1	—
Electric motors	9.0	1.4	—	18.6	2.9	—
Total (13 products)	**62.4**	**15.5**	**74.2**	**98.5**	**24.5**	**139.9**
Lighting Standards						
Incandescent reflector lamps	20.2	5.0	—	20.2	5.0	—
Outdoor lighting fixtures	10.3	0.7	—	26.1	1.8	—
General service fluorescent lamps	6.9	1.7	—	6.9	1.7	—
Total (7 products)	**50.8**	**9.3**	—	**65.6**	**15.6**	—
ALL PRODUCTS	**212**	**42**	**126**	**306**	**67**	**235**

Source: ASAP 2012

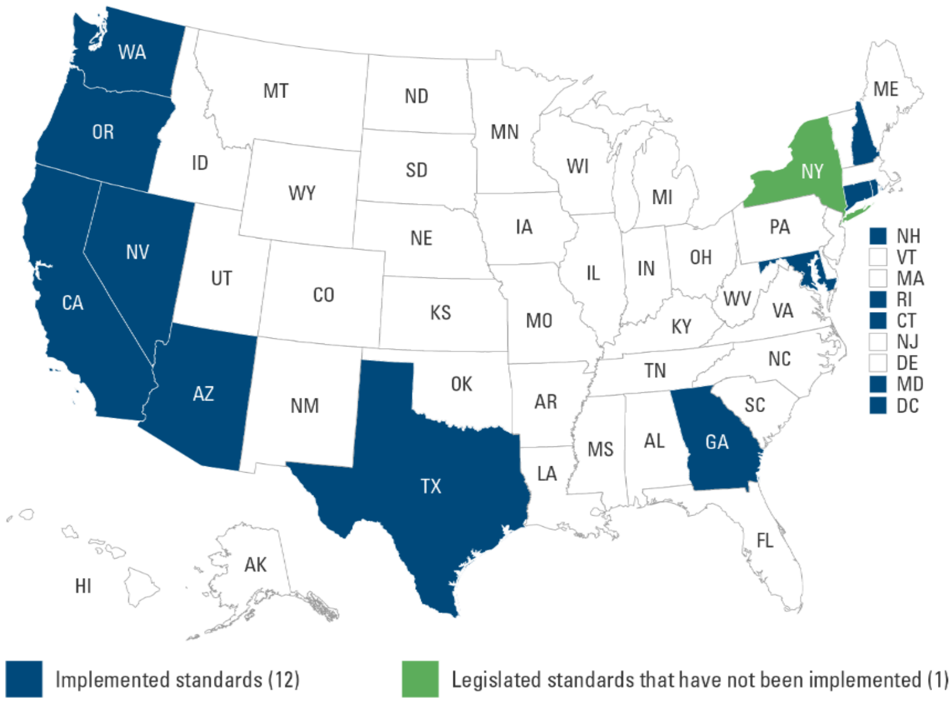
States with Appliance Efficiency Standards

Many states either have implemented appliance standards or are considering implementing them, as shown in Figure 4.4.1. California's appliance standards program dates to the 1970s, when the state began to pursue standards before the enactment of federal legislation. When the federal government opted not to issue standards under its legislative mandate in 1982, other states joined California and developed state standards. These state initiatives helped create the consensus for new federal legislation in 1987 (the National Appliance Energy Conservation Act or NAECA), the EPActs of 1992 and 2005, and EISA 2007. While the NAECA preempted state action on federally covered consumer products (with limited exceptions as discussed later), California has continued to develop efficiency standards for other products and technologies. California's standards program has contributed to substantial improvements in energy efficiency. Since its inception, the program has saved consumers over $75 billion on electricity bills alone (CEC 2013).

Additional states have recently enacted legislation supporting efficiency standards. These include Arizona, Connecticut, Georgia, Maryland, Nevada, New Hampshire, New York, Oregon, Rhode Island, Texas, Washington, and the District of Columbia. Table 4.4.2 lists adopted and pending efficiency standards by state.

In 2013, Oregon passed Senate Bill 692, which added standards for televisions and battery chargers effective in 2014 as well as double-ended quartz halogen lamps effective in 2016 (ODOE 2014). These new standards are expected to save 244 GWh and $22 million annually in utilities by 2020 (OSL 2013).

Figure 4.4.1: States with or Considering Appliance Standards



Source: Compiled by ICF International based on ASAP 2014.

Table 4.4.2: States with Adopted or Pending Appliance Efficiency Standards

Product	AZ	CA	CT	DC	GA	MD	NH	NV	NY	OR	RI	TX	WA
Battery chargers		X								X			
Bottle-type water dispensers		X	X	X		X	X		O	X	X		X
Commercial hot-food holding cabinets		X	X	X		X	X		O	X	X		X
Consumer audio and video products			X						O	X			
Digital television adapters									O				
Double-ended quartz halogen lamps										X			
External power supplies										Y			
Faucets		X			X								
General service incandescent lamps		Y						X					
Metal halide lamp fixtures		Y											
Pool pumps	X	X	X						O				X
Portable electric spas	X	X	X						O	X			X
Portable light fixtures		X							O				
Televisions		X	X						O	X			
Toilets		X			X							X	
Urinals		X			X							X	

Key: X = adopted, Y = state is implementing until national standards take effect, O = standard has been legislated but has not yet been implemented.

Source: Compiled from ASAP 2014.

Designing an Effective Appliance Standards Policy

States have substantial experience with appliance efficiency standards. Key issues they have addressed include identifying participants, design issues, and linkages with federal and state policies.

Participants

- *State legislatures.* Establishing efficiency standards in a state typically requires enabling legislation. However, once legislation is enacted, it may allow an executive agency to set further standards administratively. Because several states have established standards for administration procedures, these implementation processes can also be largely replicated from other states' experiences.
- *State energy offices.* State energy offices, which typically administer the federal state energy program funds, have generally acted as the administrative lead for standards implementation.
- *Customers.* It is important to consider the people who use the affected products during the standards development and implementation processes. Consideration includes assessing benefits and costs to consumers and impacts on product features or market choices.
- *Product manufacturers.* Companies that make affected products clearly have a stake in standards development. Proactive consultations with manufacturers can increase the speed and effectiveness of the development and implementation process. Their expertise can help refine efficiency levels and labeling and certification procedures.
- *Product distributors, installers, and retailers.* Wholesale distributors, installation contractors, and retail vendors are key players since they must know the technical requirements and labeling and certification rules to be able to participate effectively in standards implementation and enforcement.
- *Utilities.* Utilities may provide technical assistance for developing standards and support for implementation. Their relationships with customers and trade allies can also be helpful in educating markets about the effects of new standards. Utilities that operate voluntary efficiency programs may want to coordinate their incentive and education programs, gearing voluntary incentive targets to the standards.
- *Public interest organizations*. Groups representing consumers, environmental interests, and other public interests can offer technical expertise and important public perspectives in developing and implementing standards as baselines.

Key Design Issues

- *Defining the covered products and their energy efficiency, applicability, and cost-effectiveness*. States have adopted appliance standards not currently preempted by federal standards covering from one to 12 products. Some products may not be appropriate candidates for standards if, for example, they have recently been covered by federal law, or they are not appropriate for the state's climate or markets. States target certain products for standards based on their total energy savings potential, technical feasibility, and economic attractiveness. Because technologies suitable for appliance standards are typically already being used in well-known, consistent applications, estimating their energy savings has been relatively straightforward.
- *Assessing overall benefits and costs.* In addition to the economic assessment of individual technologies, states have conducted overall assessments of benefits and costs. Benefits can include energy savings, energy bill reductions, electric reliability benefits, reduction in future energy market prices, and criteria air

pollutant reductions and GHG emission prevention. Costs can include product buyer costs, product manufacturer costs, and program administration costs.

- *Availability of test methods.* Test methods are necessary to set efficiency levels for the state appliance standards. Test methods may have been established by federal agencies such as DOE and the U.S. Environmental Protection Agency (EPA), by other states that have already set standards, or by industry associations representing companies that make the products of interest.
- *Defining certification and labeling requirements*. Like test methods, product certification and labeling procedures may have already been established by federal or state agencies or by industry associations. In some cases, it may be necessary for appliance standards regulations to define a labeling or certification method beyond those already established. On the other hand, and in rare instances, technical or market issues may warrant certification or labeling exemptions for certain products. For example, if a standard calls for a simple, prescriptive design change, that feature may be so visible on the product that certification and labeling may not be needed.
- *Establishing inspection and enforcement procedures*. Inspection and enforcement of state appliance standards regulations has typically involved self-policing. Industry competition is usually such that competitive manufacturers report violations. Federal standards and voluntary programs are starting to move toward more stringent inspection and enforcement schemes, with the voluntary ENERGY STAR program and some federal lighting and motor standards requiring third-party certification. Making product performance data publically available (e.g., by listing compliant products on the state website) could encourage fair participation and reporting, as well as invite self-policing by industry stakeholders. While states may want to reserve the legal right to inspect individual products or installations, it is rare that state agencies have had to institute regular inspection or sustained enforcement actions.

Interaction with Federal Policies

Federal laws such as NAECA, EPAct 1992, EPAct 2005, and EISA 2007 have established appliance efficiency standards for more than 50 products (see Table 4.4.3), representing about 90 percent of home energy use, 60 percent of commercial building energy use, and about 30 percent of industrial energy use (DOE 2015a). States can actively promote efficient models of these products by increasing consumer awareness and developing other programs.

States are preempted from setting their own standards for the products covered by federal standards. State efficiency standards that were established before a product was covered under NAECA are pre-empted as of the effective date of the federal standard (i.e., the date that manufacturers must comply with that standard). Nevertheless, some states are enacting standards for products that are not yet covered by federal law, for which DOE rulemakings will take place (as directed by EPAct or EISA), and/or that are being considered for coverage under NAECA, expecting to gain several years of savings in the interim. States can apply for waivers of preemption for products that are covered by federal law. If they face special conditions, for example, states can cite those circumstances as the basis for a waiver. California for instance was granted a waiver for metal halide lamp fixtures; this means its two tier standards, the second of which will take effect in 2015, will not be preempted by federal standards (ASAP 2014). Meanwhile, Oregon’s standards for external power supplies will be allowed to remain in effect until 2016, when the federal standards broaden their scope to catch up with Oregon (ASAP 2014).

Table 4.4.3: Products with Existing Federal Appliance Efficiency Standards or Active Rulemakings

Consumer Products	
o Battery chargers	o Furnace fans
o Ceiling fans	o Furnaces and boilers
o Central air conditioners and heat pumps	o Hearth products
o Clothes dryers	o Ranges and ovens
o Clothes washers	o Microwave ovens
o Computer/battery backup	o Pool heaters
o External power supplies	o Portable air conditioners
o Dehumidifiers	o Refrigerators and freezers
o Direct heating equipment	o Room air conditioners
o Dishwashers	o Water heaters
Commercial and Industrial Products	
o Commercial ice makers	o Pumps
o Clothes washers	o Refrigerated beverage vending machines
o Commercial package air conditioners and heat pumps	o Refrigeration equipment
o Commercial packaged boilers	o Single package vertical air conditioners and heat pumps
o Compressors	o Small electric motors
o Computer room air conditioners	o Unit heaters
o Distribution transformers	o Walk-in coolers and freezers
o Electric motors	o Warm air furnaces
o Fans and blowers	o Water heating equipment
o Packaged terminal air conditioners and heat pumps	
Lighting Products	
o Ceiling fan light kits	o Incandescent reflector lamps
o Fluorescent lamp ballasts	o Light-emitting diode lamps
o General service fluorescent lamps	o Luminaires
o General service incandescent lamps	o Medium-base compact fluorescent lamps
o General service lamps	o Metal halide lamp fixtures
o High-intensity discharge lamps	o Torchieres
o Illuminated exit signs	o Traffic signal modules and pedestrian modules
Plumbing Products	
o Commercial spray valves	o Urinals
o Faucets	o Water closets (flush toilets)
o Showerheads	

Source: DOE 2015b

Interaction with State Policies

It is important for states to recognize that their appliance efficiency standards are different from ENERGY STAR efficiency specifications. The former set minimum energy efficiency performance levels that all appliances must meet; the latter are set at higher energy efficiency levels to help identify the top performers in the marketplace (typically the top 25 percent). As the market share of these products grows over time, EPA revisits ENERGY STAR specifications to ensure continued relevance in the marketplace and savings for the consumer above and beyond standard appliance offerings. It is also important to note that the scope of products covered by ENERGY STAR may be narrower and application-specific, and performance requirements may be climate-dependent. Because of these differences, ENERGY STAR specifications may not be an appropriate basis for market-wide appliance efficiency standards.

Program Implementation and Evaluation

Many states have learned that they do not need to start from scratch when developing and implementing appliance efficiency standards; in many cases, they can refer to the work already conducted by states with established appliance efficiency standards. States have made minor adaptations to existing legislation based on the product lists and analyses conducted by other states. States have also consulted national and regional organizations with expertise and technical support capability. (For more information about states' activities, see "State Examples" later in this section.)

While a state agency can initiate an inquiry into efficiency standards, legislation is typically needed to enable executive agencies to regulate in this area. Once legislatively authorized, states have followed these steps toward successful implementation of appliance efficiency standards:

- *Establish a stakeholder process*. Notify affected manufacturers, consumers, utilities, state agencies, and public interest organizations about the initiative. Develop information materials and hold workshops to inform stakeholders and solicit feedback.
- *Define covered products.* Develop a specific list of product and equipment types to be covered by the program. States have obtained lists of eligible products from other states that have recently enacted standards and from national organizations.
- *Conduct benefit-cost analysis and related studie*s. (See "Key Design Issues" described earlier in this section.)
- *Conduct rulemaking*. The rule typically defines covered products, effective dates, efficiency standards, test methods, certification and labeling procedures, inspection and enforcement procedures, penalties for noncompliance, procedures for appeals, waivers and other exceptions, and contact information for the agencies involved. A rulemaking also provides formal notice, review, and comment procedures. When enabling legislation authorizes the executive branch to add new products or update standards on covered products, the regulatory process may be reopened after a few years.
- *Monitor, review, and modify the program as needed*. Based on stakeholder response and market trends, some states have made specific program modifications, including revisions to covered products, efficiency levels, and effective dates, as well as process improvements such as more frequent stakeholder input cycles and more transparent public information processes.

Best Practices for Standards Design and Implementation

- *Learn from others.* There are many lessons to be learned from states that have adopted appliance standards.
- *Consult with stakeholders*. Identify key groups early, including product manufacturers, affected retailers and customer groups, advocates, and utilities. Keep stakeholders informed and seek their input regularly.
- *Conduct a benefit-cost analysis* of the proposed standards.
- *Address key issues,* such as covered products, efficiency levels, effective dates, test methods, product certification, labeling requirements, and enforcement.
- *Review and adjust covered product lists* to be sure they are technically and legally up to date.

Typical implementation considerations include:

- *Effective dates*. A single date is typically established after which noncomplying products may not be sold or installed in the state. In some cases, where warranted by product-specific considerations, extra time is allowed for manufacturers or retailers to prepare for the new standards.
- *Test methods.* A specific method must be defined for testing the efficiency of a given product type. DOE, ENERGY STAR, industry associations, and/or technical societies such as ASTM International (formerly the

American Society for Testing and Materials), the American Society of Mechanical Engineers, the Illuminating Engineering Society of North America, and ASHRAE (formerly the American Society of Heating, Refrigerating, and Air Conditioning Engineers) are typical sources of appliance test methods.

- *Product certification.* The federal standards program is essentially self-certifying; that is, manufacturers use DOE-approved test procedures and submit certification reports to attest that affected products comply with standards. Some states, notably California, maintain databases of covered products to identify which models are in compliance with their state standards.
- *Labeling requirements*. To date, state standards programs have relied primarily on national labeling and other information programs to address the need to label covered products. For example, federal law requires the Federal Trade Commission to operate an appliance labeling program for defined product types, and the EPA ENERGY STAR program includes certain labeling guidelines. In some cases, industry associations that maintain their own certification programs set labeling guidelines for certain products. Labeling issues vary by product type and are resolved on a case-by-case basis.
- *Enforcement*. The California program is largely self-policing. Manufacturers are expected to provide complying products and competitive forces are expected to prevent violations. Enforcement actions typically depend on market participants to bring violation claims.

Historically, the federal standards and ENERGY STAR programs were largely self-policing. In 2011, EPA launched new ENERGY STAR third-party certification and verification program requirements; more recently, DOE has ramped up verification and enforcement efforts. Under ENERGY STAR, products are chosen and tested on an annual basis, and both DOE and EPA continue to provide a vehicle for product complaints and challenges.

Evaluation

Appliance efficiency standards programs have achieved defined results with minimal expenditure of public funds. Evaluating the benefits and costs of the standards is important during the standards setting process. Once enacted, little field evaluation is typically performed.

Depending on the state enabling law, the implementing agency may be authorized to increase standards for affected products and/or to set standards for other product types. These actions are likely to involve detailed technical and economic evaluation. Improvements in the standards setting process itself can also be considered at such times.

Best Practices for Standards Evaluation

- Conduct technical and economic evaluation of opportunities to increase appliance standards and/or set standards for new products.
- Review markets and product applications periodically (e.g., every 3 to 5 years) to determine whether new or adjusted regulations are needed to avoid degradation of savings.

Once a state has operated a standards program for several years, it is helpful to conduct a program review to improve procedures and implement other enhancements.

A key consideration for assessment is degradation of savings. Standards are established for a typical assumed application; over time the use of the product or device may change so that the original intent of the standard is not being served, or technology may change to the point that the device is used differently. Consequently, it can be valuable to review the markets and applications in which standards-covered devices are used, to ensure that the standards are having the intended effect. If the market or application context changes sufficiently for a product, the applicable standard may need to be reevaluated.

Other opportunities for evaluation include assessments of energy, demand, emissions, and other impacts over time, both for evaluating effectiveness and for quantifying emissions impacts for air quality or climate policy purposes. A periodic process evaluation of the standards program can also be helpful to ensure that stakeholder participation is appropriate, technical methods are up-to-date and effective, and rulemaking procedures are as transparent and streamlined as possible.

State Examples

California

California was the first state to initiate an appliance efficiency standards program (in 1977) and maintains the most active and well-funded standards program of any state. California law now covers over 50 products, 17 of which have not been replaced by federal standards (ASAP 2014). Most recently, in 2010 California approved efficiency standards for televisions, and in 2012 California created standards for battery chargers and external power supplies (ACEEE 2013). Most state standards programs in recent years have used California's covered products (or a subset of these products) and technical procedures as the basis for their efforts.

The California Energy Commission operates the standards programs for the state. It develops technical and economic assessments of products recommended for rulemakings, develops draft regulations, holds public participation processes, issues final rules, monitors compliance, and maintains a database of covered products. Recently, California's investor-owned utilities have increased their role in the program, providing technical advice and recommending and advocating for new appliances to be covered. Since the 2006–2008 program cycle, these utilities have also been able to claim credit for program savings in their energy efficiency targets through the California Public Utilities Commission (Cadmus 2012).

California's standards program has contributed to substantial improvements in energy efficiency. Since California's appliance standards program was first established, it has saved consumers over $75 billion on electricity bills alone (CEC 2013). The building code and appliance standards currently in place contribute a combined gross energy savings of 3,229 GWh and electricity demand savings by 446,000 kW annually (CPUC 2013).

In order to go beyond federal standards, California must obtain a federal waiver. The state requested and was allowed to implement national standards for general service incandescent bulbs earlier than mandated. California has also been granted a waiver to avoid federal preemption of its metal halide lamp fixture standards.

Over the course of 2014 and 2015, California is releasing draft regulations on a variety of new standards for appliances including faucets, toilets, urinals, air filters, dimming ballasts, LED lamps, MR lamps, pool pump motors, portable electric spas, computers, monitors, displays, network equipment, game consoles, and commercial clothes dryers. These proposals have the potential to bring annual savings of 50 billion gallons of water, 1,400 MW of peak electricity, 9,800 GWh of electricity, and 162 million therms of natural gas. The standards are expected to result in natural resource savings of $2 billion annually (CEC 2014).

Websites: http://www.energy.ca.gov/appliances/
http://www.energy.ca.gov/appliances/database/historical_excel_files/
(contains California appliance data)

Connecticut

Connecticut enacted efficiency standards legislation in 2004, 2007, and most recently in 2014 through Senate Bill 1243. Through this legislation, Connecticut has drawn or is drawing up plans to implement nine appliance standards that are not currently covered by federal standards. These appliances include bottle-type water dispensers, commercial hot food holding cabinets, hot tubs, swimming pool pumps, compact audio equipment, DVD players and recorders, and televisions (DSIRE 2014).

Website: http://www.ct.gov/deep/cwp/view.asp?a=4120&Q=481608

Oregon

In 2005 and 2008, Oregon passed legislation setting minimum energy efficiency standards for appliances. The standards that have not been preempted by federal standards cover bottle-type water dispensers, hot food holding cabinets, compact audio devices, DVD players and recorders, and portable electric spas. In addition, Oregon's standards for external power supplies will be allowed to remain in effect until 2016, when the federal standards broaden their scope to catch up with Oregon (ASAP 2014).

In 2013, Oregon passed Senate Bill 692. This bill added standards for televisions and battery chargers effective in 2014, as well as standards for double-ended quartz halogen lamps effective in 2016 (ODOE 2014). These new standards are expected to save 244 GWh and $22 million annually in utilities by 2020 (OSL 2013).

Website: http://www.oregon.gov/ENERGY/CONS/Pages/StateRegulatedApplianceStandards.aspx

What States Can Do

Depending on whether authority for efficiency standards already exists, states interested in exploring appliance efficiency standards can begin a new standards initiative, upgrade standards for products currently covered by state law, or expand coverage to new products.

Action Steps for States

States that have adopted appliance efficiency standards can conduct the following action steps:

- Assess whether the state has authority to upgrade current standards or set standards for other products. If it has authority, determine appropriate increases in efficiency levels for current standards or appropriate new products and efficiency levels. If it does not have authority, work with policy-makers to assess the benefits of allowing the implementing agency to upgrade standards and set standards for other products.
- Develop a list of products for which standards could be established and conduct an initial assessment of efficiency levels and potential savings. Conduct a rulemaking process to determine the final products to cover and the associated efficiency levels. Encourage active stakeholder participation and use transparent analysis and decision-making procedures.
- Periodically report on program impacts and operations.
- Assess stakeholder communication and participation and revise these processes, if needed.
- Actively promote consumer awareness of appliances for which EISA 2007 directs DOE to set standards.

States that are considering adopting appliance efficiency standards can:

- Review sample legislation, product lists, and analyses available from other states.
- Consult with stakeholders, national and regional associations, and other key parties to conduct preliminary cost/benefit and feasibility analyses.
- Work with policy-makers to determine whether appliance efficiency standards are an appropriate option.
- Actively promote consumer awareness about the energy cost savings and environmental benefits of appliance standards.

Information Resources

Information about States

Title/Description	URL Address
Appliance Efficiency Program. This website provides information and resources on California's appliance efficiency programs, including current regulations, rulemakings, a database of energy efficiency appliances, and background information.	http://www.energy.ca.gov/appliances/
2014 Appliance Efficiency Regulations. This document provides California's appliance efficiency regulations, and related public comments, hearing transcripts, and other information.	http://www.energy.ca.gov/2014publications/CEC-400-2014-009/CEC-400-2014-009-CMF.pdf
California's Appliance Standards: A Historical Review, Analysis and Recommendations, Staff Report. This 1983 report by the California Energy Commission reviews the history of California's appliance standards.	URL not available.
Energy Efficiency Standards: A Low-Cost, High-Leverage Policy for Northeast States. The analysis conducted for this project showed that efficiency standards have very large and highly cost-effective economic, energy, and environmental benefits for states in the Northeast.	http://www.eswaterheater.org/sites/default/files/library/1147/313.pdf
State-Regulated Appliance and Equipment Standards. Overview of the current and federally preempted appliance standards in Oregon.	http://www.oregon.gov/ENERGY/CONS/Pages/StateRegulatedApplianceStandards.aspx
Product Efficiency Standards. Overview of standards from the Connecticut Department of Energy and Environmental Protection.	http://www.ct.gov/deep/cwp/view.asp?a=4405&Q=481608&deepNav_GID=2121#ProductEfficiency
Multi-State Appliance Collaborative. This website has information by state on each state's appliance standards program and information by appliance on relevant state standards.	http://appliancestandards.org/

General Information about Appliance Efficiency Standards

Title/Description	URL Address
The American Council for an Energy-Efficient Economy (ACEEE). The ACEEE website contains many publications and resources on all aspects of energy efficiency, economic development, and environmental concerns.	http://www.aceee.org
ASAP. This group provides information and resources on federal and states appliance standards.	http://www.standardsasap.org

Title/Description	URL Address
Codes and Standards White Paper on Methods for Estimating Savings. This 2005 paper addresses California building and appliance energy efficiency standards, and the role of codes and standards programs as part of utility portfolios of energy efficiency programs.	http://www.cpuc.ca.gov/NR/rdonlyres/6E783BC7-3467-484E-AD2A-29EF4A50432B/0/Mahone_2005_CS_White_Paper_SavingsEstimatingSavings.pdf
Collaborative Labeling and Appliance Standards Program. This program's website provides information and resources on developing countries that are pursuing energy efficiency and labeling programs.	http://www.clasponline.org/
Appliance and Commercial Equipment Standards. This DOE website provides information on state and federal appliance standards.	http://energy.gov/eere/buildings/appliance-and-equipment-standards-program
Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards. This 2006 report describes opportunities for state governments to set minimum-efficiency standards for 18 appliances and other types of equipment currently not covered by federal standards.	http://www.aceee.org/sites/default/files/publications/researchreports/a062.pdf
Northeast Energy Efficiency Partnerships (NEEP). NEEP's website provides information on promoting energy efficiency in the Northeastern United States.	http://www.neep.org
Energy Efficiency Standards: A Low-Cost, High-Leverage Policy for Northeast States. This report provides information about energy efficiency standards in the Northeastern states.	http://www.eswaterheater.org/sites/default/files/library/1147/313.pdf
Realized and Prospective Impacts of U.S. Energy Efficiency Standards for Residential Appliances. 2002 report on a Lawrence Berkeley National Laboratory project that involved developing an analytical framework to estimate energy, environmental, and consumer economic impacts of federal residential energy efficiency standards.	http://eetd.lbl.gov/sites/all/files/realized_and_prospective_impacts_of_us_energy_efficiency_standards_for_residential_appliances_lbnl-49504.pdf
Smart Energy Policies: Saving Money and Reducing Pollutant Emissions Through Greater Energy Efficiency. The report details nine specific policy recommendations that could have a substantial impact on the demand for energy in the United States while also providing positive economic returns to American consumers and businesses.	http://www.aceee.org/sites/default/files/publications/researchreports/E012.pdf
DOE State Energy Program This DOE website provides information and resources on state energy programs.	http://energy.gov/eere/wipo/state-energy-program
Rules, Regulations & Policies for Energy Efficiency. This table, part of the Database of State Incentives for Renewables and Efficiency (DSIRE), summarizes details on federal and individual state appliance standard programs.	http://programs.dsireusa.org/system/program?type=62&

Examples of Legislation

State	Title/Description	URL Address
Arizona	House Bill 2332. This bill sets minimum efficiency standards for 15 products.	http://www.azleg.gov/legtext/49leg/1r/bills/hb2332s.pdf
California	2014 Appliance Efficiency Regulations. This document provides California's appliance efficiency regulations, and related public comments, hearing transcripts, and other information.	http://www.energy.ca.gov/2014publications/CEC-400-2014-009/CEC-400-2014-009-CMF.pdf
Colorado	A Bill for an Act Concerning Energy Efficiency Standards for Specified Devices (House Bill 04-1183). This bill sets minimum energy efficiency standards for 14 products.	http://www.swenergy.org/policy/legislation/2004/colorado/HB-1183.pdf http://www.swenergy.org/policy/legislation/2004/colorado/HB-1183_FactSheet.pdf
Connecticut	An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future (Senate Bill 1243). Establishes the Department of Energy and Environmental Protection and sets minimum performance standards for appliances.	http://www.cga.ct.gov/2011/ACT/PA/2011PA-00080-R00SB-01243-PA.htm
Maryland	State Government—Energy Efficiency Standards (House Bill 1030). This bill, which was enacted in January 2004, provides legislative language for Energy Efficiency Standards for 10 products.	http://mlis.state.md.us/2005rs/billfile/HB1030.htm
Massachusetts	An Act Establishing Minimum Energy-Efficiency Standards for Certain Products (Chapter 139 of the Acts of 2005). This act requires establishment of minimum efficiency standards for five products.	http://www.mass.gov/legis/laws/seslaw05/sl050139.htm
Oregon	An Act Relating to Minimum Energy Efficiency Standards; Creating New Provisions; and Amending ORS 469.229, 469.223, 469.238 and 469.239 (Senate Bill 692). Establishes minimum energy efficiency standards for certain products. Prohibits sale or installation of products that do not meet standards.	https://olis.leg.state.or.us/LIZ/2013R1/Measures/Text/SB0692/Enrolled
Pennsylvania	An Act Providing for Minimum Energy Efficiency Standards for Certain Appliances and Equipment; and Providing for the Powers and Duties of the Pennsylvania Public Utility Commission and of the Attorney General (House Bill 2035). Pennsylvania bill introduced in 2003.	http://www.legis.state.pa.us/CFDOCS/Legis/PN/Public/btCheck.cfm?txtType=PDF&sessYr=2003&sessInd=0&billBody=H&billTyp=B&billNbr=2035&pn=4640
Rhode Island	Energy and Consumer Savings Act of 2005 (S 0540). Rhode Island's appliance standards legislation, signed July 1, 2005.	http://webserver.rilin.state.ri.us/BillText05/SenateText05/S0540.htm
Vermont	Senate Bill 52. An Act Relating to Renewable Energy Portfolio Standards, Appliance Efficiency Standards, and Distributed Electricity (Senate Bill 52). Vermont bill introduced in 2005.	http://www.leg.state.vt.us/docs/legdoc.cfm?URL=/docs/2006/bills/house/S-052.HTM
Washington	An Act Relating to Energy Efficiency (Senate Bill 5098). Washington bill establishing minimum standards and testing procedures for 13 electrical products that are not covered by federal law.	http://apps.leg.wa.gov/documents/billdocs/2005-06/Pdf/Bill%20Reports/Senate/5098.SBR.pdf
United States	Energy Policy Act of 2005.	http://energy.gov/sites/prod/files/2013/10/f3/epact_2005.pdf

State	Title/Description	URL Address
United States	Energy Independence and Security Act of 2007.	http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf

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Title/Description	URL Address
ACEEE. 2001. Overall Savings from Federal Appliance and Equipment Efficiency Standards. American Council for an Energy-Efficient Economy. Accessed June 21, 2005.	URL not available.
ACEEE. 2013. California Appliance Standards. American Council for an Energy-Efficient Economy. Accessed April 2, 2015.	http://database.aceee.org/state/california
ASAP. 2012. The Efficiency Boom: Cashing In on the Savings from Appliance Standards. Appliance Standards Awareness Project. Accessed July 9, 2014.	http://www.appliance-standards.org/sites/default/files/The%20Efficiency%20Boom.pdf
ASAP. 2014. Energy and Water Efficiency Standards Adopted and Pending by State. Appliance Standard Awareness Project. Accessed July 10, 2014.	http://www.appliance-standards.org/sites/default/files/State_status_grid_Feb_21_2014.pdf
Cadmus. 2012. 2010–2012 California Statewide Codes and Standards Program Process Evaluation: Final Report. Accessed July 14, 2014	http://www.calmac.org/publications/SCE-PG%26E_C%26S_Process_Evaluation_FINAL_5-28-12.pdf
CEC. 2013. 2013 Integrated Energy Policy Report. California Energy Commission. Accessed July 16, 2014.	http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF.pdf
CEC. 2014. Notice of Pre-Rulemaking Schedule. California Energy Commission. Accessed. Accessed November 20, 2104.	http://www.energy.ca.gov/appliances/documents/pre-rulemaking_schedule.pdf
CPUC. 2013. Fact Sheet: Energy Efficiency Statewide Codes and Standards Program (2013–2014). California Public Utilities Commission. Accessed July 15, 2014.	http://www.cpuc.ca.gov/NR/rdonlyres/EA5DEB05-AD8F-4D17-9D7B-0C3613A36E49/0/201314Codes_StandardsFactSheet.pdf
DOE. 2015a. Saving Energy and Money with Appliance and Equipment Standards in the United States. U.S. Department of Energy. Accessed March 24, 2015.	http://energy.gov/eere/buildings/downloads/appliance-and-equipment-standards-fact-sheet
DOE. 2015b. Standards and Test Procedures. U.S. Department of Energy. Accessed March 24, 2015.	http://energy.gov/eere/buildings/standards-and-test-procedures
DSIRE. 2014. Connecticut: Incentives/Policies for Energy Efficiency. Database of State Incentives for Renewables and Efficiency. Accessed March 26, 2015.	http://programs.dsireusa.org/system/program/detail/1563
ODOE. 2014. Rulemaking for Appliance Energy Efficiency Standards. Oregon Department of Energy. Accessed July 10, 2014	http://www.oregon.gov/energy/Pages/Rulemaking-Appliance-Standards.aspx
OSL. 2013. Oregon State-Level Benefits from Proposed Appliance Standards in SB 692-2. Oregon State Legislature. Accessed July 15, 2014.	https://olis.leg.state.or.us/liz/2013R1/Downloads/CommitteeMeetingDocument/12182

4.5 Lead by Example

Policy Description and Objective

Summary

State and local governments are implementing a range of policies and programs that advance clean energy within their own facilities, fleets, and operations. These "lead by example" initiatives help state and local governments achieve substantial energy cost savings and greenhouse gas (GHG) reductions while promoting adoption of clean energy technologies by the public and private sectors.

"Lead by example" programs offer states opportunities to achieve substantial energy cost savings within their own operations, demonstrate environmental leadership, and raise public awareness of the benefits of clean energy technologies.

States are leveraging their purchasing power, their control of significant energy-using resources, and the high visibility of their public facilities to demonstrate clean energy technologies and approaches that lower their energy costs and reduce emissions. They also work closely with local governments, schools, colleges and universities, parks and recreation facilities, and other public sector organizations to promote clean energy within their operations. Lead by example programs take many forms, including:

- Incorporating clean energy principles into statewide energy policies.
- Adopting energy efficiency savings goals for existing public buildings.
  - Benchmarking building energy performance using ENERGY STAR Portfolio Manager and identifying under-performing buildings to target for energy efficiency improvements.
  - Assessing the energy efficiency of a building in terms of its design, construction, and energy systems by using the U.S. Department of Energy's (DOE) Asset Scoring Tool.[38]
- Establishing above-code energy efficiency performance standards for new and renovated public buildings.
- Developing and adopting green building standards with minimum energy efficiency requirements for public housing.
- Procuring energy-efficient equipment for public facilities, including implementing "green fleets" programs, using electric vehicles, and establishing electric vehicle charging infrastructure.
- Purchasing and using renewable energy in public facilities.
  - Increasing use of green power through programs such as the Green Power Partnership.
- Developing innovative financing mechanisms, including:
  - Approving legislation enabling state agencies (and local governments) to enter into energy savings performance contracts (ESPCs), which require that the energy savings cover the cost of financing the improvements out of current and future operating budgets.
  - Establishing energy efficiency revolving loan funds to finance improvements in state and local facilities.
  - Establishing commercial property assessed clean energy (PACE) legislation or ordinances that enable repayment of clean energy measures through property assessments.

[38] DOE's: http://energy.gov/eere/buildings/building-energy-asset-score.

- o Creating a statewide master financing program, such as a lease-purchase agreement, that enables government agencies to own the equipment at the end of the lease term.
- o Directing public pension fund trustees and managers to establish energy-efficient investment strategies for real estate and securities portfolios and/or allocate investment funds for energy-efficient and renewable energy technology development.

- Providing technical assistance and training to state and local facility managers and their staff, including:
  - o Developing advanced building design and commissioning guidelines.
  - o Assisting with energy audits and implementation of verified savings using ESPCs.
  - o Building operator certification training.

Substantial energy and cost savings can be achieved through energy-efficient improvements in public facilities. DOE's State Energy Program has implemented energy-efficient retrofits in more than 150 million square feet of state and local buildings, resulting in annual cost savings of more than $250 million (DOE 2014b).

Objective

The objectives of state lead by example programs vary from state to state. They include:

- Serving as a leading component of comprehensive statewide clean energy programs and initiatives, and encouraging action by a broad range of public and private sector organizations.
- Accelerating adoption of clean energy in the marketplace by setting an example and demonstrating cost-effectiveness.
- Sponsoring research, development, and demonstration projects to promote commercialization of early-stage clean energy technologies and practices.
- Educating and informing policy-makers and stakeholders and raising public awareness about the multiple environmental, economic, and energy benefits that clean energy offers.
- Demonstrating cost-effective ways to reduce GHGs and address climate change.
- Achieving cost savings through adoption of energy-efficient technologies and clean generation.

Benefits

Lead by example programs provide direct operational benefits to state and local governments, including:

- Reducing facility operation costs and increasing funding available for non-energy-related expenditures.
- Encouraging clean energy development in the state and region and demonstrating environmental leadership.
- Achieving substantial cost savings through aggregated purchasing of energy-efficient products and green power.

New York's Energy-Efficient State Buildings

New York's Executive Order 88, issued by the governor's office in 2012, establishes a target to reduce energy consumption in state buildings by 20 percent in 2020 relative to 2010–2011 levels.

The order includes requirements such as developing a comprehensive operations and maintenance plan for the state's building portfolio, and performing an energy efficiency analysis in the design phase of all capital project plans. Onsite renewable energy generation may be used as a credit toward meeting the target (New York State Governor's Office 2012).

- Supporting the development of in-state markets for clean energy products, manufacturers, and services (e.g., ESPCs, renewable energy systems manufacturers, installers, energy-efficient product retailers).
- Attracting businesses that commercialize clean energy technologies to their state.
- Understanding how they use energy and where best to focus energy savings efforts.

Many state lead by example programs focus on improving the energy efficiency of equipment and building systems. Programs can achieve additional benefits, however, by purchasing or generating clean power for public facilities. A number of options are available to state and local governments:

- Purchasing green power for public facility consumption.
- Using combined heat and power (CHP) technologies to reduce energy use through higher efficiency.
- Developing onsite clean energy facilities, such as solar photovoltaic (PV), wind, and CHP.
- Using existing government resources for clean power production (e.g., electricity generation from landfill gas, methane recovery at sewage treatment plants, and biomass resulting from tree and garden trimming).

Types of State Lead by Example Programs

While the possibilities for state lead by example initiatives are broad, state lead by example initiatives typically fall into one of the following categories:

- *State clean energy plans.* Several states are incorporating specific clean energy goals and objectives for state facilities in their state energy plans. States that show leadership in this area include California, New Hampshire, and Texas. (See the *State and Local Examples* later in this section.)
- *Energy savings targets.* States also set energy savings goals for existing facilities, typically expressed as percentage targets with calendar milestones (e.g., reducing energy use per square foot by 20 percent by 2010). Several states have enacted legislation to set these targets. For example, in 2012, the governor of Oregon released a 10-Year Energy Action Plan, which set a statewide goal to reduce energy consumption in all state-owned buildings by 20 percent by 2023 (OR 2012). Connecticut, California, Minnesota, New Hampshire, New York, Vermont, and others have also adopted energy savings targets.
- *Energy efficiency performance standards.* A growing number of states and localities are establishing sustainable design principles that incorporate energy efficiency criteria in performance standards for new and renovated buildings and facilities. As of 2013, 16 states have set energy efficiency targets for public facilities (NCSL 2013).
- *Energy-efficient purchasing.* States are setting minimum energy efficiency specifications for a range of products (e.g., appliances, office equipment, green fleets of vehicles that use alternative fuels). In some cases, states establish procurement policies that require vendors to provide them with products that have earned ENERGY STAR certification. Where mandatory low-bid requirements are in place, legislative authority might be required to modify procurement regulations. States that have issued executive orders and/or legislation to require procuring energy-efficient products include Alabama, Arizona, California, Colorado, Connecticut, Delaware, D.C., Hawaii, Illinois, Kentucky, Louisiana,

Iowa's Executive Order 41

Iowa's Executive Order 41 was adopted on April 22, 2005; it directs state agencies to obtain at least 10 percent of their electricity from renewable energy sources by 2010. To satisfy this requirement, agencies may generate their own renewable energy or participate in their utility's green power programs (Iowa DNR 2005).

Maryland, Massachusetts, Michigan, Nevada, New Hampshire, New Jersey, New York, North Carolina, Texas, Vermont, and Virginia.

- *Energy-efficient public housing*. State housing authority programs can promote clean energy in public housing and other residential buildings through measures such as establishing minimum energy performance criteria. For example, the Michigan State Housing Development Authority requires windows, patio doors, and appliances (refrigerators, dishwashers, washers, and room air conditioners) in public housing to be ENERGY STAR qualified (MSHDA 2009).

> In Maryland, the State Agency Loan Program provides 0 percent loans to state agencies for cost-effective, energy-efficient improvements in state facilities. This self-sustaining fund is capitalized with national oil overcharge funds. Since 2007, Maryland's program has provided more than $10.5 million to upgrade lighting, controls, boilers, chillers, and other energy equipment, with projected energy cost savings of more than $32 million (DSIRE 2014).

- *Clean energy generation and procurement.* Purchasing and using renewable energy and clean energy generation for state and local facilities is another way states are leading by example. State and local agencies have established clean energy supply targets that are met through onsite generation or by purchasing green power electricity or renewable energy certificates. An increasing number of state and local governments, including New Jersey, New York, and Iowa, are aggregating electricity demand to purchase green power. States are also identifying opportunities to generate clean onsite power, such as CHP systems, and to use clean onsite generation technologies for backup or emergency power.
- *Innovative financing.* States are developing a wide range of innovative financing mechanisms, including revolving loan funds, commercial PACE financing, tax-exempt master lease-purchase agreements, lease revenue bonds, pension funds, and performance contracting. These mechanisms, used to finance programs to implement energy efficiency improvements in existing buildings, renovation projects, and new state facilities, are usually administered by the state energy office or other lead agency, which coordinates the program across multiple state agencies.
- *Technical support.* Many states lead by example by providing technical assistance, training, and evaluation support to state and local agencies and facility operators. State examples include California's new building design and commissioning guidelines and Oregon's Building Commissioning Program. California's Energy Partnership Program provides a variety of services including conducting energy audits, preparing feasibility studies, and reviewing existing proposals and designs. In Washington, school districts are advised to seek the assistance of the General Administration's ESPC program for energy performance contracts and for project oversight. Missouri has trained more than 100 building operators to Building Operator Certification Level I/II so that they have the requisite knowledge to operate building systems at peak efficiency.

Examples of State and Local Green Power Purchasing Contracting

- In 2010, Delaware entered a cooperative electricity purchase of renewable energy for service to schools, offices, state parks, clinics, emergency responders, and prisons. As of 2013, state and local partners procured more than 80 million kilowatt-hours (kWh) of renewable energy and saved more than $1 million annually (Delaware DFM 2014).
- In 2013, Houston, Texas, signed a 2-year agreement to purchase more than 620 million kWh of Green-e certified renewable energy credits for wind projects annually. This purchase accounts for half of the city's municipal power needs (EPA 2014a).
- Peterborough, New Hampshire, uses 100 percent green power for all of its public facilities through Green-e certified renewable energy credits. Peterborough also plans to increase its use of onsite renewable energy and is currently constructing a solar array to power its new wastewater treatment facility. Once completed, it is expected to be the largest solar array in the state at one megawatt; it will save the town between $400,000 and $800,000 in electricity costs over a 20-year period (EPA 2014a).
- The Cape Light Compact in Massachusetts negotiates lower cost electricity and other benefits for all members, which includes all 21 towns in Cape Cod and Martha's Vineyard. It offers customers green power products with up to 100 percent renewable energy (Cape Light Compact 2014; Connecticut 2009; DSIRE 2012).
- In 2014, Oak Ridge, Tennessee, launched a community challenge to encourage greater participation in the region's renewable energy program, resulting in 5.5 percent community-wide green power use and a participation rate nearly three times the rate at the start of the challenge. Residents, businesses, and the local government used more than 73 million kWh of renewable energy annually, including more than 126,000 kWh of onsite solar power at the Oak Ridge National Laboratory (EPA 2014a).

Designing an Effective Lead by Example Program

Although specific program designs vary from state to state, a number of common elements have helped states develop effective lead by example programs. These include involving multiple agencies and levels of government, identifying funding sources, and leveraging federal and state programs.

Participants

- *Executive branch.* The executive branch plays a key role in lead by example initiatives. Many state governors have issued executive orders that set energy savings targets for existing buildings, define energy and environmental performance standards for new buildings, set fuel economy targets for state-owned or -leased vehicle fleets, create green power purchasing policies, and create efficiency guidelines for purchasing energy-using equipment. Since most lead by example initiatives involve state-owned or -leased property, the executive branch typically has broad powers to change policies and practices involving state facilities, fleets, purchasing operations, and other aspects of state government. New York's Executive Order 88, for example, sets a goal of reducing energy consumption by 20 percent in state-owned and -managed buildings by 2020, relative to a 2010/2011 baseline.
- *State legislature.* In many cases, legislative authority is not needed to launch lead by example initiatives. However, legislative authority may be required when modifying procurement regulations (e.g., to release state agencies from mandatory low-bid requirements when purchasing green power or to enable agencies to enter into

New Hampshire has a master lease program for state facilities that leverages energy savings from current and future operating budgets to cover the financing cost of new equipment. California offers a revenue bond program to provide low-cost financing of alternative energy equipment and for energy and water conservation measures by state and K–12 facilities. While performance contracts are not financing agreements, per se, they can assist with project funding and implementation. In Louisiana, state agencies will be able to issue requests for proposals that essentially follow the performance contract model developed by the state Energy Fund. Colorado passed enabling legislation authorizing performance contracting in the early 1990s, and is now ranked fourth in the United States for energy performance contracts completed by state. As of 2013, Colorado's program had completed $330 million in projects and had $82 million in current performance contracts (Colorado Energy Office 2014).

long-term energy service agreements for performance contracting). For example, Connecticut has used a series of legislative actions to incorporate lead by example principles in its General Statutes, beginning with Public Act 06-187 in 2006, which directed the Connecticut Office of Policy and Management to adopt building construction standards for state facilities that meet or exceed the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design (LEED) Silver rating. This was followed by Public Act No. 07-242 in 2007, which established mandatory efficiency requirements for certain equipment purchased by the state, and Public Act No.11-80 of 2011 established goals for reducing state energy consumption. Most recently, Public Act No. 13-298 was adopted in 2013, allowing the Department of Energy and Environmental Protection to benchmark energy and water consumption of all state-owned buildings larger than 10,000 square feet (DSIRE 2013).

- *State energy offices.* In many states, the energy office develops and administers a range of clean energy programs and provides technical assistance and training to state and local agency staff and facility managers. State energy offices are deeply involved in energy efficiency programs and allocate or oversee more than $7 billion of energy efficiency funds derived from ratepayers and state appropriations each year (NASEO 2015). They often direct efforts to implement state lead by example efforts. State energy offices also work with other state agencies, local governments, school districts, and other public organizations to identify clean energy opportunities statewide.
- *State department of general services and department of the treasury.* One of these agencies typically serves as the custodian of state facilities. It administers state capital construction programs and establishes guidelines for construction, operation, and purchasing practices. For example, the Maryland Department of General Services (DGS) helps Maryland state agencies track energy use and costs, reduce energy consumption, and procure renewable energy and deregulated energy for state facilities. DGS has installed solar panels on four of its own buildings and works with state agencies to develop renewable energy projects (Maryland DGS 2015).
- *State housing and economic development offices.* These agencies may operate a variety of programs, including low- and moderate-income housing and development programs, state mortgage financing programs, and enterprise zone and brownfield redevelopment initiatives. For example, the Iowa Economic Development Authority supports a variety of clean energy programs, including the Economic Development by Gaining Efficiency initiative (a statewide recognition program that engages industrial stakeholders in energy efficiency projects to reduce energy costs), as well as a collaborative effort with the Iowa Department of Natural Resources to streamline the CHP permitting process (Iowa Economic Development Authority 2015).
- *Local governments.* Many local governments have initiated and adopted their own lead by example programs. For example, in Maryland, Montgomery County has developed a green power purchasing program to leverage the buying power of multiple local jurisdictions. Some states work with local governments to educate local officials about these opportunities and to coordinate, pool, and set common criteria for such initiatives. States can also provide financial assistance, education, training, and technical assistance to local governments. For example, the California Energy Commission's (CEC) Energy Partnership Program offers technical assistance to cities, counties, hospitals, and colleges and universities. The program helps these local groups identify energy efficiency improvements in existing buildings and energy-efficient options in new construction. The CEC also helps these groups identify state loans and other financing sources for project installation (CEC 2013).
- *School districts, colleges, and universities.* There are many opportunities to improve energy efficiency and purchase or generate clean onsite power at K–12 schools, colleges, and universities. One option is to use efficiency savings in operating budgets to finance new energy projects, thereby freeing up capital budget

dollars for other uses. In fact, some colleges and universities have found that investing in energy efficiency projects provides better yields than conventional investments such as the stock market. For example, Duke University has used endowment funds to finance energy efficiency and renewable energy projects.

- *Utility energy programs.* Utilities are often responsible for achieving energy efficiency or renewable energy targets established by state legislatures. Utilities that have energy efficiency and onsite generation programs can support a state's lead by example efforts by providing technical assistance to state facility managers and new facility design teams. In some cases, utilities provide funding and incentives to state agencies for clean energy projects. Utilities that administer public benefit funds or that have regulated efficiency acquisition or renewable energy mandates are typically best positioned to provide this kind of assistance.
- *Nonprofit organizations.* Some states designate and work with third-party nonprofit organizations to develop and administer lead by example programs. For example, Iowa established the State of Iowa Facilities Improvement Corporation, a nonprofit corporation that helps agencies implement energy efficiency measures (EPA 2009).
- *State treasurers and public pension fund managers.* The role of pension fund trustees and state treasurers is to provide policy direction for fund managers, who are increasingly looking for opportunities to improve the value of their portfolios. Some state treasurers and public pension fund managers invest in clean energy programs and energy audit investments to identify cost savings. For example, New York State's comptroller established the Green Strategic Investment Program, which commits $500 million over three years to invest in renewable energy and clean technology under the $154.5 billion New York State Common Retirement Fund (New York Office of the State Comptroller 2013).

Funding and Financial Considerations

States sometimes pay for energy efficiency and renewable energy projects with general funds allocated through the budget and appropriations process. Another source of funding is DOE's State Energy Program, which annually allocates Congressional-appropriated funds to 56 states, territories, and the District of Columbia. However, because of fiscal constraints, states are developing new funding approaches for their clean energy investments. One popular strategy involves redirecting the operating budget dollars saved from the utility budget when energy conservation improvements are made and using the savings to pay for the financing of the needed equipment.[39] Several states have adopted innovative funding mechanisms to support lead by example programs, including:

- *Revolving loan funds.* This mechanism involves making loans and re-lending current loan payments to fund new projects. The original capitalization can come from a variety of sources, including system benefits charges and oil overcharge refunds. They are typically low-interest, long-term loans for energy conservation or renewable energy projects. They may cover all capital expenditures or may be on a cost-shared basis. The Texas LoanSTAR (Saving Taxes and Resources) program, described in the *State and Local Examples* later in this section, provides an example of how Texas has structured its loan program. (For more detailed information on revolving loan funds, see Chapter 3, "Funding and Financial Incentive Policies.")
- *Commercial PACE.* PACE is an innovative financing structure that enables commercial and industrial property owners to finance energy efficiency and renewable energy conservation upgrades to buildings.

[39] For example, the South Carolina Energy Office provides a number of resources to help public institutions and local governments use ESPCs. For more information, see http://www.energy.sc.gov/perfcont.

PACE can pay for new heating and cooling systems, lighting improvements, solar panels, water pumps, insulation, and more for almost any property: homes, commercial, industrial, nonprofit, and agricultural. An example is the BetterBuildings Northwest Ohio Challenge. The Toledo-Lucas County Port Authority administers a PACE program that enables virtually every type of building owner to be eligible for fixed rate competitive financing to pay for 100 percent of the high-efficiency improvements to their buildings. The BetterBuildings Challenge has completed 84 projects worth $18 million at an interest rate between 5 and 6 percent (PACE 2015).

- *ESPCs.* The ESPC industry has developed over the past 25 years in response to the need for major new capital investments in energy efficiency, particularly in public and institutional facilities. Energy savings performance contracting is a construction method that allows a facility to complete energy-saving improvements within an existing budget by financing them with money saved through reduced utility expenditures. Facilities make no initial capital investment and instead finance projects through guaranteed annual energy savings. Although only a few states have developed model programs, several states have created enabling legislation helping to develop an industry capable of bringing significant capital investment to state governments. (See Chapter 3, "Funding and Financial Incentive Policies.")
- *Aggregated purchasing contracts for green power.* An increasing number of organizations, including state and local governments, reduce their need for funding by aggregating electricity demand to purchase green power. By combining the electrical needs of a number of agencies, state and local governments can often negotiate lower prices for green power. It is easier to achieve savings from aggregated green power purchases in restructured markets where there are competing energy suppliers.
- *Qualified Energy Conservation Bonds (QECBs) or other public bonds.* Bonds are one of the most common forms of financing used by states because they are a low-cost capital source available to most entities. States may consider using bonds for a variety of clean energy purposes, including financing a specific set of energy upgrades in their own facilities (which can be combined with an ESPC) and/or capitalizing finance programs for public sector energy upgrades (e.g., revolving loan funds; see above). A variety of bonds are available to states for clean energy initiatives. Municipal/public bonds are the most traditional, and there are also federally subsidized-option debt products aimed specifically at supporting clean energy, such as QECBs and Qualified Zone Academy Bonds. States may also wish to partner with state-chartered bond authorities, such as housing finance authorities, which can provide tax-exempt bond financing to nonprofits and industry. A successful example is Massachusetts' "green bond" issuance, the first of its kind, which capitalizes the state's Clean Energy Investment Program.
- *Leasing arrangements*. Leasing energy-related improvements, especially the use of tax-exempt lease-purchase agreements for energy efficiency equipment, allows states to finance retrofits and then use the energy savings to pay for the financing cost. Leases are contracts that allow an entity to obtain (or purchase) equipment or real estate. They are similar to long-term rental agreements where the lessee gets to use the equipment for a period of time in return for regular payments to a third party (lessor). Leases come with a purchase option that can be exercised at the end of the lease period. Leases often have slightly higher rates than bond financing; however, they can be a faster and more flexible tool. States can also establish programs to aggregate lease-purchase financing demand from public entities across the state and issue Certificates of Participation to fund these projects. Participants can then get more attractive rates than they would otherwise have access to and avoid the time and effort required to set up their own individual financing options. Washington's Local Option Capital Asset Lending program is an example.
- *Pension funds.* Some states use pension funds to invest in clean energy projects. Pension fund managers seek a mix of investments that ensure stable returns for their contributors when they retire. Energy cost

savings are captured over a set period to pay off the capital investment, and generate a solid return to the pension fund.

For example, Washington Real Estate Holdings (a real estate manager for the Washington State Investment Board, which manages the state's pensions) completed a $3.5 million energy efficiency upgrade of Union Square that lowered the building energy costs by 40 percent and created 30 jobs for a year (Feldman 2005).

- *Use of life-cycle cost accounting for energy efficiency projects.* Cost-effective energy efficiency investments more than pay for themselves in the form of reduced energy bills over the life of the investment. However, government procurement and capital budgeting practices frequently do not take life-cycle costs into account. Procurement rules (e.g., those applicable to small purchases, such as equipment replacement) often require states to accept the lowest bid, on a first-cost-only basis. Similarly, capital budgeting (e.g., applicable for larger investments such as new buildings or major renovations) often accounts only for the debt service obligations to the government and does not recognize operating budget savings that can more than offset the debt service payments. These practices often result in the rejection of cost-effective energy efficiency investments because the accounting rules do not fully recognize the benefits of these investments.

  To overcome these problems, states have modified procurement rules by 1) specifying minimum efficiency levels for designated types of purchases (such as requiring certain product types to be ENERGY STAR certified) or 2) instituting a life-cycle cost bid procedure, where vendors provide both equipment investment costs and estimated lifetime energy costs for designated equipment types. For capital projects, a similar approach can be used: either requiring projects to meet specified energy performance targets or including life-cycle energy costs in the project accounting analysis.

Interaction with Federal Policies

Several federal programs, described below, provide resources for states as they develop lead by example programs.

DOE Better Buildings Challenge

The Better Buildings Challenge is a voluntary leadership initiative that highlights leaders who have committed to upgrading buildings and plants across their portfolio and providing their energy savings data and strategies as models for others to follow. DOE offers technical assistance and helps Challenge participants create energy efficiency implementation models to support their commitment to measure, track, and improve portfolio-wide energy performance. The Challenge involves, but is not limited to, states, municipalities, commercial businesses, and industrial corporations that make a public commitment to reduce energy consumption in their facilities (DOE 2014a).

ENERGY STAR®

The U.S. Environmental Protection Agency (EPA) offers its ENERGY STAR program to governments, schools, and businesses as a straightforward way to achieve superior energy management and realize the cost savings and environmental benefits that can result. EPA's guidelines for building energy management promote a strategy that starts with the top leadership, engages the appropriate employees throughout the organization, uses standardized measurement tools, and helps an organization prioritize and gets the most from its efficiency investments. The following ENERGY STAR initiatives may offer resources for states as they lead by example.

- *National Building Competition*. This annual "Biggest Energy Loser" competition, first held in 2010, focuses on reducing energy consumption in government buildings, educational and healthcare facilities, and commercial buildings. Between 2013 and 2014, contestants in the 2013 National Building Competition saved more than $20 million and reduced GHG emissions by more than 130,000 metric tons, equivalent to the annual electricity use of nearly 18,000 homes (ENERGY STAR 2014a).
- *Targeted assistance to states.* ENERGY STAR provides targeted information resources, technical assistance, tools, and communications and outreach support to help state and local governments improve energy efficiency within their own operations. ENERGY STAR tools include guidelines for energy management that are helpful to states in improving their energy and financial performance, as well as a Portfolio Manager, which provides tools related to benchmarking, measurement and verification, and investment priorities (ENERGY STAR 2014b).
- *Purchasing and procurement.* As part of its targeted assistance to states, ENERGY STAR provides a comprehensive guide to purchasing energy-efficient products. These purchasing and procurement resources include sample procurement language and energy efficiency specifications for many products. For products not covered under ENERGY STAR, EPA provides links to the DOE's recommended energy-efficient products used by federal government procurement officials (ENERGY STAR 2014c).

EPA Combined Heat and Power Partnership

The CHP Partnership is a voluntary program to reduce the environmental impact of power generation by promoting the use of CHP. The partnership works closely with energy users, the CHP industry, state and local governments, and other stakeholders to support the development of new projects and promote their energy, environmental, and economic benefits (EPA 2014b).

EPA Green Power Partnership

The Green Power Partnership is a voluntary program developed by EPA to boost the market for clean power sources that do not result in the environmental and health risks associated with conventional electricity generation. State and local governments participating in the partnership receive EPA technical assistance and public recognition (EPA 2014d).

DOE State Energy Program

The State Energy Program is a federally funded program administered by DOE that provides funding and technical assistance resources to state energy offices. Many states have used State Energy Program resources to support their lead by example programs and activities (DOE 2005d). It provides funding to states through "formula grants," which are annual grants that states can use for a variety of energy efficiency activities, including lead by example efforts. DOE

CHP Partner: Texas A&M University

EPA's CHP Partnership helped develop a CHP project with Texas A&M University. The system can operate during a power outage to the grid, ensuring that the university can maintain critical operations, such as emergency housing, research facilities, and a veterinary hospital, without grid power. The system produces 45 megawatts of power, while simultaneously providing space cooling, space heating, and hot water to the 5,000-acre campus. Over the last 10 years, the CHP system has reduced the university's energy consumption by 40 percent per square foot and saved $150 million. The system reduces carbon dioxide emissions by 99,600 tons per year, equivalent to the annual emissions of more than 9,000 homes (EPA 2013).

Green Power Partner: Western Pennsylvania Energy Consortium

The Western Pennsylvania Energy Consortium, which won a Green Power Purchasing Award in 2009, seeks to save the city of Pittsburgh and Allegheny County money on their electricity bills. By collectively procuring green power, Consortium members saved nearly 20 percent per unit of green power energy relative to traditional sources. In 2013, the Consortium purchased 42 million kWh of green electricity, 25 percent of its total consumption, in support of Pittsburgh's GHG reduction goals of 20 percent below 2003 levels by 2023. The Consortium also provides guidance for similar organizations across the state of Pennsylvania looking to procure green energy and realize similar cost savings (EPA 2014c).

also awards funding competitively to states to fund innovative projects that are designed to meet DOE's national focus on fundamentally and permanently transforming markets across all sectors of the economy.

DOE Federal Energy Management Program

The Federal Energy Management Program (FEMP) works to reduce the operating costs and environmental impacts associated with federal facilities by advancing energy efficiency and water conservation, promoting the use of onsite generation and renewable energy, and improving utility management decisions at federal facilities. Although the FEMP focuses mainly on federal facilities, it offers online information resources, an annual training conference, and workshops that are available to state and local government energy managers (DOE 2005a). The FEMP website also provides a compendium of energy efficiency purchasing recommendations, interactive energy cost calculators, and other resources to help purchase energy-efficient products (DOE 2003, 2005b).

DOE Building Technologies Office

The Building Technologies Office (BTO) partners with private and public sector organizations to improve building efficiency through the development of innovative, cost-effective energy saving solutions. The BTO conducts work in three key to continually develop these solutions: research and development, market stimulation, and building codes and equipment standards. State and local governments can access and utilize BTO resources, including guidelines, training information, funding opportunities, partnerships, and technical assistance. BTO resources include step-by-step guidance for developing and implementing energy efficiency programs for residential buildings, commercial building design guides and performance data, and case studies (DOE 2015).

Housing and Urban Development Housing and Community Development Programs

The U.S. Department of Housing and Urban Development's (HUD's) Energy-efficient and Green HOME Housing program encourages the use of energy-efficient and environmentally friendly designs and conservation measures. Through the HOME Investment Partnership Program, HUD provides resources to state and localities during the building, buying, and/or rehabilitating of affordable housing. In addition to providing formula grants, HUD also collaborates with EPA and DOE to promote ENERGY STAR qualified housing and provides training and technical assistance on how to conserve energy in HOME-assisted housing (HUD 2015).

Interaction with State Policies

A variety of state programs and policies can be further leveraged by lead by example programs. Key opportunities include:

- *Procurement policies and accounting methods.* Over the last 30 years, some states have modified their public procurement and accounting methods to encourage energy efficiency investments and renewable energy procurements. These innovations include:
    - Permitting long-term contracts, which are often needed for performance contracting agreements.
    - Modifying low-bid requirements, since performance contracts and other energy-saving investments might increase up-front capital costs, but produce lower overall life-cycle costs.
    - Revising leasing regulations, so that private entities can be owners of equipment for tax purposes. This can be key to attracting private investment in public facilities.

- o Modifying budgeting and accounting practices, so that facilities (e.g., schools) are allowed to keep some portion of energy savings from efficiency projects. Otherwise, energy bill savings could simply result in reduced budget outlays in subsequent years and would not encourage facility managers to develop energy efficiency projects.
- o Changing state budget "scoring" rules, so that performance contracting, bond issues, or other debt obligations are treated comprehensively rather than simply as costs. Even though these state obligations are often covered by guaranteed-savings agreements, legislative budget procedures often fail to give them a net savings accounting treatment.
- o Requiring that state facilities procure a percentage of electricity demand from renewable resources.

- *State bonding authority.* States can use public financing mechanisms, such as educational, health, and environmental bond issuance authorities, to help develop clean energy projects or add clean energy features to planned facility bond issues.
- *Air quality planning.* EPA encourages states to use energy efficiency and renewable energy resources to achieve emissions reductions. Some states have developed specific calculation methods for quantifying the contribution that energy efficiency projects can make to emission reduction targets.

  For example, through the Texas Emissions Reduction Plan (also known as "Senate Bill 898"), Texas works with local governments in "nonattainment counties" (those below air quality standards) to reduce electricity consumption by 5 percent per year, in each year from 2011 to 2021.

Important Considerations for Lead by Example Programs

- o *Learn from your peers*. Consult with other states that have implemented lead by example initiatives.
- o *Secure support from leaders and stakeholders*. The support of top-level leadership and key stakeholders can be critical to the successful revision of clean energy practices that affect state-owned facilities and fleets. For example, in some cases it may be appropriate for the governor (and legislature, if enabling laws are needed) to establish overall goals and/or to require specific rule changes. Involving stakeholders in planning can ensure their buy-in and support.
- o *Follow up with administrative support.* While a law or executive order provides the initial structure for lead by example programs, it is also important to design a strong administrative structure. This entails 1) establishing a lead agency with the authority to implement key targets, 2) setting up a coordinating structure among affected agencies to ensure that the agencies remain involved and that targets are met, 3) developing an approach for evaluation of savings, 4) developing an annual reporting system to track progress against goals, and 5) ensuring that funds are available for programs that exceed current staff and budget capacities.
- o *Leverage federal programs.* Review and assess existing federal programs to identify those that provide resources for designing and implementing a lead by example program. For example, the ENERGY STAR program provides energy efficiency specifications for products and building energy performance benchmarking tools.
- o *Review and update the program.* Periodically (e.g., every 5 years or less) review and update the state's efforts to bring clean energy investments to its facilities and fleets. Expand efforts that show success and/or potential for success and revise or eliminate unproductive programs.

Program Implementation and Evaluation

Because states can choose from a wide range of lead by example programs, specific design and implementation approaches might differ by program. For example, state policy-makers may identify one state agency or department to administer and implement their energy efficiency programs and a different agency to lead efforts to encourage onsite generation or renewable energy. While multiple agencies may be involved in program design and implementation, the more successful state efforts typically include a multi-agency coordination structure.

Successful program implementation flows from a sound design, which in turn flows from a carefully developed overall strategy or plan. For example, some states have developed clean energy plans that set targets for percentage reductions in state facility energy use by certain dates, followed by an implementation plan that includes the specific measures, budgets, timetables, and other details needed to reach those targets.

Evaluation

Evaluation of lead by example programs is important in determining the effectiveness of an initiative. While procedures for evaluating lead by example initiatives will vary according to specific project features, the following general guidelines are applicable to all programs:

- *Develop baselines.* Baselines will vary depending on the type of initiative. For existing buildings, current energy use or current building practices define baselines for energy performance. For fleets, estimated current fuel economy averages can serve as baseline data. For procurement procedures, baseline information can be based on product data or efficiency standards.
- *Measure and verify savings.* Develop reporting and database systems as needed to document the energy savings and other benefits of program initiatives (e.g., cost savings, job creation, pollutant reductions, health impacts). DOE's Uniform Methods Project is developing a framework and a set of protocols for determining the energy savings from specific energy efficiency measures and programs. The protocols provide a straightforward method for evaluating gross energy savings for common energy efficiency measures (DOE 2014c). For larger and more complex efficiency projects, a project-specific measurement and verification method might be more appropriate (EVO 2014). For example, eProject Builder is a secure, online tool that enables energy savings performance contractors and their customers to upload and track project-level information and benchmark proposed ESPC projects against historical project data. (For more information, see Section 4.1, "Energy Efficiency Resource Standards"; Chapter 3, "Funding and Financial Incentive Policies"; and Section 4.2, "Energy Efficiency Programs.")
- *Communicate results.* Use monitoring and tracking information to document the energy, economic, and environmental benefits derived from the program. By communicating results and benefits to key audiences, states can document progress toward their lead by example goals and promote the benefits of clean energy, describe recommendations for improvement, and obtain continued support for their programs and projects. Reporting results also enhance transparency and comparability of information while encouraging participation from public and external stakeholders. To enhance visibility and accessibility, states can consider reporting results via a dedicated, public website.
- *Review and reinforce effectiveness.* Many worthy initiatives fade into inactivity after initial efforts are complete. Use evaluation efforts to ensure that innovations result in lasting changes in institutional behavior and become part of the organizational culture.

Best Practices: Implementing Lead by Example Programs

- *Coordinate across state agencies.* Involve multiple parties during the design, implementation, and evaluation stages of program development.
- *Assess energy use.* Identify opportunities for energy efficiency improvements or more efficient generation and assess the potential energy savings from these options.
- *Develop an intervention strategy*. A number of incentives, financing mechanisms, and education/outreach opportunities are available to states seeking to implement lead by example initiatives. States can provide education and training to contractors and vendors that provide associated services (which also supports local economic growth and job creation), provide a comprehensive range of cost-effective options for participants, provide a high-quality customer service experience, and accurately track program activities in a way that facilitates savings measurement. When implementing innovative financing approaches, note that states may need to modify their rules to allow agencies to use certain mechanisms (e.g., performance contracting) or accounting methods (e.g., extended payback periods). (See Chapter 3, "Funding and Financial Incentive Policies," for more detailed information on financing options.)

State and Local Examples

California

The CEC administers several lead by example programs. In addition, local governments participate in state programs and have developed their own lead by example programs.

- *Assembly Bill 758 and American Recovery and Reinvestment Act (ARRA) Funds*. Assembly Bill 758, known as the Comprehensive Energy Efficiency in Existing Buildings Law, requires the CEC to develop a comprehensive program to achieve greater energy efficiency in the state's existing residential and nonresidential building stock that falls significantly below the efficiency required by the current version of Title 24 Building Energy Standards. The law also requires the California Public Utilities Commission to investigate each electrical and gas corporation's ability to provide energy efficiency financing options to their customers for implementing the program. The first phase began with the ARRA of 2009's implementation period (2010–2012). The CEC used ARRA funds ($251 million in total) to finance a portfolio of programs that supported energy efficiency efforts through state and local upgrade programs, workforce training, and financing. Through these programs, more than 14,000 homes and 7,700 nonresidential buildings had energy efficiency retrofits. In addition, more than 10,000 individuals participated in workforce education and training. Overall, evaluation results indicate that energy savings exceeded 184 gigawatt-hours (GWh) and 3.8 million therms annually. Furthermore, 4.2 GWh in annual electricity generation has resulted from the implementation of renewable energy generation projects.

  Websites:
  Assembly Bill 758: http://www.energy.ca.gov/ab758/
  CEC ARRA Programs: http://www.energy.ca.gov/ab758/pilot-programs.html
  Evaluation of CEC ARRA Programs: http://www.energy.ca.gov/2014publications/CEC-400-2014-011/CEC-400-2014-011.pdf

- *PACE.* In July 2008, California amended its state law to enable cities and counties to offer PACE financing programs to property owners. PACE allows private property owners to pay for energy efficiency and renewable energy projects through an addition to their property tax bill, overcoming the high upfront costs that prevent most property owners from investing in such retrofits.

  Financing may be used for improvements to developed property only if the property owner agrees to a contractual assessment (that is, agrees to repay the loan) on his/her property tax bill for up to 20 years. In

California, local governments that have implemented programs using this property tax financing mechanism include:

- CaliforniaFIRST
- California Home Energy Renovation Opportunity (HERO) Program
- Green Finance San Francisco
- Los Angeles County Commercial PACE Program
- Clean Energy Chula Vista
- Placer County (mPower Placer)
- City of Folsom (mPower Folsom)
- Berkeley Financing Initiative for Renewable and Solar Technology
- Sonoma County (Energy Independence Program)
- Western Riverside Council of Governments HERO Program
- San Bernardino Associated Governments HERO Program

Website: General information and list of California PACE providers: http://energycenter.org/policy/property-assessed-clean-energy-pace

- *Senate Bills 77/96 and Assembly Bill 14—California PACE programs.* Senate Bill 77 of 2010 required the California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) to develop and administer a PACE Bond Reserve program to help reduce overall program costs. The bill appropriated $50 million to the authority through January 1, 2015. Due to legal issues raised by the Federal Housing Financing Agency in 2010, many jurisdictions in California put a hold on developing PACE programs; CAEATFA therefore appropriated half of its PACE funding to the Clean Energy Upgrade Financing Program through Assembly Bill 14. Under this program, CAEATFA offers financial assistance in the form of a loan loss reserve to participating financial institutions that provide loans to finance the installation of energy efficiency improvements or onsite generation renewable energy sources on residential properties. The goal of the Clean Energy Upgrade Financing Program is to increase access to retrofit financing by reducing its cost and to grow the number of green jobs in the state.

  In 2013, Senate Bill 96 directed CAEATFA to develop the PACE Loss Reserve Program to mitigate the potential risk to mortgage lenders associated with residential PACE financing. The $10 million Loss Reserve Program will protect mortgage holders from losses associated with a PACE lien on the property.

  Websites:
  CAEATFA PACE Loss Reserve Program: http://www.treasurer.ca.gov/caeatfa/pace/index.asp
  CAEATFA Clean Energy Upgrade Financing Program:
  http://www.treasurer.ca.gov/caeatfa/abx1_14/index.asp
  CAEATFA report on Senate Bill 77: http://www.treasurer.ca.gov/caeatfa/pace/2011.pdf
  Senate Bill 96: http://leginfo.ca.gov/pub/13-14/bill/sen/sb_0051-0100/sb_96_bill_20130911_enrolled.pdf
  Assembly Bill 14: http://leginfo.ca.gov/pub/11-12/bill/asm/ab_0001-0050/abx1_14_bill_20110802_chaptered.pdf

- *California Executive Order B-18-12.* Issued in April 2012, this order requires all new state buildings and major renovations beginning design after 2025 to be constructed as zero net energy facilities with interim targets, and directs agencies and departments to reduce their energy consumption by 20 percent from

2003 levels by 2018. The order requires new and renovated state-owned facilities larger than 10,000 square feet to meet USGBC LEED Silver certification,[40] requires existing state buildings over 50,000 square feet to complete LEED-Existing Building (EB) certification by December 31, 2015, requires new and existing buildings to incorporate building commissioning procedures to improve building operations, and sets procurement policies for ENERGY STAR qualified electrical equipment. The order further instructs the CEC to establish energy use intensity threshold targets to set requirements for commissioning of existing buildings.[41]

Websites:
Executive Order B-18-12: http://gov.ca.gov/news.php?id=17508
Green Building Action Plan: http://www.climatechange.ca.gov/climate_action_team/documents/Green_Building_Action_Plan.pdf

- *Energy Efficiency Financing Program.* Through this program, the CEC provides low-interest loans for public schools, public hospitals, and local governments to fund energy audits and install energy efficiency measures. The CEC offers 0 percent and 1 percent interest rates, depending on eligibility, and the maximum loan per application is $3 million. The interest rates are fixed for the entire length of the loan. The repayment schedule is based on the annual projected energy cost savings from the aggregated projects, and loans must be repaid within 20 years.

  Website: http://www.energy.ca.gov/efficiency/financing/

- *Energy Partnership Program.* The CEC offers this program to help cities, counties, hospitals, and other facilities target energy efficiency improvements for existing facilities and energy-efficient options for new construction. The CEC provides a variety of services, including conducting energy audits, preparing feasibility studies, reviewing existing proposals and designs, developing equipment performance specifications, reviewing equipment bid specifications, and assisting with contractor selection and commissioning. The CEC also helps identify state loans and other financing sources for project installation.

  Website: http://www.energy.ca.gov/efficiency/partnership/

- *Assembly Bill 1103*. Passed in 2007, this bill requires electric and gas utilities to record consumption data for all non-residential customers for at least 12 months. These data can be uploaded to ENERGY STAR Portfolio Manager in case a building owner or operator requests the data. Additionally, the bill requires all non-residential building owners to disclose ENERGY STAR Portfolio Manager benchmarking data and ratings to any potential buyer, lender, or lessee.

  Website: http://www.energy.ca.gov/ab1103/documents/ab_1103_bill_20071012_chaptered.pdf

- *Proposition 39*. This proposition changed the corporate income tax code in order to make up to $550 million available annually for eligible energy projects at California local education agencies. The change went into effect for the 2013–2014 fiscal year and is set to last for 5 years. Under the program, these agencies—including public school districts, charter schools, state special schools, and county offices of education—can submit a proposal and receive funding for projects that upgrade energy efficiency or

[40] USGBC certifies new buildings based on a cumulative 69-point system at several possible levels: Certified (26–32 points), Silver (33–38 points), Gold (39–51 points), and Platinum (52–69 points). Points are based on a variety of criteria, including energy efficiency, ozone impacts, site development impacts, materials choices, and indoor air quality.

[41] The commissioning process for existing buildings is defined as adjusting energy systems to operate at their intended efficiency levels. Commonly referred to as re-commissioning, commissioning of buildings is a periodic check on system performance.

promote clean energy generation. These projects may include new or repaired HVAC systems, lighting, windows, thermostats, or onsite energy generation.

Website: http://energy.ca.gov/efficiency/proposition39/

- *Other local programs.* Local governments in California are actively involved in developing or purchasing clean energy supplies. For example, Yolo County developed a 7-megawatt-capacity onsite solar energy project with the capacity to generate almost 14 million kWh of solar energy, equivalent to 152 percent of the county's electricity needs. As of 2013, this project avoided carbon dioxide emissions equivalent to those of 2,000 passenger vehicles per year. Santa Monica became the first city in the United States to convert to 100 percent renewable energy in municipal buildings. Many other California cities have installed renewable energy systems. For example, the municipal facilities in Tulare, San Jose, and Santa Clara have installed solar PV and biogas fuel cell technology to generate onsite renewable energy.

  Websites:
  Onsite renewable energy generation: http://www.epa.gov/greenpower/toplists/top30onsite.htm
  Green power procurement:
  http://epa.gov/statelocalclimate/documents/pdf/greenpowerprocurement508final.pdf

New Hampshire

The state government is the largest energy user in New Hampshire, with heating, cooling, and electricity costs of more than $22 million annually in 2010. New Hampshire has implemented several projects to measure energy efficiency, track energy savings, and fund related projects for public entities.

- *Executive Order 2011-1.* Under a previous executive order issued in 2005, New Hampshire's state government reduced its energy use by 16 percent per square foot over 5 years. Executive Order 2011-1, issued April 15, 2011, sets a new target to reduce statewide fossil fuel use by 25 percent from 2005 levels by 2025, with interim goals for 2015 and 2020. State staff are required to purchase equipment with an ENERGY STAR rating. Every state agency must also implement a "clean fleets" program to reduce transportation fuel use.

  Website: http://sos.nh.gov/ExecOrderLynch.aspx

- *Executive Order 2004-7.* This order requires the New Hampshire Department of Administrative Services to develop an energy information system, which includes an energy efficiency rating system. State staff were required to conduct an inventory of annual energy use by each of the state's 1,200 facilities starting in 2001 and use EPA's Portfolio Manager to assess each facility's energy efficiency. Procedures for tracking and reporting energy use information by each state department are currently being developed.

  The executive order also authorizes a steering committee to develop an energy reduction goal and plan, a procedure for conducting audits of facilities that score between a 40 and a 60 on the rating system, procurement policies that require ENERGY STAR products, new energy efficiency standards for new construction, and a procedure for commissioning new facilities that ensures adoption of energy-efficient design specifications and equipment operations. The executive order also establishes specific policies for the transportation sector. The order stipulates that all new vehicles purchased by the state must achieve a highway fuel economy of 30 miles per gallon or better and an emissions classification for a low-emission vehicle or better. Other efficiency measures affecting transportation include the purchase of low-rolling-resistance tires, an anti-idling initiative, and the promotion of ride-sharing among agencies.

  Website: http://sos.nh.gov/ExecOrderBenson.aspx

- *Senate Bill 409, Building Requirements for State Funded Buildings*. Passed in July 2010, S.B. 409 requires state buildings or structures that are larger than 25,000 square feet and constructed or renovated with state funding to meet specific energy-efficient and sustainable building design standards. This law went into effect on July 1, 2011.

  Website: http://www.gencourt.state.nh.us/legislation/2010/SB0409.html

Texas

Texas' State Energy Conservation Office (SECO) administers and delivers a variety of energy efficiency and renewable programs in all market sectors, including state and local facilities.

- *Alternative Fuels Program.* This program promotes using alternative transportation fuels in Texas by demonstrating their positive environmental impact, technical feasibility, and energy efficiency.

  Website: http://www.seco.cpa.state.tx.us/transport/alt-fuels/

- *LoanSTAR Revolving Loan Program.* The Texas LoanSTAR Program is SECO's most visible program. As of January 2014, the program had provided more than $395 million in over 237 loans for energy efficiency projects, financed for state agencies, institutions of higher education, school districts, and local governments. The program's revolving loan mechanism allows borrowers to repay loans through the stream-of-cost savings generated by the funded projects.

  Website: http://www.seco.cpa.state.tx.us/ls/

- *Senate Bill 898, the Texas Emissions Reduction Plan.* This bill established a goal to reduce electricity consumption by at least 5 percent each year until 2021, beginning in 2011. This policy imposes new energy efficiency requirements on political subdivisions (i.e., cities and counties) in 41 urban and surrounding counties. The affected political subdivisions must implement energy efficiency measures designed to decrease electric consumption while improving air quality. SECO provides assistance and information to the political subdivisions to help them meet their goals.

  Website: http://www.seco.cpa.state.tx.us/energy-reporting/history.php

- Senate Bill 700, Relating to Energy and Water Management Planning and Reporting by State Agencies and Institutions of Higher Education. The Texas legislature passed this bill in June 2014. The bill requires state agencies and institutions of higher education to set percentage goals for reducing their use of water, electricity, gasoline, and natural gas, and to include those goals in their comprehensive energy plans.

  Website: http://legiscan.com/TX/text/SB700/2013

What States Can Do

States have chosen from a wide variety of approaches and goals in developing their lead by example programs. These programs have reduced energy costs for state agencies, increased funding for non-energy-related expenditures, and helped stimulate development of clean energy projects and resources. States have also used lead by example programs to encourage other organizations to take actions that support clean energy.

Action Steps for States

Based on the best practices and examples of effective state programs described above, states can take the following action steps when developing their lead by example programs.

- Look across the entire government to identify opportunities for the state to lead by example on clean energy. Communicate with state agencies, local governments, schools, and other public sector organizations to identify effective ways to incorporate clean energy into their activities. Engage facility managers and agency staff for program planning, implementation, training, tracking, and evaluation.
- Explore requirements to ensure that cost-effective energy efficiency improvements are implemented in both new and existing buildings, since these have provided a major opportunity for energy savings in many states. This includes:
    - *Standards for new buildings.* Most states require that their new facilities meet the most recent version of the ASHRAE 90.1 standard. However, some states have adopted more advanced standards, such as CEC's Title 24 Building Energy Standards (CEC 2005). Voluntary advanced building energy efficiency guidelines are available from ENERGY STAR and the New Buildings Institute (ENERGY STAR 2015; NBI 2004). Some states have adopted green building standards (USGBC is leading this effort through its LEED certification program; see USGBC 2005). (For more information on building codes, see Section 4.3, "Building Codes for Energy Efficiency.")
    - *Performance targets for existing buildings.* Typical targets have been set at 20 percent reduction in current energy use per square foot of floor area, using a recent base year and setting a compliance date of between 5 and 15 years from enactment of the target.
- Consider procurement policies for products, equipment, and green power.
- Investigate targets for using renewable energy to power state and local facilities, allowing flexibility for different agencies to either develop onsite generation or purchase green power, depending on local conditions. States can also explore opportunities to use CHP at state facilities.
- Develop and enable financing mechanisms. States have developed a range of financing methods, including adoption of legislation or rules that ensure that state facilities can use financing strategies such as performance contracting and revolving loans. (See also Chapter 3, "Funding and Financial Incentive Policies.")
- Offer staffing, technical assistance, and training to facility managers and staff on developing energy efficiency programs. Some states have established accountability structures within and between agencies so that procurement, facility management, and accounting departments are all engaged in a common effort to save energy.
- Ensure that agencies are authorized to use and are using ESPCs and performance contracting to implement energy savings projects in their facilities, if internal sources of project financing are lacking. States can adopt legislation authorizing the use of performance contracting in public facilities.

Information Resources

General Information about State and Local Programs

Title/Description	URL Address
American Council for an Energy-Efficiency Economy: State and Local Energy Efficiency Policy Database. Database of energy efficiency policies implemented at the state and local level across multiple sectors.	http://aceee.org/sector/state-policy
CEC: How to Finance Public Sector Energy Efficiency Projects. Describes strategies and funding sources that public sector agencies can use to finance energy efficiency projects.	http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001A.PDF
CEC: Title 24 Building Energy Standards. Describes the energy standards for residential and nonresidential buildings.	http://www.energy.ca.gov/title24
California Energy Partnership Program. Provides technical assistance to cities, counties, special districts, public or nonprofit hospitals, public or nonprofit public care facilities, and public or nonprofit colleges/universities to improve energy efficiency in new and existing facilities. Helps arrange financing to conduct projects.	http://www.energy.ca.gov/efficiency/partnership/
California Executive Order S-20-04. This order established a goal of reducing energy use in state-owned buildings by 20 percent by 2015 and directs compliance with the Green Building Action Plan, which provides details on how the state can achieve these goals. The commercial sector is also encouraged to comply with these two policies. They require CEC to develop a building efficiency benchmarking system and commissioning and retro-commissioning guidelines for commercial buildings.	Executive Order S-20-04: http://gov.ca.gov/news.php?id=3360 Green Building Action Plan: http://gov.ca.gov/docs/Green_Building_Action_Plan_B.18.12.pdf
California Tier 1 and Tier 2 Energy Efficiency and Sustainable Building Measures Checklists. These checklists ensure that energy efficiency and sustainable building measures are included in new building construction and renovations. Tier 1 checklist items have been evaluated as "cost effective" and must be incorporated into projects when part of the project scope. Tier 2 checklist items may or may not be cost-effective, but should be considered for inclusion. While the checklists include some performance standards, they are primarily prescriptive in nature.	http://www.calrecycle.ca.gov/GreenBuilding/Design/Tiers.pdf
Cape Light Compact. This regional services organization provides energy efficiency programs and aggregated power cost negotiations for its members.	http://www.capelightcompact.org/
Consortium for Energy Efficiency: State and Local Government Purchasing Model Program Plan: A Guide for Energy Efficiency Program Administrators. A step-by-step guide for developing and adopting a successful state and local government procurement program.	http://ncprojectgreen.com/Documents/StateLocalGovModelPP.pdf
Efficiency Vermont. Vermont's statewide energy efficiency utility provides technical assistance and financial incentives to help residents as well as public- and private-sector organizations identify and pay for cost-effective approaches to energy-efficient building design, construction, renovation, equipment, lighting, and appliances.	http://www.efficiencyvermont.com/index.cfm
Energy Efficiency's Next Generation: Innovation at the State Level. A guide for model policy measures for energy efficiency.	http://www.aceee.org/research-report/e031

Title/Description	URL Address
New Jersey Clean Energy Program. The New Jersey Board of Public Utilities administers this program, which provides information and financial incentives to help New Jersey residents, business, and communities reduce their energy use, lower costs, and protect the environment.	http://www.njcleanenergy.com/
New Jersey's Green Power Purchasing Program. This program allows the state to aggregate electricity purchases for 200 facilities and negotiate lower costs.	http://www.state.nj.us/dep/dsr/bscit/GreenPower.pdf
New York Guidelines: Executive Order No. 88 "Build Smart NY" New York State Government Buildings. This document elaborates on the requirements of the Executive Order and provides details on the policies and protocols for implementation.	https://www.nypa.gov/BuildSmartNY/Guidelines.pdf
North Carolina Division of Energy, Mineral, and Land Resources: Energy Section. The Resources for Government Web page describes North Carolina's Utility Savings Initiative, a comprehensive, multi- programmed approach to reducing utility expenditures and resources in state buildings.	http://www.energync.net/home/efficiency/government.html
Commissioning for Better Buildings in Oregon. Provides technical assistance to ensure that building systems are designed, installed, functionally tested, and capable of being operated and maintained according to the owner's operational needs.	http://www.oregon.gov/ENERGY/CONS/BUS/comm/docs/commintr.pdf?ga=t
Oregon SEED. This program provides energy efficiency assistance for new and renovated public buildings.	http://egov.oregon.gov/ENERGY/CONS/SEED/SEEDhome.shtml
Texas A&M Energy Systems Laboratory. This laboratory provides tools, technical assistance, and training to help government and building industry users design and evaluate a wide range of energy savings projects.	http://esl.tamu.edu/

Examples of Legislation and Model Language

State	Title/Description	URL Address
California	Executive Order S-20-04. This executive order establishes energy conservation standards for state-owned buildings and encourages commercial building owners, local governments, and schools to take similar measures.	http://gov.ca.gov/news.php?id=3360
	Energy Efficiency Revenue Bond Program. This website provides official documents from the program.	http://www.energy.ca.gov/efficiency/revenuebonds/
Colorado	Public Energy Performance Contracting. This website provides sample guidance and documents to assist with energy performance contracting.	http://www.colorado.gov/cs/Satellite/GovEnergyOffice/CBON/1251599983018
Connecticut	Chapter 298: Energy Utilization and Conservation. This general statute requires the state Department of Energy and Environmental Protection to establish an energy management plan that maximizes energy efficiency for state-owned and leased buildings.	http://www.cga.ct.gov/2011/pub/chap298.htm
Hawaii	Revised Statutes 196-9. This bill requires newly constructed or substantially renovated state-owned facilities to be built to meet LEED Silver standards.	http://www.capitol.hawaii.gov/hrscurrent/vol03_ch0121-0200d/HRS0196/HRS_0196-0009.htm

State	Title/Description	URL Address
Maryland	Senate Bill 267. This 2006 bill sets energy performance standards in state buildings.	http://mlis.state.md.us/2006rs/bills/sb/sb0267e.pdf
	House Bill 376. This 2008 bill requires new or renovated state and new school buildings to be constructed as high performance buildings.	http://mgaleg.maryland.gov/2008rs/fnotes/bil_0006/hb0376.pdf
New Hampshire	Executive Order 2004-7. Signed in October 2004, the order requires 10 percent efficiency improvement in 1,200 state buildings.	http://sos.nh.gov/ExecOrderBenson.aspx
New York	Executive Order 88. This order directs state agencies and authorities to improve the energy efficiency of state buildings.	http://www.governor.ny.gov/news/no-88-directing-state-agencies-and-authorities-improve-energy-efficiency-state-buildings
Oregon	ORS 276.900-915, State Agency Facility Energy Design. This law established the Oregon SEED program in 1991. SEED helps ensure that state facilities are designed, constructed, renovated, and operated to “minimize the use of nonrenewable energy resources and to serve as models of energy efficiency.”	http://www.oregon.gov/energy/CONS/SEED/docs/AppendixA.pdf
	Senate Bill 1149. Adopted in 1999, this bill restructured the electric power industry and created a Public Purpose Fund to finance specified energy-related capital projects, including building commissioning.	http://energytrust.org/About/PDF/sb1149.pdf
All States	Consortium for Energy Efficiency: Model Energy Efficiency Purchasing Policy. This document includes model language to be used by state and local governments interested in directing agencies to purchase energy-efficient products.	http://ncprojectgreen.com/Documents/StateLocalGovModelPP.pdf

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CEC. 2013. Energy Partnership Program. California Energy Commission.	http://www.energy.ca.gov/efficiency/partnership/index.html
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Connecticut. 2009. EPA Recognizes Connecticut As One of Nation’s Top Green Power Purchasers. March 9.	http://www.ct.gov/governorrell/cwp/view.asp?A=3675&Q=435526

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DOE. 2005c. State Energy Program: Projects by Topic—What Are State and Local Government Facility Projects in the States? U.S. Department of Energy.	http://www.eere.energy.gov/state_energy_program/topic_definition_detail.cfm/topic=115
DOE. 2014a. Better Building Challenge: Frequently Asked Questions (FAQ). U.S. Department of Energy.	https://www4.eere.energy.gov/challenge/sites/default/files/uploaded-files/BBChallengeProgramFAQ_FINAL2_5-8-14.pdf
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DSIRE. 2013. Connecticut: Incentives/Policies for Energy Efficiency: Energy Efficiency Requirements for State Government. Database of State Incentives for Renewables and Efficiency. Accessed July 3, 2013.	http://programs.dsireusa.org/system/program/detail/2390
DSIRE. 2014. Maryland: Incentives/Policies for Renewables and Efficiency: State Agency Loan Program. Database of State Incentives for Renewables and Efficiency. Accessed October 16, 2014.	http://programs.dsireusa.org/system/program/detail/163
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ENERGY STAR. 2014b. State and Local Governments: Tools and Resources.	https://www.energystar.gov/buildings/sector-specific-resources/state-and-local-government-resources

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EPA. 2009. Clean Energy Lead by Example Guide: Strategies, Resources, and Action Steps for State Programs. U.S. Environmental Protection Agency.	http://www.epa.gov/statelocalclimate/documents/pdf/epa_lbe_full.pdf
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EPA. 2014a. Green Power Partnership: Green Power Leadership 2014 Award Winners. U.S. Environmental Protection Agency.	http://www.epa.gov/greenpower/awards/winners.htm
EPA. 2014b. Combined Heat and Power Partnership. U.S. Environmental Protection Agency.	http://www.epa.gov/chp/
EPA. 2014c. 2013 Award Winners: Green Power Leadership Awards. U.S. Environmental Protection Agency.	http://www.epa.gov/greenpower/awards/winners2013.htm
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New York State Governor's Office. 2012. Executive Order No. 88. Directing State Agencies and Authorities to Improve the Energy Efficiency of State Buildings.	http://www.governor.ny.gov/executiveorder/88
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PACE. 2015. PACE Programs: Ohio. PACE*Now.*	http://www.pacenow.org/resources/all-programs/

Chapter 5. Renewable Portfolio Standards

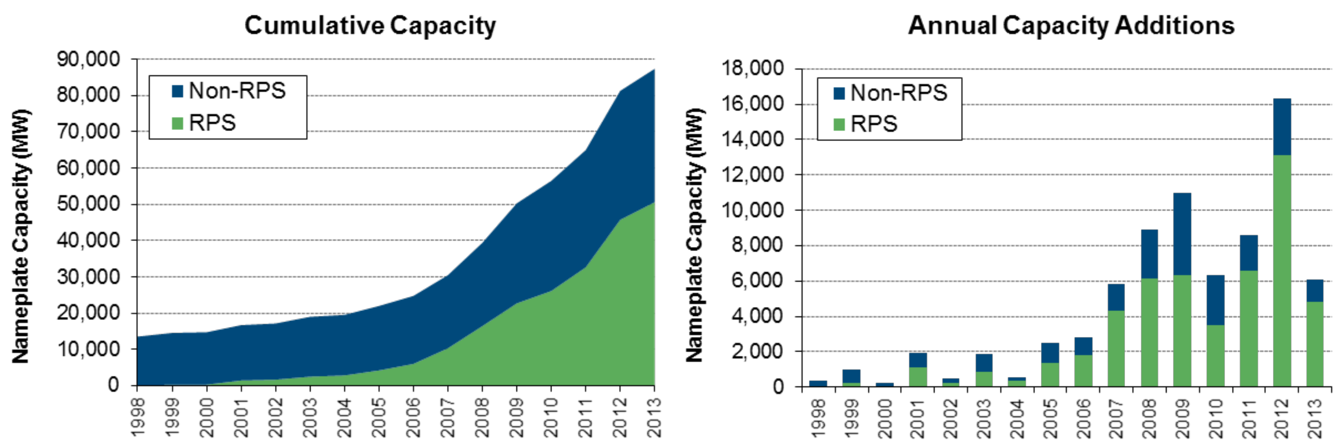
Policy Description and Objective

Summary

A renewable portfolio standard (RPS) requires electric utilities and other retail electric providers to supply a specified minimum percentage (or absolute amount) of customer demand with eligible sources of renewable electricity. As of March 2015, 29 states and Washington, D.C. have established mandatory RPS requirements. An additional eight states have adopted non-binding renewable portfolio goals (DSIRE 2015d).

In 2013, state RPS policies applied to 56 percent of all U.S. retail electricity sales (LBNL 2014). Between 1998 and 2013, 61 percent, or 46 gigawatts, of new, non-hydro[42] renewable energy capacity developed was added in states with existing or pending RPS requirements. While this information is an imperfect metric, it indicates that RPS policies are a key driver for new renewable electric generation facility development in the United States (LBNL 2013).

Figure 5.1: Cumulative and Annual Non-hydro Renewable Energy Capacity in RPS and Non-RPS States, Nationally



Source: LBNL 2014

RPS policies have supported the installation of new wind capacity, which accounted for approximately 78 percent of RPS-motivated renewable energy capacity additions between 1998 and 2012. In recent years, RPSs have also increasingly supported the development of new solar capacity, particularly distributed generation (DG) such as customer-sited solar systems.[43] Seventeen states and Washington, D.C., now include solar or DG-specific targets (also referred to as “set-asides” or “carve-outs”) in their RPS requirements. Outside of California, solar and DG RPS policies drove approximately 60 to 80 percent of all new U.S. solar photovoltaic

[42] Hydropower has historically been the dominant source of renewable energy and there are many hydropower projects across the country. Therefore, when discussing growth in the renewables sector, emphasis is typically given to non-hydro renewables.

[43] DG, also called onsite generation, refers to small-scale, electric-generating technologies installed at, or in close proximity to, the end-user’s location.

(PV) additions since 2005 (LBNL 2014). In some states, RPSs have also supported the development of other renewable sources such as solar thermal electric power, geothermal, and hydropower.

Many states have adopted RPS requirements because they are an administratively efficient, cost-effective, market-based approach to achieving renewable electricity policy objectives. RPS requirements can be used in both regulated and restructured electricity markets. States have tailored their RPS requirements to satisfy particular state policy objectives, electricity market characteristics, and renewable resource potential. Consequently, there is wide variation in RPS rules from state to state regarding the minimum requirement of renewable energy, implementation timing, eligible technologies and resources, and other policy design details.

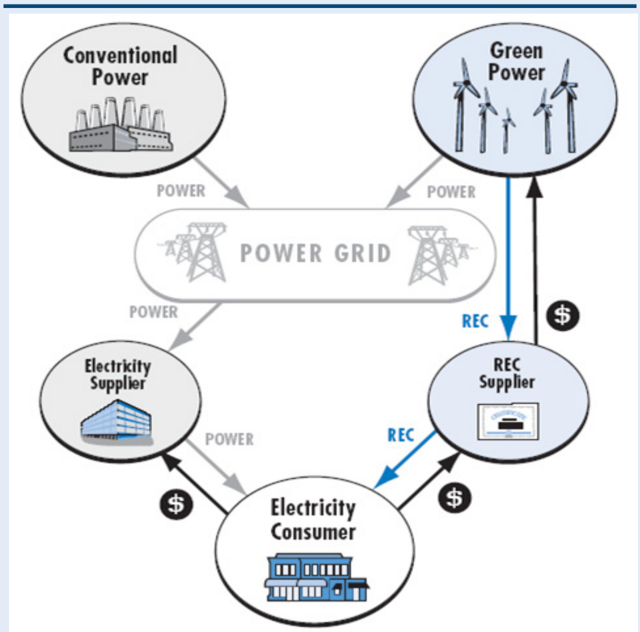
An electricity supplier demonstrates compliance with RPS requirements by one of these three mechanisms:

- Own a renewable energy facility and retain its renewable electricity, including the renewable energy certificates (RECs).
- Purchase electricity and RECs from a renewable facility (sometimes called renewable electricity or bundled renewable electricity).
- Purchase RECs only (sometimes called unbundled RECs).

A REC is a tradable right (separate from the electrical energy itself) to the environmental, social, and other generator attributes associated with 1 megawatt-hour (MWh) of renewable electricity generated by a specific facility. These attributes convey information about the generator, such as: type of resource (e.g., wind), plant-level air emissions (if any), geographic location, nameplate capacity (megawatt [MW]), commercial operation date, ownership, and eligibility for RPS compliance or voluntary market certification. A REC is the basis for demonstrating renewable electricity ownership, procurement, use, and compliance (CRS 2014).

Unlike procuring renewable electricity (bundled electricity and RECs), REC-only transactions are not constrained by the physical delivery of electricity over the power grid. They can therefore be traded between two parties regardless of the location of the generator relative to the utility seeking compliance under an RPS. State RPSs typically limit the eligibility of RECs based on either the location of the generating facility or whether it sells power to the state or to the regional grid. As of January 2014, 35 states and territories allow RECs to satisfy either mandatory RPS requirements or voluntary renewable portfolio goals (CRS 2014).

Figure 5.2: Renewable Energy Certificates Illustrated



Source: DOE and EPA 2010

Objective

States create RPS programs because of the energy, environmental, and economic benefits of renewable energy. Many states have also adopted RPS programs to stimulate market and technology development and to ultimately help make renewable energy competitive with conventional forms of electric power.

Benefits

RPS benefits are the same as those from renewable energy in general:

- Environmental improvement (e.g., less air and carbon pollution, climate change mitigation, waste reduction, habitat preservation, conservation of water and other valuable natural resources).
- Increased diversity and security of energy supply, with greater reliance on domestic, regional, and in-state resources.
- Reduced volatility of power prices given the stable (or nonexistent) fuel costs of renewables.
- Local economic development resulting from new jobs, taxes, and revenue associated with new renewable capacity (NREL and LBNL 2014).

An RPS can function in both traditionally regulated and competitive state electricity markets. Furthermore, states often find that RPS requirements provide a cost-effective approach to achieving energy and environmental goals. Because RPS compliance is market-based, an RPS typically leads to development of the most cost-competitive forms of renewable energy (currently wind power in most cases), unless the RPS includes features that also encourage higher cost renewable technologies. Finally, because it is market-based, an RPS can achieve its policy objectives efficiently and with relatively modest impacts on customer bills.

States with RPS Requirements

Tremendous diversity exists among state RPSs with respect to the minimum requirements of renewable energy and implementation timing (see Tables 5.1 and 5.2), as well as eligible technologies and resources. Although no new states have enacted RPS requirements since 2009, states with existing RPS policies have continued to refine their rules to reflect new technology, resource, and policy considerations that have changed over time. Between 2007 and 2013, 24 states passed major revisions to existing RPS policies. For example, 11 states have added solar and/or DG set-aside requirements since 2007 (LBNL 2013).

Many of the early RPS laws emerged as part of state deregulation of the electricity sector. However, states that are not deregulated have adopted RPS requirements while addressing other policy concerns, such as rising natural gas and coal prices or climate change. To date, 13 states and Washington, D.C., have enacted RPS requirements as part of restructuring legislation,[44] and 16 states have enacted RPS requirements under traditional utility regulation (NREL and LBNL 2014).

[44] A restructured market is defined here as one in which "the traditional electric utility monopoly, where the utility provides generation, transmission, and distribution, has been split. Customers in restructured states can choose which electric service company will supply their generation." The following states are thus counted as operating in restructured markets: Connecticut, Delaware, Illinois, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Texas, and Washington, D.C. (NREL and LBNL 2014).

Table 5.1: Mandatory State RPS Requirements

State	Main Target	Solar or DG* Target
AZ	15% by 2025	4.5% customer-sited DG by 2025 (half from residential)
CA	33% by 2020	
CO	30% by 2020 (IOUs) 10% by 2020 (co-ops and large munis)	IOUs: 3% of the 2020 requirement DG by 2020 (half customer-sited) Co-ops: 0.75 to 1% DG by 2020 (depending on size) Various credit multipliers available
CT	27% by 2020	IOUs must solicit 15-year contracts for ZRECs and LRECs from customer-sited facilities of up to 1 MW (ZRECs) and 2 MW (LRECs), within certain annual budgets.
DC	20% by 2020	2.5% solar by 2023
DE	25% by 2026	3.5% solar by 2025, 3x multiplier for solar installed before Jan. 2015
HI	40% by 2030	
IA	105 MW	
IL	25% by 2025	1.5% solar PV by 2025 1% DG by 2015 (50% <25kW)
KS	20% by 2020	
MA	22.1% by 2020 New renewable energy: 15% by 2020 (+1%/year after)	1,600 MW by 2020
MD	20% by 2022	2% solar by 2020
ME	30% by 2000 New renewable energy: 10% by 2017	
MI	10% and 1,100MW by 2015	3x multiplier for solar
MN	25% by 2025 (Xcel: 31.5% by 2020)	1.5% solar by 2020 (IOUs)
MO	15% by 2021	0.3% solar electric by 2021
MT	15% by 2015	
NC	12.5% by 2021 (IOUs) 10% by 2018 (co-ops & munis)	0.2% solar by 2018
NH	24.8 % by 2025	0.3% solar electric by 2014
NJ	20.38% by 2021	4.1% solar electric by 2027
NM	20% by 2020 (IOUs), 10% by 2020 (co-ops)	4% solar electric by 2020, 0.6% customer-sited DG by 2020
NV	25% by 2025	1.5% solar by 2025, 2.4x multiplier for PV until 2015

Table 5.1: Mandatory State RPS Requirements

State	Main Target	Solar or DG* Target
NY	29% by 2015	0.58% customer-sited by 2015
OH	12.5% by 2026	0.5% solar electric by 2026
OR	25% by 2025 (large utilities) 5-10% by 2025 (smaller utilities)	20 MW solar PV by 2020 2x multiplier for PV installed before 2016
PA	18% alternative energy by 2021	0.5% solar PV by 2020
RI	16% by 2020	
TX	5,880 MW by 2015	2x multiplier for all non-wind
WA	15% by 2020	2x multiplier for DG
WI	~10% by 2015 (varies by utility)	

Co-op= cooperatively owned utility; GWh= gigawatt-hour; IOU= investor-owned utility; kW= kilowatt; LREC= low emission renewable energy certificate; munis= municipally owned utility; MW= megawatt; Xcel=Xcel Energy; ZREC= zero emission renewable energy certificate

*The solar or DG targets may be part of the renewable energy targets or in addition to the renewable energy targets in the Target column. It varies by state.

Sources: LBNL 2013; DSIRE 2015d, 2015e

Table 5.2: Voluntary State Renewable Portfolio Goals

State	Target	Comments
AK	50% by 2025	RPS to be developed
IN	10% by 2025 (includes non-renewable alternative resources)	
ND	10% by 2015	
OK	15% by 2015	
SD	10% by 2015	
UT	20% by 2025	Extra credit for solar or customer-sited renewable energy
VA	15% by 2025	Extra credit for solar or customer-sited renewable energy
VT	Renewable energy meets any increase in retail sales by 2012 20% renewable energy and CHP by 2017	Even though utilities are required to contract with renewable generators, purchase of RECs is not required.

CHP= combined heat and power

Source: DSIRE 2015d

Designing an Effective RPS

There are several key elements states consider in designing effective RPS requirements. These elements include stakeholders, goals and objectives, program applicability, resource assessments, resource and technology eligibility, program structure, and administration. The discussion that follows reflects lessons learned from states' experiences in developing and implementing RPS requirements. In addition, this section provides insights on interactions of the RPS requirements with other state and federal policies.

Stakeholders

A number of organizations can actively participate in designing RPS requirements. While state legislatures and utility commissions play a central role in designing policy and regulations, it is important to include other stakeholders who are impacted by RPSs in the RPS design process. The role of each of these stakeholders is detailed below:

- *State legislatures/governors.* Typically the state legislature enacts legislation to mandate RPS requirements. However, in some states, legislation is not always necessary to introduce RPS requirements. For example, Colorado, Missouri, and Washington adopted RPS requirements by state ballot initiatives. In New York and Arizona, the utility commissions established RPS requirements under their existing regulatory authority by adopting administrative rules. Governors sometimes also play an active role in shaping RPS-related policies.
- *State public utility commissions (PUCs).* A state's PUC or other state agency is generally tasked with establishing the detailed rules governing RPS requirements. In crafting detailed RPS rules, state agencies follow the enabling legislation's intent and requirements but must sometimes resolve technical and policy issues that can influence the program's effectiveness.
- *Renewable electricity generators.* The efforts and ability of renewable energy developers to build new generating facilities are critical to the success of RPS requirements. Therefore, the legitimate commercial needs of these generators are an important component of the design phase. These needs can be addressed by facilitating long-term contracts, streamlining permitting processes, etc., so that generators have more certainty in the financial success of renewable projects.
- *Utilities.* Whether operating in restructured electricity markets or in traditionally regulated states, utilities are usually the entities on which RPS obligations fall. Ensuring that utility needs are addressed (e.g., recovery of compliance costs associated with RPS requirements) is vital in making RPS requirements effective.
- *Competitive electric service providers (ESPs).* In states that support retail electric choice, competitive ESPs that provide generation service to customers are usually subject to RPS requirements. Administrative feasibility, flexibility, and compliance provisions are key concerns of many ESPs.
- *Other agencies*. In some cases, states have carved out specific roles for other agencies, while the state PUCs retain overall RPS responsibilities. For example, the New York State Energy Research and Development Authority (NYSERDA) administers New York's RPS. Similarly, in 2007, the Illinois state legislature created the Illinois Power Agency to oversee procurement of RPS requirements for investor-owned utilities supplying electric service to 100,000 customers or more (DSIRE 2015b).
- *Other stakeholders.* Developing RPS rules has involved numerous other stakeholders, including state and local government officials, environmental organizations, ratepayer advocates, labor unions, trade associations, project developers, and others.

Goals

States often have multiple RPS goals, such as benefitting the environment, developing local economies, hedging fossil fuel price risks, and advancing specific technologies (NREL 2007). Depending on their goals, states may have broader “clean energy standards,” requirements that encompass more than just renewable energy. Some requirements, such as those in Pennsylvania and Ohio, are called alternative energy portfolio standards. They may have a separate tier or target for non-renewable technologies that the state wants to support, but sometimes renewable and non-renewables (e.g., fuels cells and combined heat and power [CHP]) qualify within the same tier.

Similarly in some states, energy efficiency may be eligible to satisfy an RPS, again sometimes as a separate tier (as in Connecticut) or in direct competition with renewables (as in North Carolina, though it is currently limited to a maximum of 25 percent of the target). CHP is often eligible as an efficiency resource.

Regardless of the scope, these goals can serve as a guide to design choices for RPS requirements. It is important, therefore, to clearly articulate these goals and objectives during rule implementation and to ultimately produce the best RPS design for the state.

Applicability

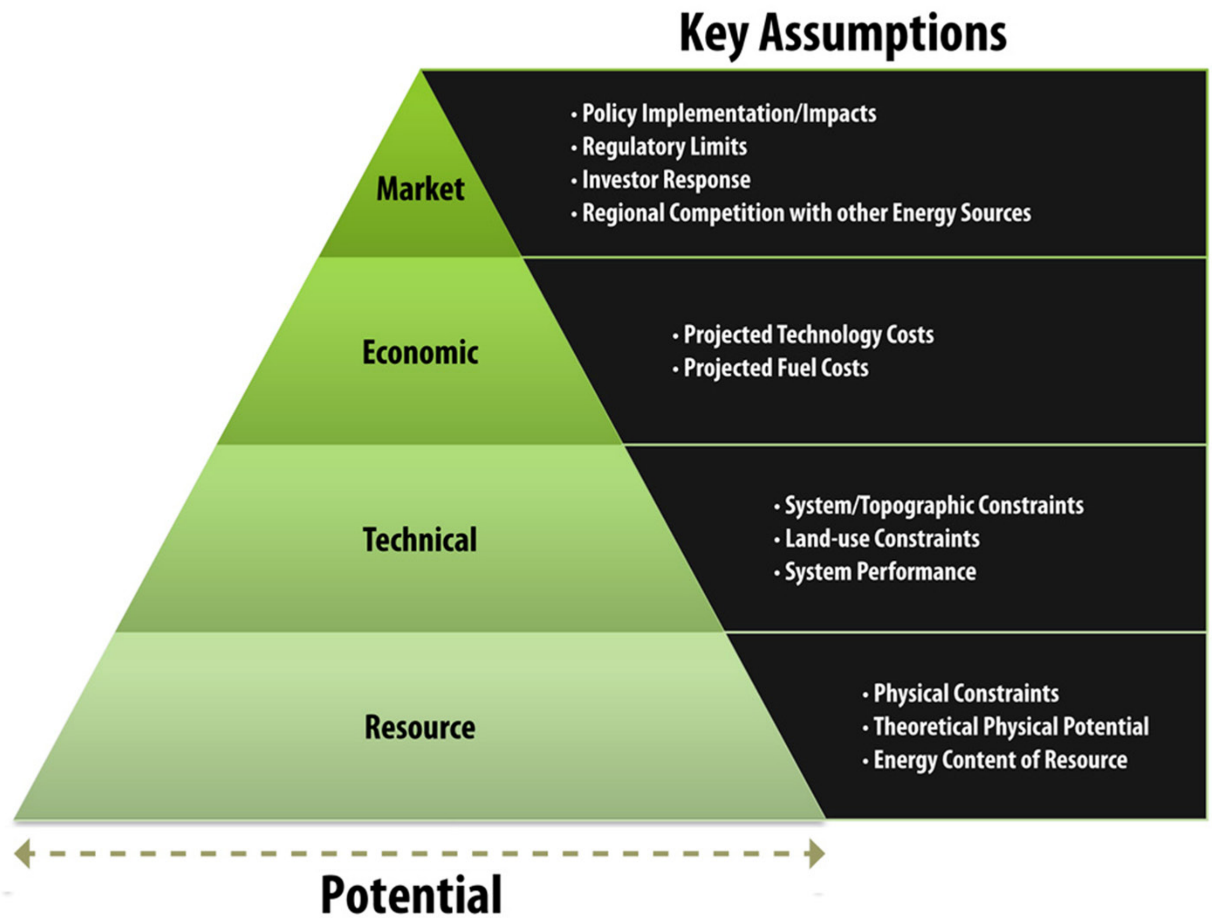
A common RPS policy element is determining the applicability of the requirements to utilities and ESPs. Some states have exempted municipally and cooperatively owned utilities from RPS requirements if they are not regulated by the PUC. Other states have adopted separate RPS requirements for municipally and cooperatively owned utilities, despite them being predominately self-regulated. For example, the Colorado, Washington, Oregon, and North Carolina RPS rules include specific requirements for municipally and cooperatively owned utilities (DSIRE 2015d).

States may also determine applicability by utility size, for example, exempting smaller utilities regardless of how they are governed or regulated. Some states allow certain customer loads to opt out of the RPS, thereby avoiding cost recovery and reducing the utility load to which the RPS targets apply. For example, Texas allows customers that receive electric service at transmission-level voltage to opt out, and Maryland allows industrial process load to opt out. Some states, such as Colorado, allow municipally or cooperatively owned utilities to opt in to the common RPS requirements.

Assessing Renewable Energy Resource Potential

States can use existing information to assess renewable energy resource potential for development in their state or region. For instance, the National Renewable Energy Laboratory (NREL) has developed maps and tools to conduct renewable energy resource assessments at the state, national, and international level (NREL 2013b). Assessments are available by renewable energy resource (e.g., solar energy) and technology type (e.g., solar PV and concentrating solar power) as well as potential under a range of assumptions (e.g., technical, economic). Using recent assessments will inform many of the necessary decisions in designing an effective RPS.

Figure 5.3: Defining Potential



Source: NREL 2012

Resource and Generator Eligibility

States with successful RPSs have ensured that a resource or technology's eligibility aligns with the objectives of the RPS. States need to address different topics during the process of defining resource and technology eligibility:

- *Technologies and fuel.* Which fuel sources and energy production technologies will be eligible? Some fuel sources are universally accepted (such as wind and solar PV), with almost no technology or project limitations. Other fuels have sometimes been excluded (e.g., municipal solid waste), or conditioned upon qualifying project technologies (e.g., run-of-river hydroelectric), project scale (e.g., small hydro), or project performance characteristics (e.g., low emission biomass combustion).

Eligible technologies may also include concentrating solar thermal, geothermal, ocean thermal, tidal and wave energy, and landfill gas. There are many states that consider CHP systems as a qualifying technology; however, they differ in their eligibility criteria.[45]

- *Existing versus new.* How are renewable resources built prior to the establishment of RPS requirements to be treated? Do they count toward RPS compliance or not? States have typically set a date to establish which renewable resources are eligible based on project commissioning. Some state rules are designed to prevent existing renewables from capturing additional revenues related to the RPS, which could increase ratepayer costs. However, other states may have an interest in ensuring there is some support for renewables already operating, and may therefore develop separate technology carve-outs within the RPS requirement for existing and new renewables.
- *Geographic eligibility and deliverability.* In which geographic area must the resources be located to be eligible under RPS requirements (e.g., energy generation just within the state or energy generation within a regional power market)? Does it suffice for a renewable project to deliver into the broader regional transmission organization (RTO)/independent system operator (ISO) that serves the state? RPS requirements and other policies in neighboring states may also affect this decision. For instance, many Mid-Atlantic state RPSs allow out-of-state resources to contribute, so long as they deliver into the broader PJM network. This allows developers to consider projects in the Midwest, where resources may be more cost-effective. Strict in-state eligibility requirements may raise legal concerns under the Interstate Commerce Clause (ICC), which prohibits states from favoring local industry to the disadvantage of out-of-state competitors (CESA 2011).[46]

Structure

While RPS requirements vary and program designs continue to evolve, experience with some program elements to date have identified best practices for structuring RPS requirements. These structural elements include:

- *Amount of renewable energy.* A key element of an RPS is the size of the renewable energy target. As shown in Tables 5.1 and 5.2, program targets vary from 10 to 40 percent and are influenced by many factors, including a state's goals, renewable energy potential, and definition of eligible technologies and resources. Sometimes siting, public acceptance, and balance of system capabilities (e.g., transmission capacity) also influence the amount of renewable energy that can ultimately be accessed. A number of states have increased their targets after the initial adoption of an RPS. The ramp rate for achieving the ultimate RPS target is also important. Every state will have unique economic, environmental, and policy factors that lead to the creation of a best-fit approach. States have found that since there are no absolutes, the keys to success are careful analysis and modeling of the expected impacts before establishing the targets.

[45] In a number of states, CHP of all fuel types qualify while in others (e.g., Arizona) only renewably fueled CHP qualifies. Some portfolio standards, however, only recognize certain fuel-type CHP systems. Some standards define CHP system characteristics, such as power-to-heat ratios, cost-effectiveness thresholds, and eligibility requirements for systems to be installed before or after specific dates (EPA 2013).

[46] While court interpretation may vary depending on the specific situation, these cases demonstrate the importance of carefully considering geographic eligibility requirements when drafting RPS policies. In 2010, TransCanada Power Marketing sued the state of Massachusetts in federal district court, claiming that implementation of the state's RPS violated the ICC. Although the parties reached agreement out of court, the lawsuit raised concerns about the constitutionality of certain geographic eligibility provisions in state RPS requirements. Other legal cases have continued to raise ICC concerns; some have been resolved and others are still pending (CESA 2014). See CESA (2011) for policy recommendations on how to avoid RPS conflicts with the ICC.

- *Targeted support among eligible resources.* States may have policy interests in promoting particular renewable energy technologies and deployment locations to advance market competitiveness or other social, economic, or environmental objectives (NREL 2007). Technology tiers (also known as "carve-outs" or "set-asides") and credit multipliers are the primary approaches used to meet these objectives. A technology tier establishes a specific target for the subset of technologies or resources within that tier, sometimes "carved out" of the overall RPS obligation and sometimes in addition to the main tier targets. These eligible technologies may be viewed as crucial for renewable policy objectives but may be less competitive due to higher cost, greater technical difficulty, or other market barriers. For example, New Jersey has a solar tier that requires that 4.1 percent of retail sales be supported by solar electric generation by 2028.

  The most common resource tier approaches taken to date include: 1) separate tiers for new and existing resources; 2) separate tiers differentiated by broad groups of eligible technologies or fuel types; and 3) a separate carve-out or tier for a specific technology, fuel type, or location (such as solar, customer-sited DG, offshore wind, or renewables sited on eligible landfills or brownfields). With respect to customer-sited projects, states should address whether RECs will be procured in exchange for a rebate, by a separate payment for REC value, or via a solar renewable energy certificate (SREC) market. In any case, states should be very clear and unambiguous about whether the utility or the customer has rights to the RECs and under what circumstances.

- *Time horizon.* Adequate time is required to establish, implement, and create new renewable electricity facilities and markets. Therefore, RPS requirements with sufficiently long timelines will enable markets to develop. They will also provide project developers and investors time to plan and recover capital investments. RPS requirements typically start at modest levels and ramp up over a period of 10 to 20 years from the first year of compliance to the year the ultimate target is reached. Most states also require that once reached, the target percentage or capacity be maintained indefinitely. RPS requirements that persist will inspire confidence among developers and financiers.

- *Energy versus capacity.* Most states have chosen to base RPS targets on percentage of retail energy sales (MWh) rather than installed capacity (MW). While targets based on retail sales are straightforward to calculate because energy is measured by a common denominator (MWh), there is less certainty on the actual target itself as future retail sales are uncertain. Moreover, calculating percent of retail sales can involve several questions about what basis to use for retail sales (e.g., use retail sales from the current year, the previous year, or some other historical baseline year). Conversely, while there is more certainty on a capacity-based target, the actual output for each MW can vary widely depending on the technology type; therefore, the share of renewables in the generation mix can vary from year to year. Currently, Iowa and Texas have capacity-based targets in their RPSs. Kansas also has a capacity-based target, although the capacity is based on peak demand and can therefore fluctuate from year to year. Massachusetts has an energy-based RPS target, but also has a capacity-based carve-out for solar.

- *Mandatory or voluntary.*[47] While the longevity of RPS requirements is crucial for project financing, developing new renewable energy projects also depends on instilling investor confidence in the REC market and other trading mechanisms related to RPS requirements. To create investor confidence that demand will be more predictable and certain, most states use an RPS or mandatory structure with financial consequences for noncompliance. A renewable portfolio goal that is not enforced may do little to provide investors with sufficient assurance that financial returns will be adequate to invest in new renewable

[47] Strictly speaking, an RPS is a mandatory target with potential financial penalties for noncompliance. However, there are states that have well-defined voluntary renewable portfolio goals (see Table 5.2).

facilities, especially when renewable energy options are more expensive than conventional power supplies. In addition, compliance obligations that apply to the broadest possible group of retail sellers, including both default service providers (distribution utilities) and competitive energy service providers, will increase demand for renewable resources.

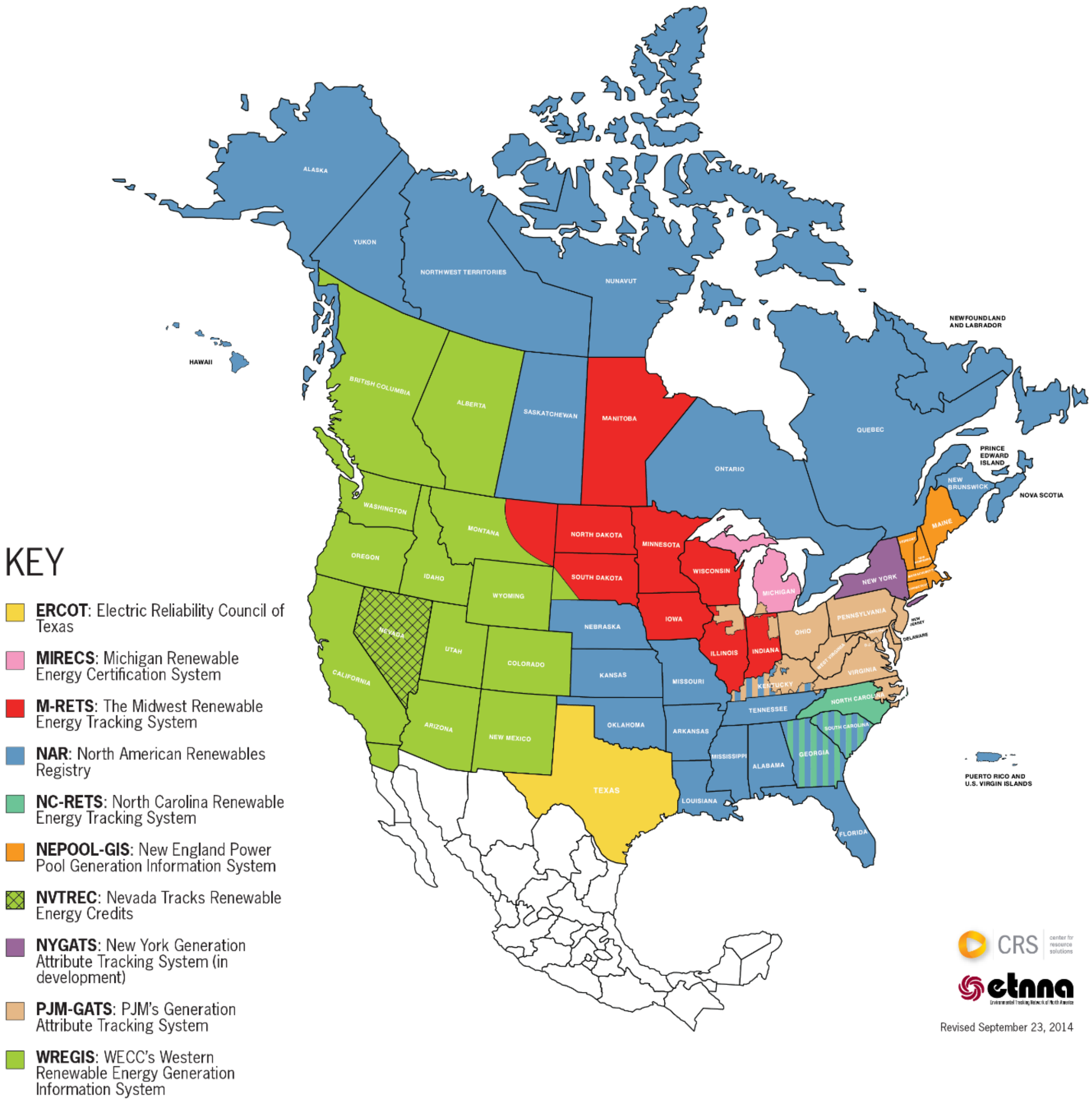
Administration

When considering how the RPS requirements will be administered, some key issues include:

- *Planning and reporting compliance strategy*. Under traditional regulation, PUCs can require utilities to submit RPS compliance plans in advance to demonstrate that they are on track to meet their renewable requirements. Moreover, making such plans public will allow stakeholders to provide their input on compliance strategies, so as to ensure that RPS goals are being met and that the least cost options are being pursued.
- *Accounting.* For RPS compliance, it is important to accurately and regularly account for the renewable energy generated and delivered to consumers. Most states require affected utilities to file an annual report demonstrating compliance, which is usually shown by ownership and retirement of RECs issued by state or regional tracking systems.[48] (See Figure 5.4 for a map of existing tracking systems.)
- *Enforcement*. Enforcement options are numerous, but a number of states use an alternative compliance payment, especially in restructured states. Under such a policy, if a retail supplier cannot meet its RPS obligation by acquiring the renewable electricity or RECs, the supplier must pay a per-kilowatt-hour (kWh) charge for the shortfall. Alternative compliance payment rates vary, generally ranging from 1 to 6 cents per kWh, with higher amounts for solar-specific RPS requirements (e.g., up to 52 cents per kWh in Massachusetts, but declining by 5 percent annually). These may or may not be recoverable in rates, depending on the state treatment. Some states "recycle" payments to support energy efficiency and renewable energy development. In Ohio, the cost of alternative compliance payments is not recoverable by the utilities (a true penalty), while costs may be recovered in other states. States without alternative compliance payment options can usually enforce compliance with financial penalties, which are explicit in some states and discretionary in others.
- *Flexibility mechanisms.* Because retailers may face difficulties in complying with a renewable energy purchase obligation, many states provide flexibility mechanisms for retailers. For instance, there may be uncertainty about when a project may come online due to lengthy permitting processes or doubt about how well the project will actually perform. These mechanisms can allow a retail supplier to receive credit for renewable energy generated before the compliance date (e.g., credit for early compliance, forward compliance banking, REC banking) and some flexibility when compliance is not met by the specified date (e.g., deficit banking, true-up period). Similarly, allowing for multi-year compliance periods also provides more flexibility to utilities without compromising RPS end goals. The alternative compliance payment, discussed above, is also a flexibility tool.

[48] Before issuing RECs, the tracking systems verify generator characteristics and the amount of electricity generated from each. Once issued, RECs may be traded from one party to another. REC ownership gives the owner the right to use it for RPS compliance or for other purposes. The tracking systems provide reports to utilities or others who can use them to substantiate RPS compliance claims. For more on tracking systems, see: http://www.epa.gov/greenpower/gpmarket/tracking.htm; http://www.cesa.org/assets/2014-Files/RECs-Attribute-Definitions-Hamrin-June-2014.pdf; and http://www.resource-solutions.org/pub_pdfs/Tracking%20Renewable%20Energy.pdf.

Figure 5.4: North American Certificate Tracking Systems



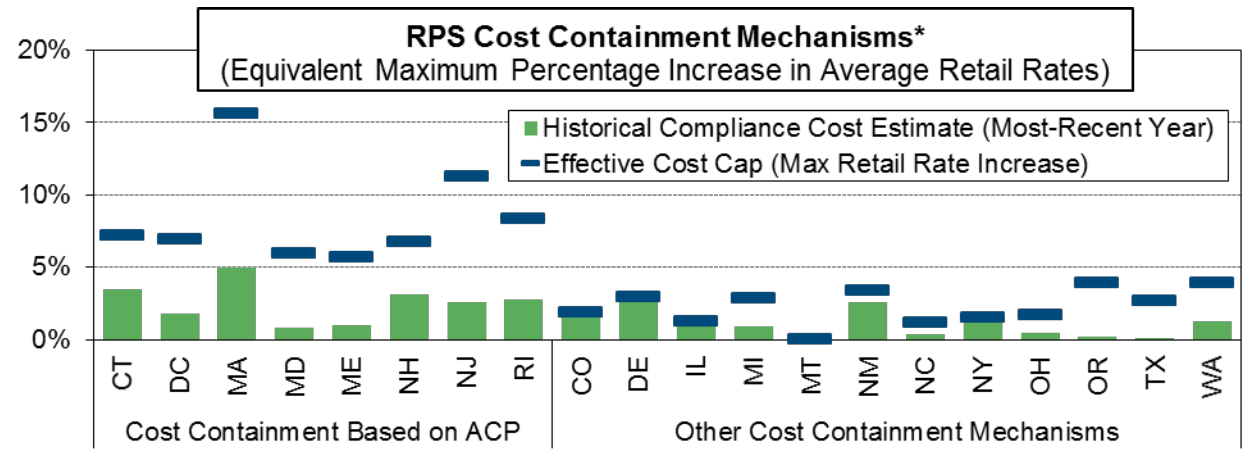
Source: ETNNA 2014

- *Cost recovery.* Retail suppliers will likely incur costs to comply with RPS requirements by buying RECs, developing renewable generation, or entering into power purchase agreements (potentially at above-market rates). Therefore, RPS requirements generally have a mechanism to enable the utility to pass eligible costs on to retail customers via existing rate structures or by a new surcharge to utility bills.
- PUCs do not regulate competitive retail supplier rates; therefore, suppliers will need to recover their costs through the prices they charge to their customers who are subject to competitive market conditions. In many RPS states, the cost of alternative compliance payments may be recovered in utility rates or in

competitive retail supplier electricity prices. However, in some states, cost recovery depends on whether these costs were prudently incurred. In Ohio, alternative compliance payments are not recoverable.

- *Cost caps.* In response to concerns over the impact of RPS policy costs on consumers, many states have adopted cost caps to place an upper bound on ratepayer impacts. These cost caps may be set as a percent increase in retail rates, a percent of utility revenue requirements, or as a cap on the increase in consumer monthly bills (NREL and LBNL 2014). Cost caps may also take the form of an alternative compliance payment. By setting a price that suppliers can pay in lieu of acquiring the renewable energy or RECs, the alternative compliance payment functions as a cap on retailers' exposure to potentially high renewable energy prices. When used, alternative compliance payments typically reflect an inadequate supply of eligible renewables with regard to RPS requirements and can generally be recovered from the customers by regulated utilities. Effective caps are usually low enough to limit ratepayer impacts, but high enough to encourage renewable energy development (see Figure 5.5).

Figure 5.5: Most States Have Capped Rate Impacts Below 10 Percent and Many Below 5 Percent



** For states with multiple cost containment mechanisms, the cap shown here is based on the most-binding mechanism. MA does not have a single terminal year for its RPS; the calculated cost cap shown is based on RPS targets and ACP rates for 2020. "Other cost containment mechanisms" include: rate impact/revenue requirement caps (DE, KS, IL, NM, OH, OR, WA), surcharge caps (CO, MI, NC), renewable energy contract price cap (MT), renewable energy fund cap (NY), and financial penalty (TX). Excluded from the chart are those states currently without any mechanism to cap total incremental RPS costs (AZ, CA, IA, HI, KS, MN, MO, NV, PA, WI), though some of those states may have other kinds of mechanisms or regulatory processes to limit RPS costs.*

Source: LBNL 2014

A recent analysis of RPS ratepayer impacts found that estimated RPS compliance costs were roughly equal to less than 3 percent of average retail electricity rates (LBNL 2014). It is important for states to perform such analyses in conjunction with the design of an RPS to ensure that the renewable energy target is not set too high, which would result in higher costs.

Interaction with Federal and State Programs and Policies

RPS programs will be more effective if they are reinforced by complementary federal and state programs and policies. Being aware of these programs and policies, their goals, and how they might affect RPS requirements will help states design their RPS. They will avoid implementation pitfalls by assessing in advance how RPS requirements would interact with both state and federal policy.

Interaction with Federal Programs and Policies

- *Federal tax credits.* Federal corporate tax credits, such as the renewable energy production tax credit (PTC), the business energy investment tax credit (ITC), and the Modified Accelerated Cost Recovery System (MACRS), offer financial incentives to renewable energy developers for qualifying forms of renewable energy. The basis for these credits and incentives differ. The PTC provides an inflation-adjusted per-kWh tax credit for electricity generated by qualified energy resources. The ITC provides a tax credit based on a specific percentage of expenditures on eligible systems. The MACRS provides the basis for depreciation deductions for certain renewable energy properties (DSIRE 2015a). The PTC has been extended mostly in 1- to 2-year intervals since first enacted and has lapsed several times. These lapses resulted in significant decreases in project completions during those periods (AWEA 2014). Both the PTC and the ITC are important to the economic feasibility of many new projects that supply state RPSs, and are therefore critical to meeting RPS goals. It is up to Congress whether to renew these frequently debated policies.
- *Transmission facility extension costs*. Transmission line extensions can be costly for remotely sited projects. Without affordable transmission, renewable energy projects are unlikely to be built, and RPS supply may go unmet. Whether transmission line extensions (and the projects they serve) get built may depend on the allocation of transmission costs. In determining who pays for the build-out of transmission, policy-makers judge whether line extensions provide societal benefits, such as reliability, and therefore might justify socializing the costs, or whether the developer is the principal beneficiary, which suggests that the developer alone must shoulder the costs. Although siting transmission is a state issue, how to allocate transmission costs is within FERC's jurisdiction. States can communicate their position on the need for the projects both to the RTO (or control area operator) and to FERC. Regarding cost allocation, regulators should be prepared to question cost allocation recommendations, to consider whether new renewable projects provide system benefits or only project benefits, and to allocate costs accordingly.

Interaction with State Programs and Policies

- *State, local, and utility financial incentives.* Most states or utilities offer incentives for renewable energy development, particularly for customer-sited renewable projects, because they have a hard time competing with utility-scale projects on cost. For instance, since distributed solar is relatively more expensive than other forms of renewables, states often use financial incentives (such as tax exemptions, rebates, or production-based payments or credits) to support small to moderate-sized solar projects. This support can be in addition to DG or solar carve-outs that are included in the RPS. In adopting incentive programs, states should be clear about who owns the RECs (the customer that owns the project or the state/utility that provided the incentive) and should pay attention to whether the additional incentives go further than necessary to create a level playing field. Websites such as http://www.dsireusa.org and http://www.cleanenergystates.org track such individual state and utility renewable energy incentive policies for the entire country.
- *Long-term contracting.* In states with traditional utility regulation, utilities are typically responsible for long-term planning and they have a long-term outlook. However, the rules differ in states with a restructured electricity sector. In many cases, uncertainty about future loads means that default service providers and competitive retail suppliers might not be willing to enter into long-term contracts for renewable electricity or REC purchases. This limits the ability of renewable energy developers to secure project financing, which typically requires a sufficient long-term revenue stream to ensure adequate debt coverage ratios used by project financiers. Some restructured states have addressed this problem by directing distribution utilities to enter long-term purchase agreements through competitive solicitations; if approved by the PUC prior to contract execution, cost recovery will be assured. Getting new projects built

will increase the supply of renewable energy for RPS compliance, and increasing supply will help lower the price of RECs and the cost of RPS compliance. To learn how this might work, states can review other states' policies that encourage or require long-term contracting, such as Maine, Massachusetts, and Rhode Island.

- *Interconnection standards.* Smaller-scale DG projects are sometimes subject to the same, frequently lengthy and costly, interconnection procedures as larger projects even though their system impact is likely to be significantly less. If interconnection procedures are overly expensive in proportion to the size of the project, they can overwhelm project costs to the point of making clean DG uneconomical. In some states, each utility may have different interconnection requirements for similar projects, creating a challenge for developers of multiple small projects. Standard interconnection rules establish uniform processes and technical requirements that apply to utilities and proposed projects within the state. Removing these barriers to DG makes it easier to meet RPS DG or solar targets. States may wish to revisit or update their interconnection requirements to ensure that they are appropriate and consistent for projects of similar size. For more information, see Section 7.3, "Interconnection and Net Metering Standards."
- *Emissions regulations.* Some states have expressly prohibited eligible RPS resources from selling emission allowances or credits they obtain through state environmental incentive programs. Many other state RPS rules are silent about the interaction between emission rules and RPS requirements. Uncertainty and confusion, and potentially double claims, may result. Generally, RPS requirements are intended to produce environmental benefits. A clear statement of policy with respect to avoided emissions, emission reductions and allowances, would reduce the likelihood of double counting these benefits. Since most states require RECs for RPS compliance, it is important to know what environmental attributes must be included with a REC. States can remove uncertainty and make explicit their policy intention by carefully defining the environmental attributes of a REC. Distinguishing clearly between direct, plant-level emissions (zero for most renewable sources), on the one hand, and emission allowances or avoided emissions, on the other, would be helpful.
- *Voluntary green power programs and double claims.* Efforts to encourage renewable energy purchases by electricity consumers are intended to increase renewable energy sales beyond the levels mandated by RPS requirements. If this voluntary demand is also counted towards satisfying a mandatory RPS, consumers' voluntary demand will diminish because voluntary buyers want their purchase to have an effect that is above and beyond what is required by law or regulation. As a result, many states prohibit counting voluntary demand toward RPS compliance. Additionally, double counting voluntary demand will result in lower effective amounts of renewable energy being supported by RPS requirements. As a result, many states prohibit double counting: RECs used to satisfy an RPS may not be counted towards any voluntary program or product. States can review their RPS rules to make sure that voluntary demand is not counted for RPS compliance, and that double claims are prohibited. For example, the New Jersey RPS rules specifically prohibit the sale of RECs used for RPS compliance in voluntary green power programs, and vice versa (NJCEP 2014).

Examples of RPS Design Choices and Approaches

Many innovations and best practices can be found in state RPSs, some of which have already been described. The following are a sampling of additional noteworthy elements in these rules. State cases are shown in the *State Examples* section later in this chapter.

- *REC tracking.* Texas was the first state to adopt the use of RECs to verify compliance and develop an efficient renewables market. Texas regulators also saw RECs as complementary to their efforts at restructuring the broader electricity market. State RPS rules now commonly use RECs for RPS compliance, as well as REC tracking systems for verification and avoiding double-counting. State REC use also supports environmental claim verification in voluntary markets.

- *Stakeholder review.* After Massachusetts adopted legislation mandating RPS requirements, the Massachusetts Department of Energy Resources (DOER) conducted an extensive stakeholder consultation process and commissioned a wide-ranging analytical review of design issues related to RPS requirements. This review process led to the creation of 12 white papers on key RPS requirement topics with important insights and analytical support for eventual design choices. DOER engaged stakeholders in a similar process during the development of the state's SREC I Solar Carve-Out in 2009–2010, and the SREC II Carve-Out in 2013–2014.
- *Technology tiers.* In 2001, Arizona was one of the first states to adopt a technology tier approach in its RPS. At the time, Arizona mandated that at least 50 percent of renewable energy requirements come from solar electric sources as of 2001. The state increased that number to 60 percent by the 2004–2012 timeframe. Although Arizona has since made significant revisions to this policy, a number of states have followed their example and have used technology tiers in subsequent development of RPS requirements. For example, 17 states and Washington, D.C., currently have technology tiers for solar generation or DG as a component of their RPS requirements (LBNL 2013).
- *RPS policy goals*. California's RPS goals include improved public health and environmental quality, as well as reduced burning of fossil fuels and the associated environmental impacts. These goals are linked to California's definition of a REC and its environmental attributes, including all credits, benefits, emissions reductions, offsets, and allowances directly attributable to the eligible generation.
- *Long-term perspective*. New Mexico has provided a long-term, stable investment environment by extending the final year's target of 20 percent by 2020 "and thereafter," so that investors will not face a demand cliff as the RPS target approaches its zenith.
- *Cost caps*. In Colorado, RPS costs may not exceed 2 percent of the total electric bill annually for each customer. Michigan has expressed its cost caps as a fixed dollar amount per month, differentiated by customer class. Both are calculated as the incremental cost of compliance.

Best Practices: Designing an RPS

The best practices identified below will help states design an RPS. These best practices are based on the experiences of states that have RPS requirements.

- Assess renewable energy potential that is available for development under a range of assumptions.
- Develop broad support for an RPS, including top-level support from the governor and/or legislature.
- Clearly articulate all RPS goals and objectives, since these will drive RPS rules and structure.
- Specify which renewable energy technologies and resources will be eligible, driven by the stated goals and objectives. Also consider state and regional resource availability if a goal/objective is to encourage resource diversity through a technology tier. Then, determine the mix and amount of renewable energy desired.
- Finally, consider using energy generation (not installed capacity) as a target, establish a long timeline to encourage private investment, make compliance mandatory for all retail sellers, make enforcement credible, allow utility cost recovery, establish cost caps, and consider flexible compliance mechanisms.

Implementation and Evaluation

This section provides an overview of the implementation and evaluation of RPS requirements.

Roles and Responsibilities of Implementing Organizations

States enacting RPS requirements (e.g., the state legislature) designate one agency as the primary implementation authority. A number of agencies and organizations will likely be involved in the implementation regardless of which agency is named as lead. These include:

- *State PUCs.* PUCs will be involved in enforcing RPS requirements and overseeing cost and ratepayer issues.
- *State energy offices.* These offices, or similar State Public Benefit Corporations (e.g., NYSERDA) and quasi-public agencies (e.g., Massachusetts Clean Energy Center or Connecticut Green Bank), may provide financial support for new facilities and may also be responsible for siting new projects. They can also be actively involved in developing administrative rules based on legislation and are often required to conduct evaluations and provide reports to the legislature, sometimes with recommendations on possible revisions. These agencies may also be involved in "making the market" by supporting emerging REC markets and administering renewable energy funds that are targeted toward enhancing compliance with RPS requirements.
- *ISOs.* ISOs (e.g., Energy Reliability Council of Texas or RTOs) may support REC tracking systems by providing data on generation and loads; they may also support markets for renewable energy generation.

Evaluation

Periodic evaluation of RPS requirements is key to their success (CESA 2012, 2013). The enabling legislation for RPS requirements sometimes includes provisions for annual or periodic evaluation and reporting of progress. Massachusetts, for example, requires an annual report.

While scheduled policy evaluations are important, experience has shown that altering RPS policy midstream without sufficient justification or consistency with the original legislative intent can hinder the program. The danger is that if long-term certainty and stability in the policy are lacking, project developers and regulated retail providers may delay plans and projects and fail to deliver the RPS's intended results.

Best Practices: Implementing an RPS

The best practices identified below will help states implement an RPS. These best practices are based on the experiences of states that have implemented an RPS.

- Identify the most appropriate lead agency or organization for RPS implementation authority.
- Establish a transparent and easy-to-use accounting system for compliance.
- Provide retail suppliers with some flexibility in their compliance.
- Make sure a credible noncompliance enforcement mechanism is in place.
- Conduct a mid-course performance review and make modifications if warranted and consistent with the RPS's original intent.

State Examples

The following state examples illustrate the diverse types of RPS design approaches, policy objectives, and implementation strategies that states have deployed. Each example highlights a particular design issue or policy objective.

California

Increasing Targets by Building on Earlier Successes

In 2002, California set its initial RPS target at 20 percent by 2017. However, the state later accelerated that target to 20 percent by 2010. In 2009, the state instituted a 33 percent standard by 2020 through executive order, later codified in law (CPUC 2015). In 2015, the governor proposed a revised target to 50 percent by 2030.

Massachusetts

Differentiating New from Existing Renewable Resources

Massachusetts has two separate renewable targets: Class I for new resources and Class II for existing resources. The Class I target is set at 15 percent by 2020 and will increase by 1 percent each year thereafter. Eligible resources for Class I must have an online date after December 31, 1997, whereas resources operating prior to that date fall under Class II. By assigning separate tiers for new and existing resources, the state encourages the development of new renewables while also acknowledging and providing some support to existing renewables (DSIRE 2015c).

New Jersey

Requiring a Separate Target for Solar

Even though the state RPS target for New Jersey is 20.38 percent by 2021, it also has a separate target requiring solar resources to meet an additional 4.1 percent by 2028. The separate technology requirement has created a market specifically for RECs from eligible New Jersey solar resources. Given that the price of solar is higher than most forms of renewables, New Jersey SREC prices are also considerably higher than other New Jersey RECs. Therefore, the solar tier allows the state to target its support for solar without distorting the broader REC market (LBNL 2010).

Rhode Island

Determining Eligibility by Delivery of Electricity to the Greater Region

The Rhode Island RPS requires eligible generation units to be located in the New England Power Pool (NEPOOL) control area. However, generation units in an adjacent control area can also qualify if the energy they produce is delivered into NEPOOL for consumption by New England consumers. Therefore, a renewable generator in New York could qualify as an eligible unit under the Rhode Island RPS if it can deliver into the NEPOOL control area to which Rhode Island belongs (RI PUC 2015).

Wisconsin

Supporting Non-Electrical Technologies in its RPS

Wisconsin's RPS lists a few non-electrical technologies as eligible resources, specifically solar water heaters; solar light pipes; ground source heat pumps; and installations that generate output from biomass, biogas, synthetic gas, densified fuel pellets, or fuel produced by pyrolysis. The state also has regulations that direct how eligible RECs can be issued from these resources that do not produce electricity (WI PSC 2012).

What States Can Do

Action Steps for States

RPSs accelerate the development of renewable and clean energy supplies. Benefits include a clear and long-term target for renewable energy generation that can increase investors' and developers' confidence in the prospects for renewable energy. States have chosen from a wide variety of approaches and goals in developing their RPS requirements. The best practices common among these states have been explored above. Action steps are outlined below.

States with existing RPS requirements have made it a priority to identify and mitigate issues that might adversely impact the program's success. The longevity and credibility of the RPS requirements is crucial for investment in new renewable projects. More specifically, states with existing RPS requirements can:

- Monitor the pace of installing new renewable projects to ensure that the renewable resources needed to meet RPS goals will be in place. If adequate resource development is lagging, identify the reasons for any delay and explore possible mitigation options. For example, lengthy siting and permitting policies for renewable projects often present obstacles to successful RPS implementation.
- Monitor utility and retail supplier compliance and the impact on ratepayers. Any significant, unanticipated adverse impacts on ratepayers can be addressed by implementing or adjusting cost caps or other appropriate means.
- Evaluate the scope of eligible technologies and, as needed, consider adding eligible technologies or altering the percentage requirements. At the same time, it is important to recognize that long-term stability and policy certainty are important; frequent changes may undermine the success of RPS requirements.

Broad political and public support for establishing renewable energy goals have been an important part of establishing RPS requirements. Many states have found that after establishing general support for goals, it is helpful to hold facilitated discussions among key stakeholders regarding appropriate RPS design. More specifically, states that do not have existing RPS requirements can:

- Establish a working group of interested stakeholders to consider design issues and develop recommendations for RPS requirements.
- Analyze costs and benefits as they did in New York and Texas.
- Publicize RPS goals as they are reached to ensure that state officials, public office holders, and the public know that the RPS requirements are working and achieving the desired results.

Related actions that states can take include:

- Consider the need for additional policies or regulations that will help make RPS requirements successful. Transmission-related policies have been critical to the success of large wind farms that are some distance from load centers and require transmission line extensions or upgrades. Determining the preferred way to allocate the cost of transmission upgrades or interconnections can impact a state's ability to meet its RPS goals.
- Consider adopting (or improving) policies that facilitate customer-sited clean DG projects, especially if specific DG targets have been adopted.

Information Resources

General Information

Title/Description	URL Address
Evaluating Experience with Renewables Portfolio Standards in the United States. This document provides an analysis of U.S. experience with RPSs, including lessons learned.	http://emp.lbl.gov/sites/all/files/lbnl%20-%2062569.pdf
State-Federal RPS Collaborative. The collaborative serves a forum for dialogue and cooperation among state and federal government officials and other stakeholders involved in the implementation of state RPS policies. The Collaborative publishes reports and papers related to RPS policy and design.	http://www.cesa.org/projects/state-federal-rps-collaborative/ http://www.cesa.org/projects/state-federal-rps-collaborative/rps-publications/
REC Definitions and Tracking Mechanisms used by State RPS Programs. This State-Federal RPS Collaborative report provides an overview of individual state REC definitions and compares state and regional REC tracking systems.	http://www.cesa.org/assets/2014-Files/RECs-Attribute-Definitions-Hamrin-June-2014.pdf
The State of State Renewable Portfolio Standards. This State-Federal RPS Collaborative report highlights achievements of RPS policies, the strengths and weaknesses of RPS policies, and potential challenges to RPS policy success in the future.	http://www.cesa.org/assets/2013-Files/RPS/State-of-State-RPSs-Report-Final-June-2013.pdf
Projecting the Impact of State Portfolio Standards on Renewable Energy and Solar Installations. This PowerPoint presentation estimates and summarizes the potential impacts of existing state RPSs on renewable energy capacity and supply, and of state RPS solar set-asides on solar PV capacity and supply.	http://www.ilsr.org/wp-content/uploads/files/images/solarestimates0105.ppt
Real Energy Solutions: The Renewable Electricity Standard. This fact sheet from the Union of Concerned Scientists provides an overview of a renewable energy standard (RES). An RES can diversify our energy supply with clean, domestic resources. It will help stabilize electricity prices, reduce natural gas prices, reduce emissions of carbon dioxide and other harmful air pollutants, and create jobs—especially in rural areas—and new income for farmers and ranchers.	http://www.ucsusa.org/clean_energy/smart-energy-solutions/increase-renewables/real-energy-solutions-the.html
Renewable Electricity Standards at Work in the States. This fact sheet from the Union of Concerned Scientists gives an overview of some state RESs. In a growing number of states, RESs—also called RPSs—have emerged as an effective and popular tool for promoting a cleaner, renewable power supply.	http://www.ucsusa.org/clean_energy/smart-energy-solutions/increase-renewables/renewable-electricity-1.html
Renewable Portfolio Standards. This NREL website provides a background on RPSs, implementation issues, design best practices, and additional resources.	http://www.nrel.gov/tech_deployment/state_local_governments/basics_portfolio_standards.html
A Survey of State-Level Cost and Benefit Estimates of Renewable Portfolio Standards. This NREL report surveys and summarizes existing state-level RPS cost and benefit estimates based on information provided by electric utilities and state regulators.	http://www.nrel.gov/docs/fy14osti/61042.pdf
State Clean Energy Practices: Renewable Portfolio Standards. This NREL report examines the key factors that impact state RPS outcomes and provides an overview of critical issues and solutions among early adopter states.	http://www.nrel.gov/tech_deployment/state_local_governments/pdfs/43512.pdf

Title/Description	URL Address
Renewable Portfolio Standards Resources**.** This website is a clearinghouse for RPS-related work published by the Lawrence Berkeley National Laboratory, including PowerPoint presentation updates on the current status of RPSs in the United States as well as data files and analysis.	http://emp.lbl.gov/rps

Information about Federal Resources

Title/Description	URL Address
EPA CHP Partnership. This is a voluntary program that seeks to reduce the environmental impact of energy generation by promoting the use of CHP. The Partnership helps states identify opportunities for policy developments (energy, environmental, economic) to encourage energy efficiency through CHP. The Partnership can provide information and assistance to states considering including CHP or waste heat recovery in their RPS requirements.	http://www.epa.gov/chp/
EPA Green Power Partnership. This program provides assistance to renewable generators in marketing RECs and helps educate potential REC buyers about resources. The Partnership may be of assistance to states that employ RECs as a compliance measure for their RPS requirements but also allow for purchase and retirement of RECs for organizational “green power” designation.	http://www.epa.gov/greenpower

Information about Selected State Programs

State	Title/Description	URL Address
Arizona	Arizona Corporation Commission (ACC) Environmental Portfolio Standard Developments. This website is the ACC archive on RPS rules, suggested amendments, workshops, and public comment.	http://www.azcc.gov/divisions/utilities/electric/environmentab4l.htm
California	California Energy Commission Renewables Portfolio Standard. This website provides a history of the California RPS and relevant renewable energy links.	http://www.energy.ca.gov/renewables/
Hawaii	Hawaii Clean Energy Initiative. This website discusses Hawaii’s aggressive mandatory RPS goal of 40 percent by 2030, which is coupled with a 30 percent energy efficiency goal.	http://www.hawaiicleanenergyinitiative.org/

State	Title/Description	URL Address
Massachusetts	Massachusetts DOER: Renewable Portfolio Standard and Alternative Energy Portfolio Standard (AEPS). This website provides an archive on the state's RPS and AEPS requirements, rulings, compliance information, statutes and regulations, and compliance reports.	http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/rps-aps/
	Massachusetts DOER: Renewable Portfolio Standard, RPS Annual Reports. The RPS regulations (at 225 CMR 14.10(2)) require DOER to issue an Annual Energy Resource Report summarizing certain information from the Annual Compliance Filings.	http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/rps-aps/annual-compliance-reports.html
Minnesota	Minnesota Department of Commerce, Division of Energy Resources: Progress on Compliance with the Renewable Energy Standard. This 2013 progress report provides a history of the Minnesota RES and utility compliance information through 2011.	http://mn.gov/commerce/energy/images/2013RESLegReport.pdf
New York	New York State Public Service Commission: Retail Renewable Portfolio Standard. This website provides an archive of documents on New York RPS requirements.	http://www.dps.ny.gov/03e0188.htm
Oregon	Oregon Department of Energy: Renewable Portfolio Standard. This website provides a history of the Oregon RPS, statues, and rules.	http://www.oregon.gov/ENERGY/RENEW/Pages/RPS_home.aspx
Texas	PUC of Texas: Goal for Renewable Energy. This website provides the Texas PUC's archive of documents on RPS requirements.	https://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.173/25.173ei.aspx
	Transmission Issues Associated with Renewable Energy in Texas: Informal White Paper for the Texas Legislature, 2005. This document provides data for consideration by legislators in evaluating bills to expand the Texas RPS.	http://www.ercot.com/news/presentations/2006/RenewablesTransmissi.pdf

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CRS. 2014. The Legal Basis for Renewable Energy Certificates. Center for Resource Solutions.	http://www.resource-solutions.org/pub_pdfs/The%20Legal%20Basis%20for%20RECs.pdf

Title/Description	URL Address
DOE and EPA. 2010. Guide to Purchasing Green Power: Renewable Electricity, Renewable Energy Certificates, and On-Site Renewable Generation. U.S. Department of Energy and U.S. Environmental Protection Agency.	http://epa.gov/greenpower/documents/purchasing_guide_for_web.pdf
DSIRE. 2015a. Federal: Incentives/Policies for Renewables & Efficiency. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program?state=US
DSIRE. 2015b. Illinois: Incentives/Policies for Renewables & Efficiency. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program?state=IL
DSIRE. 2015c. Massachusetts: Incentives/Policies for Renewables & Efficiency. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program?state=MA
DSIRE. 2015d. Summary Tables: Renewable Portfolio Standard Policies. Database of State Incentives for Renewables and Efficiency. Accessed March 2015.	http://programs.dsireusa.org/system/program?type=38&
DSIRE 2015e. Renewable Portfolio Standards (RPS) with Solar or Distributed Generation Provision.	http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/03/Renewable-Portfolio-Standards-with-Solar-and-DG-Provisions.pdf
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CESA. 2012. Evaluating the Benefits and Costs of a Renewable Portfolio Standard: A Guide for State RPS Programs. Clean Energy States Alliance. Accessed September 2014.	http://www.cesa.org/assets/2012-Files/RPS/CESA-RPS-evaluation-report-final-5-22-12.pdf.
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LBNL. 2014. Renewables Portfolio Standards in the United States: A Status Update. Lawrence Berkeley National Laboratory.	http://emp.lbl.gov/sites/all/files/2014%20REM.pdf

Title/Description	URL Address
NJCEP. 2014. How to Participate. New Jersey Clean Energy Program. Accessed May 2014.	http://www.njcleanenergy.com/renewable-energy/programs/srec-registration-program/how-participate
NREL. 2007. Renewable Portfolio Standards in the States: Balancing Goals and Implementation Strategies. National Renewable Energy Laboratory.	http://www.nrel.gov/docs/fy08osti/41409.pdf
NREL. 2012. U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis. National Renewable Energy Laboratory.	http://www.nrel.gov/docs/fy12osti/51946.pdf
NREL and LBNL. 2014. A Survey of State-Level Cost and Benefit Estimates of Renewable Portfolio Standards. National Renewable Energy Laboratory and Lawrence Berkeley National Laboratory.	http://www.nrel.gov/docs/fy14osti/61042.pdf; http://emp.lbl.gov/sites/all/files/lbnl-6589e.pdf
RI PUC. 2015. Renewable Energy Standard. Rhode Island Public Utilities Commission.	http://webserver.rilin.state.ri.us/Statutes/TITLE39/39-26/39-26-5.HTM
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Chapter 6. Policy Considerations for Combined Heat and Power

Policy Description and Objective

Summary

Several policy opportunities exist for states to support greater use of combined heat and power (CHP). CHP, also known as cogeneration, is the simultaneous production of electricity and heat from a single fuel source (EPA 2007, 2014b). CHP provides an alternative to purchasing electricity from the local utility and burning fuel in an onsite furnace or boiler to produce thermal energy (such as steam). An industrial, institutional, or commercial facility can instead use CHP to provide both electric and thermal energy services in one energy-efficient step by capturing and using surplus heat that would otherwise be wasted when generating electricity. Due to the increased system efficiency, the CHP system produces the same amount of energy while requiring less fuel; it also produces lower emissions overall than equivalent, separate heat and power systems.

Optimally designed CHP offers environmental and climate change benefits to states, communities, businesses, and institutions through increased energy efficiency and reduced fuel consumption. Other benefits include improved fuel efficiency, enhanced resiliency, and more reliable power and thermal energy supplies. These reliability and resiliency benefits bolster business competitiveness, the energy infrastructure, and energy security (EPA 2013b). These benefits are enhanced when a CHP system is used in a district energy system or a microgrid.[49]

Recognizing CHP market growth benefits and barriers, President Obama issued Executive Order 13624, "Accelerating Investment in Industrial Energy Efficiency," in August 2012 (White House 2012). The executive order called for the installation of 40 gigawatts (GW) of new, cost-effective industrial CHP nationwide by the end of 2020. It specifically recognizes the lack of a single solution to addressing market barriers and looks for support through a variety of approaches. These include encouraging private sector investment by setting goals and highlighting investment benefits, improving coordination at the federal level, encouraging federal agencies to partner with and support states, and identifying investment models beneficial to the multiple stakeholders involved.

Objective

States have implemented many policies to capture CHP's environmental, energy, economic, and reliability benefits. These policies are designed to maximize the savings and reductions from CHP in meeting states' goals on energy, environment, economics, resiliency, or reliability. In these policies, CHP is commonly characterized based on the CHP system's size, fuel used (renewable or fossil fuels), technology type (such as combustion turbine, reciprocating engine, and other commonly used technologies) and process (referred to as topping cycle or bottoming cycle processes), and other characteristics such as system efficiency or market sector. These policies generally offer CHP-specific incentives or incentivize CHP along with other similar technologies or fuel types. For example, in state renewable portfolio standards (RPSs), renewably fueled CHP typically qualifies as an eligible source. Very few state portfolio standards list CHP systems that use all fuel types as

[49] For more information on microgrids, see Section 7.5, "Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration."

qualified eligible sources (EPA 2014e). Because CHP systems have such unique characteristics, CHP policies are considered more effective when they are CHP-specific rather than broadly applicable to a wide variety of energy resources (ACEEE 2014b). If the policy development process does not allow such specificity, it is helpful to have CHP and its attributes listed among the options for meeting the policy objectives. For example, an output-based regulation (OBR) for CHP can be useful, but it should also be specific enough to address thermal output. It would also be preferable to have an energy efficiency resource standard (EERS) and RPS explicitly include CHP with other technologies.

Benefits

By using fuel more efficiently to simultaneously produce electricity and thermal energy, CHP systems use less fuel than equivalent separate heat and power systems to produce the same amount of energy. Their increased efficiency offers environmental and economic benefits when compared with purchased electricity and onsite generated heat. States have found these benefits to be compelling in moving forward with CHP policies. Key CHP benefits include:

- *Efficiency benefits.* The average efficiency of central station fossil-fueled power plants in the United States is 33 percent and has remained virtually unchanged. This means that two-thirds of the fuel's energy is lost—vented as heat—at most U.S. power plants (EIA 2012). A CHP system's efficiency, depending on the prime mover, ranges from around 55 to 80 percent.[50] Because CHP is more efficient and often located closer to end-users, it requires less fuel than separate heat and power to produce a given energy output. Higher efficiency lowers operating costs and reduces emissions of all pollutants. An ACEEE analysis found that CHP systems of various sizes offer far lower levelized costs per megawatt-hour (MWh) than other non-CHP generation resources (ACEEE 2013). CHP's cost advantage also holds true when compared with smaller sized centralized systems. While a new 20 megawatt (MW) natural gas-powered combined cycle plant can yield power at a levelized cost of about 6.9 to 9.7 cents per kilowatt-hour (kWh), a new CHP plant can yield the same power at a levelized cost of about 6.0 cents per kWh (ACEEE 2013).

Measuring CHP Efficiency

The two most commonly used methodologies for determining CHP system efficiency are total system efficiency and effective electric efficiency. The calculation of total system efficiency compares what is produced (i.e., power and thermal output) with what is consumed (i.e., fuel). CHP systems with a relatively high net useful thermal output typically correspond to total system efficiencies that range from 55 to 80 percent.

Effective electric efficiency calculations allow for a direct comparison of CHP to conventional power generation system performance (e.g., electricity produced from centralized power plants, which is how the majority of electricity is produced in the United States). Effective electrical efficiencies for combustion turbine-based CHP systems range from 51 to 69 percent; reciprocating engine-based CHP systems range from 69 to 84 percent.

Both the total system and effective electric efficiencies are valid metrics for evaluating CHP system efficiency. They both consider all CHP system outputs and, when used properly, reflect CHP's inherent advantages. However, because each metric measures a different performance characteristic, using the two different metrics for a given CHP system produces different values. If the objective is to compare CHP system energy efficiency with the efficiency of a site's separate heat and power options, then the total system efficiency metric may be the right choice. If CHP electrical efficiency is needed to compare CHP with conventional electricity production (i.e., the grid), then the effective electric efficiency metric may be the right choice (EPA 2015a).

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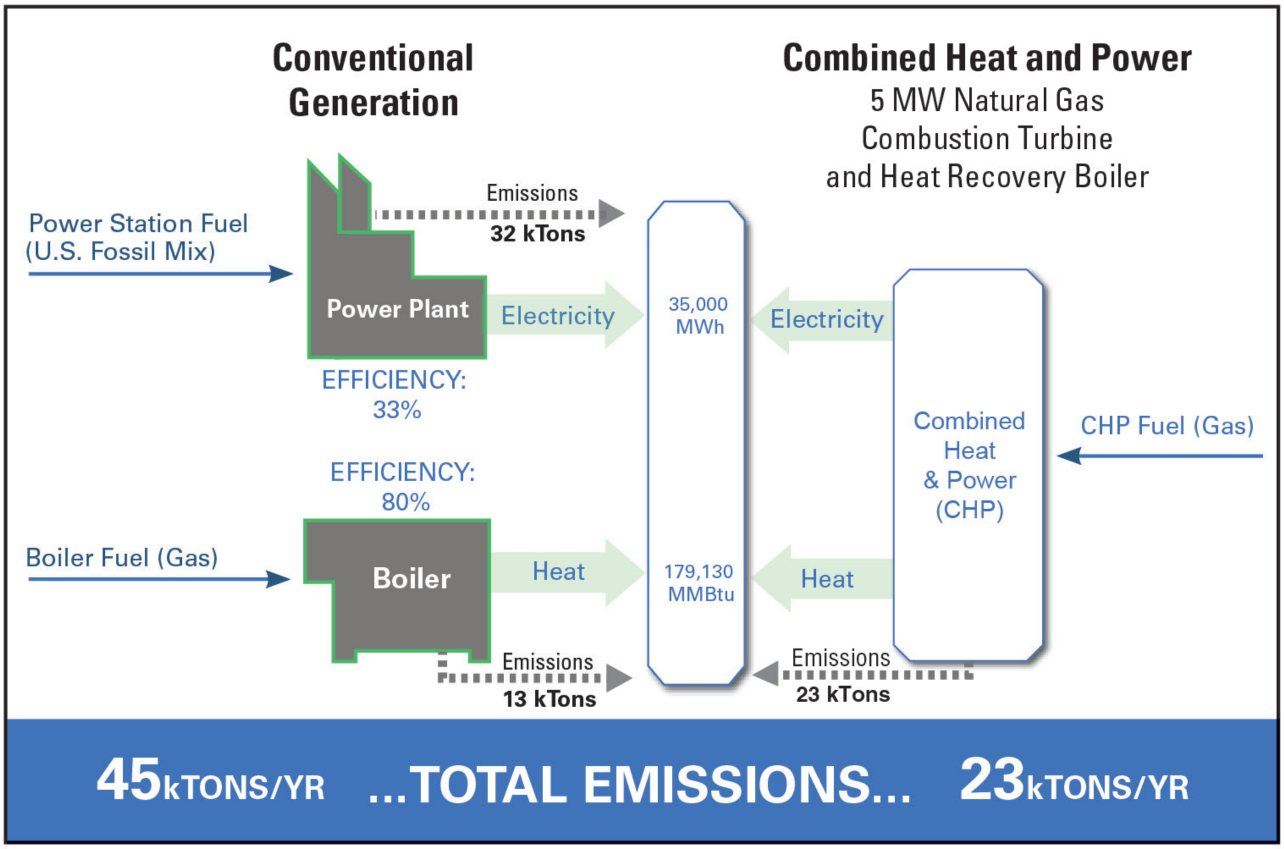
[50] The five most commonly installed CHP prime movers tend to offer the following standard ranges of achievable overall efficiency: steam turbine: around 80 percent, reciprocating engine: 77 to 80 percent, gas turbine: 66 to 71 percent, microturbine: 63 to 70 percent, and fuel cells: 55 to 80 percent (EPA 2014a).

- *Environmental benefits.* Because producing a given amount of electricity and thermal energy combusts less fuel, greenhouse gas (GHG) and criteria air pollutant emissions are reduced. Figure 6.1 shows the magnitude of a 5 MW natural gas-fired CHP system's reduced carbon dioxide (CO_2) emissions as compared with separate heat and power used to generate the same energy output.[51] A CHP system's efficiency and environmental benefits are optimal when the system is sized to meet thermal needs.

  Figure 6.1 illustrates the CO_2 emissions output from power and thermal energy generation for two systems: 1) a separate heat and power system with a fossil fuel-fired power plant (emissions based on the U.S. fossil mix) and a natural gas-fired boiler, and 2) a 5 MW combustion turbine CHP system powered by natural gas. The separate heat and power system emits a total of 45,000 tons of CO_2 per year (13 kilotons from the boiler and 32 kilotons from the power plant), while the more efficient CHP system emits 23,000 kilotons of CO_2 per year.

Figure 6.1: Conventional Generation vs. CHP: CO_2 Emissions



Source: EPA 2015b

- *Reliability benefits.* Reliability refers to the ability of power system components to deliver electricity to all points of consumption, in the quantity and quality demanded by the customer. Service interruptions and variations in power quality can happen at any time. Although most grid outages are brief, momentary occurrences that do not adversely impact anything other than the most sensitive operations, an average

[51] To analyze a facility's emission reductions, the EPA CHP Partnership's CHP Emissions Calculator can help compare the anticipated air emissions from a CHP system with those of a separate heat and power system.

facility can expect to experience an extended outage (lasting more than 5 minutes) every other year (EPA 2013a).

Rather than invest capital to install diesel backup generators that provide electricity only during an outage, a facility can design a CHP system that provides continuous electric and thermal energy to the site, resulting in annual operating cost savings. Onsite electricity generation yields increased reliability and power quality, reduced grid congestion, and avoided distribution losses.

To provide reliability benefits, the CHP system could be sized to meet the facility's base load thermal needs and to work in conjunction with the grid. The CHP operator can then decide to make or buy power from the grid based on forecasted prices or real-time price signals, system performance parameters, and optimized integrated resources such as solar electricity; thermal storage; or forms of demand response. Supplemental power purchased from the grid could provide the facility's peak power needs on a normal basis, as well as the entire facility's power when the CHP system is down for maintenance. However, the CHP system could also be configured to maintain critical facility loads in the event of an extended grid outage; in such a configuration, CHP has proven to be a reliable, alternative source of power and thermal energy (heating and cooling) during emergencies, and it has made energy infrastructure more resilient in the face of extreme weather events and other grid disruptions (EPA 2013b).

For certain types of customers, reliability is a critical business and operations issue rather than a mere inconvenience. These customers cannot afford to lose power or comfort conditions for more than a brief period without experiencing a significant loss of revenue, critical data/information, operations, or even life. Some particularly energy-sensitive customers include mission-critical computer systems, thermal-intensive industrial processing operations, high-tech manufacturing facilities, military operations, wastewater treatment facilities, research-intensive universities, museums and archives, and hospitals and other healthcare facilities.

Using CHP During Grid Outages

During Superstorm Sandy in 2012, there were several cases of malfunctioning emergency generators. The backup generator at NYU Langone Medical Center and fuel pumps for backup generators at Bellevue Hospital failed after the basements flooded (McNeal 2012; Ofri 2012). This forced the hospitals to evacuate patients to other medical centers with CHP systems or backup generators that remained operational during the storm. During the Northeast blackout in 2003, half of New York City's 58 hospitals suffered backup generator failures, and the lack of backup power allowed 145 million gallons of raw sewage to be released from a Manhattan pumping station (DOE 2013).

The New York State Energy Research and Development Authority (NYSERDA) analyzed CHP system operation at 24 sites that had received NYSERDA funding and were located in areas affected by Superstorm Sandy. Each site was grouped into one of the following four categories:

- *Category 1.* Site lost grid power. The CHP system was designed to operate during a grid outage and operated as expected.
- Category 2. Site lost grid power. The CHP system was designed to operate during a grid outage, but it failed to operate correctly.
- Category 3. Site never lost power. The CHP system was not put to the test.
- Category 4. Site lost grid power. However, the CHP system was an induction unit and was not designed to operate during a grid outage.

There were no sites identified under Category 2, and the sites in the other categories performed as expected.

*Email communication from Elizabeth Markham, NYSERDA Assistant Project Coordinator on January 14, 2013, to DOE-funded Northeast Clean Energy Application Center Staff, Timothy Banach and Tom Bourgeois.

- *Economic benefits.* CHP offers a variety of economic benefits for large energy users (EPA 2015c). These economic benefits include:
  - *Reduced energy costs.* The high efficiency of CHP technology results in energy savings when compared with conventional, separately purchased power and onsite thermal energy systems. To determine if

CHP is likely to offer a compelling return on investment at a particular site, the costs of the CHP system (capital, fuel, and operation and maintenance) can be compared with the costs of purchased power and thermal energy (hot water, steam, or chilled water) that would otherwise be needed for the site.

- *Offset capital costs.* Buildings can be connected to a CHP-based district energy system that provides district heating (steam or hot water) and district cooling services (chilled water) for space heating, domestic hot water, and air conditioning. Such services avoid onsite equipment and conserve valuable space in the building and rooftop for other revenue-generating uses.
- *Continuity of business.* Distributed generation (DG), also known as onsite generation, located closer to the end-user is inherently more reliable than power traveling long distances from remote power stations. CHP has been deployed in institutions because of the enhanced reliability that comes with proximity. The use of CHP configured for "islanding" enhances reliability and business continuity, which are key attributes for businesses and critical infrastructure to remain online in the event of a disaster or major power outage. The white paper, *Calculating Reliability Benefits*, explores the economic value of CHP as backup power (EPA 2013a).
- *Hedge against volatile electricity prices.* CHP provides a hedge against unstable electricity prices by allowing the end-user to supply its own power during periods when electricity prices are very high.

A CHP project's economic benefits depend on efficient design and operation to offset electric and capital costs, as well as policies established in the project's jurisdiction (EPA 2012). The value of these benefits will depend on the investor's needs and goals. A feasibility analysis to determine a project's technical and economic viability is typically performed in stages to reduce risk and minimize the costs and expenses of non-viable projects (EPA 2015c).

States with Policies

There are several policy options through which states can capture CHP benefits. Table 6.1 summarizes CHP-related policies, including incentives, which are currently in place in many states (EPA 2014c). They can be broadly classified under four categories: environmental, energy, financial, and utility. This section provides an overview of the four broad categories of state policies that factor into CHP's benefits. The American Council for an Energy-Efficient Economy (ACEEE) evaluates state policies that are critical for encouraging CHP in its annual State Energy Efficiency Scorecard report (2014b).

Table 6.1: State Policies Supportive of CHP

Policy/Incentive Types	Description
Bond	State or federal bonds can support CHP projects or activities (either specifically or where eligibility includes CHP). Bond programs help support CHP by establishing a means to borrow capital for CHP projects at a fixed and often lower interest rate. For example, under New Mexico's Energy Efficiency and Renewable Energy Bond Program, qualifying CHP systems at government facilities, schools, and universities may be eligible to receive up to $20 million in bonds backed by the state's Gross Receipts Tax. Further information is available in Chapter 3, "Funding and Financial Incentive Policies."
Commercial Property Assessed Clean Energy (PACE)	Commercial PACE programs allow building owners to receive financing for eligible energy-saving measures that can include CHP, repaid as property tax assessments over a period of years. For example, San Francisco has a commercial PACE program called GreenFinanceSF, which offers loans of up to 10 percent of the assessed value of a property to eligible CHP systems. Further information is available in Chapter 3.

Table 6.1: State Policies Supportive of CHP

Policy/Incentive Types	Description
Environmental Regulations	Federal and state environmental regulations can support CHP through specific inclusion or with output-based limits for thermal and electrical production. Environmental regulations can support CHP by recognizing CHP's efficiency benefits and account for them in meeting compliance obligations. For example, in Delaware, new and existing DG may be subject to emissions limits (lb/MWh) pursuant to state air quality Regulation No. 1144. Using the avoided emissions output-based approach, the rule allows a CHP system to account for its secondary thermal output when determining compliance with nitrogen oxides, carbon monoxide, and CO_2 emission limits.
Feed-in Tariff (FIT)	FITs specify per-kWh payments for electricity supplied to the grid by CHP or other DG. FITs typically offer a long-term contract to producers of energy-efficient and renewable generation based on the cost of each technology. The goal is to offer cost-based compensation to support CHP producers, providing price certainty and long-term contracts that help finance CHP investments. Under Governor Brown's Clean Energy Jobs Plan (2010), California initiated a FIT for CHP systems. Systems must be smaller than 20 MW, have an efficiency of at least 62 percent, and be placed in operation after January 1, 2008. Further information is available in Section 7.4, "Customer Rates and Data Access."
Grant	State or federal grants can support CHP projects or activities (either specifically or where eligibility includes CHP) by financing the development and purchase of CHP systems and equipment. Under Connecticut's Department of Energy and Environmental Protection, qualifying CHP projects are eligible for grants of $200/kW of nameplate capacity. Further information is available in Chapter 3.
Interconnection Standard	Interconnection processes and technical requirements govern how electric utilities will treat CHP and other DG systems that customers seek to connect to the electric grid. State public utility commission (PUC) interconnection rules typically address larger DG projects connecting to the distribution grid, whereas the Federal Energy Regulatory Commission (FERC) has jurisdiction over project interconnection at the transmission level. Transparent and uniform technical standards, procedures, and agreements established for all system sizes can reduce uncertainty and prevent time delays that CHP and distributed renewable energy can encounter when obtaining approval for electric grid connection. For example, Massachusetts' interconnection standards apply to all forms of DG, including CHP, served by the state's investor-owned utilities (IOUs). The standards follow a three-tiered approach with application fees varying based on the system's size. All system sizes are eligible to interconnect. Further information is available in Section 7.3, "Interconnection and Net Metering Standards."
Loan	State or federal loans can support CHP projects or activities (either specifically or where eligibility includes CHP) by financing the purchase of CHP systems and equipment, often at very low interest rates. In Connecticut, low-interest loans are available for qualifying CHP projects. Loans are available at a subsidized interest rate of 1 percent below the applicable rate or no more than the prime rate. Further information is available in Chapter 3.
Net Metering Policy	Net metering is a method of compensating customers for electricity that they generate onsite (e.g., using CHP) in excess of their own consumption—essentially giving them credit for the excess power they send back to the grid. Depending on individual state or utility rules, net excess generation (NEG) may be credited to the customer's account or carried over to a future billing period. Net metering policies are commonly implemented by state PUCs. Key criteria commonly addressed are system capacity limits, eligible system and customer types, treatment of NEG, and ownership of renewable energy certificates associated with customer generation. For example, in Washington State, qualifying CHP systems up to 100 kW are eligible for net metering. It is available on a first-come, first-served basis until the cumulative generating capacity of net metered systems reaches 0.50 percent of a utility's peak demand. Further information is available in Section 7.3.

Table 6.1: State Policies Supportive of CHP

Policy/Incentive Types	Description
Portfolio Standard	Portfolio standards are state regulations that require utilities to obtain a certain amount of the electricity they sell from specified sources and/or achieve specified reductions in electricity consumption. Some of these standards specifically include CHP (i.e., fossil-fueled CHP, waste heat to power, or where renewable CHP is specifically deemed eligible). Portfolio standards can help improve a CHP project's economics by rewarding eligible projects with a credit for helping to meet state targets, typically as $/MWh payments. Under Massachusetts' Alternative Energy Portfolio Standard (AEPS), CHP systems are eligible to receive credits of around $20/MWh of electrical energy output. In 2009 and 2010, about 99 percent of AEPS compliance was met through CHP projects. Further information is available in Section 4.1, "Energy Efficiency Resource Standards," and Chapter 5, "Renewable Portfolio Standards."
Production Incentive	Production incentives are payments typically made by state agencies on a per-kWh basis to operators of CHP and other DG. These incentives can help to support CHP development. Under Baltimore Gas & Electric's Smart Energy Savers Program, qualifying CHP projects are eligible to receive production, installation, and design incentives of up to $2 million. The incentive program expires on December 31, 2016. All eligible projects must be operational by that date. Further information is available in Chapter 3.
Public Benefits Fund (PBF)	PBFs are resource pools typically funded by a charge included on customers' utility bills. States generally use these funds to support energy efficiency and renewable energy, including the development of CHP. New York State has a system benefits charge (SBC) in place, which is included as a bill surcharge for customers of IOUs. Administered by NYSERDA, the SBC supports funding for eligible CHP projects and has an annual budget of $15 million. Further information is available in Section 4.2, "Energy Efficiency Programs."
Rebate	State, federal, or utility rebates can support CHP projects or activities, either specifically or where eligibility includes CHP. California's Self-Generation Incentive Program offers rebates and performance-based incentives to eligible CHP projects. The program has a maximum incentive of $5 million with a 40 percent minimum customer investment. Information on system type, financing, and operational status is available in quarterly reports available to the public on the California Public Utilities Commission website. Further information is available in Section 4.2.
State or Local Climate Change Plan	A climate change action plan lays out a strategy, including specific policy recommendations, that a state or local government will use to address climate change and reduce GHG emissions. Certain climate change action plans include specific policy or financial measures to support CHP, including zoning preferences and resiliency objectives. As an example, North Carolina's Climate Action Plan proposed a policy recommendation to encourage development of CHP systems less than 10 MW through a combination of utility incentives, information provisions, review of net metering policies, streamlining of interconnection requirements, providing low-interest loans, and/or tax credits for potential hosts/owners/developers of these systems. The goal of the recommendation is to implement 25 to 33 percent of North Carolina's CHP potential by 2020.
State Energy Plan	A well-constructed state energy plan is the outcome of a planning process among state stakeholders to move toward meeting future energy needs based on agreed goals, objectives, and criteria. It assesses current and future energy supply and demand, examines existing energy policies, and identifies emerging energy challenges and opportunities. Certain state energy plans recommend CHP to achieve the agreed-upon goals, objectives, and criteria laid out in the plans. In New Jersey's 2011 Master Energy Plan, Governor Christie set a goal to develop 1,500 MW of new DG and CHP projects over the next decade.
Energy Regulation and Policy	Federal and state energy regulations and policies, including federal and state laws, executive orders, and FERC orders, can account for the role of CHP. For example, in August 2012, President Obama issued Executive Order 13624 calling for the development of new CHP systems. The order set a target of developing 40 GW of new industrial CHP by the end of 2020.

Table 6.1: State Policies Supportive of CHP

Policy/Incentive Types	Description
State Utility Rate Policy	State PUCs can develop rate policies for utilities that account for CHP and other DG. Designs differ based on whether the utilities are in a restructured market (for more information about market structure, see the introduction to Chapter 7). In some states, municipally and cooperatively owned utilities have different rate structures. State utility rates exist for different customer classes. Design criteria that account for CHP can include a reduction or exemption from standby rates and/or exit fees, the application of daily or monthly as-used demand charges, the option to buy backup power at market prices, and guidelines for dispute-resolution processes. State utility rates take several forms and can include riders such as standby and related rates, exit fees, buyback rates, gas rates, and decoupling mechanisms. For example, under California's Departing Load Charge Exemption policy, qualifying CHP systems are exempt from paying exit fees. Further information is available in Section 7.4.
Tax	State or federal tax credits or favorable tax treatment can support CHP projects or activities, either specifically or where eligibility includes CHP. For example, CHP systems that meet a minimum efficiency of 60 percent are eligible for a 10 percent Federal Investment Tax Credit for the first 15 MW of capacity. The credit expires on December 31, 2016. Further information is available in Chapter 3.
Utility Rate	Utility rate structures can include discounts for CHP. For example, in New Jersey, commercial and residential customers that install DG systems can save up to 50 and 40 percent, respectively, on their gas delivery charges.

Source: EPA 2014c

Environmental Policies

Regional, state, and local policy actions that account for CHP's environmental benefits are primarily output-based emissions regulations, climate change action plans, and streamlined permitting programs.

Output-Based Emissions Regulations

States have found that OBRs can be effective tools for promoting CHP by relating emissions to the productive output of the energy-consuming process. The goal of OBR is to encourage the use of fuel conversion efficiency (FCE) as an air pollution control measure.

OBR define emissions limits based on the amount of pollution produced per unit of useful output, accounting for the unit's efficiency (e.g., pounds of sulfur dioxide per MWh of electricity). In contrast, input-based regulations are based on the amount of fuel burned and do not reflect a unit's efficiency. Electricity generation technologies, including CHP, have traditionally been subject to input-based emissions regulations. OBR can be used to credit all of the useful energy generated. CHP systems fare well under this approach when it credits both the thermal and electric energy they produce. OBR have been developed for state, regional, and federal rules. As of December 2014, 19 states have adopted some form of OBR (EPA 2014d). Massachusetts has adopted such an approach for a suite of air pollution regulations that include conventional emissions limits, emissions limits on small DG, allowance trading, allowance set-asides, and an emissions performance standard.

Climate Change Plans

A climate change action plan lays out a strategy, including specific policy recommendations a state would use to address climate change and reduce its GHG emissions. There are currently 19 state climate change plans that recommend implementing CHP (EPA 2014c). For example, Minnesota's Climate Change Advisory Group issued its final report in April 2008 with recommendations to the governor for reducing Minnesota's GHG emissions. Chapter 3 of the Minnesota Climate Mitigation Action Plan details recommendations for the residential, commercial, and industrial sectors and recommends CHP as one way to reduce Minnesota's GHG emissions and improve energy efficiency. The state has estimated that 50 percent of CHP's technical potential in Minnesota can be met if these recommendations are implemented (MPCA 2013).

Streamlined Permitting Programs

When installing a CHP system, a facility must obtain permits from local authorities to set up the system, connect it to the local grid, and operate it in compliance with local and state regulations. To ensure compliance with air quality standards, a facility—in consultation with the state or local permitting agency—reviews air permitting requirements and then obtains a permit before the system is installed and operated. CHP stakeholders have found the process for obtaining air permits to be time and resource intensive and a potential impediment to CHP projects (EPA 2014e). In the past decade, and particularly in the past few years, several states—including Connecticut, New Jersey, and Texas—have introduced streamlined permitting procedures for certain types of CHP units to simplify and speed up the permitting process.

Energy Policies

States have factored CHP into state energy plans, energy codes, and portfolio standards. CHP can also be considered in state energy sustainability plans when accounting for resiliency measures independently or as part of a suite of modern grid investments.

Energy Plans

As of late 2011, 38 states and Washington, D.C., had a state energy plan. Of these plans, 22 reference CHP (EPA 2014c). Some state energy plans consider CHP in the context of renewable energy resources, while others group CHP with energy efficiency resources. Highlights from the plans that mention CHP include offering financial incentives, encouraging CHP to spur economic development within the manufacturing sector, suggesting that energy portfolio standards be revised to include CHP, and suggesting that streamlined CHP permitting be implemented to encourage energy efficiency in industrial sites. For example, the 2008 Intelligent Energy Choices for Kentucky's Future identifies CHP as one method for meeting the goals under Strategy 1, "Improve the Energy Efficiency of Kentucky's Homes, Buildings, Industries, and Transportation Fleet."

The 2012 Washington State Energy Strategy was the state's first detailed strategy since 1993. The strategy focuses on energy and transportation, the largest energy-using sector in the state (WA Commerce 2012). It also addresses building energy use and distributed energy resources, including CHP. Chapter 5 cites three key reasons for including distributed energy and CHP in the strategy: timeliness (Washington has established incentives and policy mandates that encourage the development of both renewable and distributed energy systems), responsiveness (citizens and businesses are asking their state and utilities to help them develop distributed energy systems), and the potential contribution to the state's energy future (citing the example of California with its goal to develop 12,000 MW of distributed renewable energy facilities by 2020). The near-term recommendations to advance distributed renewable energy, including CHP, touch upon interconnection, net metering, and permitting. Longer term recommendations involve distributed renewable energy-compliant purchase power agreements, potential changes to Initiative 937 (the Energy Independence Act), and rationalizing state distributed renewable energy incentives.

Portfolio Standards

States use portfolio standards to increase the adoption of energy efficiency, renewable energy generation, and other clean energy technologies such as CHP. There are three main types of portfolio standards (EPA 2015d):

- *Renewable portfolio standard (RPS) or clean energy standard (CES).* An RPS typically requires electric utilities and other retail electric providers to supply a specified minimum percentage (or absolute amount) of customer load with eligible sources of renewable electricity. Some states have broader CESs that encompass more than just renewable energy. These portfolio standards are designed to increase the contribution of renewable energy and clean energy to the electric supply mix. These standards support the growth of renewable energy sources such as wind, solar, hydro, geothermal, and biomass, as well as clean energy technologies such as CHP. Some states maintain a broad RPS definition under which renewably fueled CHP systems qualify; other states explicitly include CHP, regardless of the fuel source.
- *Energy efficiency resource standard (EERS).* EERSs are designed to meet energy savings goals through energy efficiency. They are intended to encourage more efficient generation and transmission by electric and gas utilities. They are usually focused on end-use energy savings, but some include other efficiency measures such as CHP, or other high-efficiency systems or distribution system improvements.
- *Alternative energy portfolio standard (AEPS).* AEPSs are hybrid standards that allow energy efficiency to qualify within an RPS or a CES. This is done by setting targets for a certain percentage of a supplier's capacity (MW) or generation (MWh) to come from sources such as CHP. In the Massachusetts Green Communities Act of 2008, CHP was a qualified technology, with both power and thermal outputs measured for compliance.

As of February 2015, 25 states specifically name CHP and/or waste heat to power (WHP) as eligible under their RPS, EERS, or AEPS program guidelines (EPA 2015d). These states include Arizona, Colorado, Connecticut, Delaware, Hawaii, Illinois, Indiana, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, and Washington. More information on portfolio standards is available in Section 4.1, "Energy Efficiency Resource Standards," and Chapter 5, "Renewable Portfolio Standards."

Energy Reliability Policies

As disruptions in the energy supply pose a serious risk to local governments, especially at critical facilities such as wastewater treatment plants, hospitals, emergency shelters, and schools, states have observed that CHP systems can be designed to disconnect from the grid. Disconnection enables them to operate in "island mode" if grid-supplied electricity is lost during extreme weather or other circumstances and provides increased reliability for these critical facilities. States have also found that using CHP to generate electricity on site avoids the need to rely on non-CHP backup generators and can even improve the overall reliability of the electricity grid by reducing peak load and blackout risks.

Some state and local governments have developed, or are in the process of developing, policies to include CHP and other forms of clean DG in critical infrastructure planning. This ensures the energy security and reliability of emergency facilities. For example, the damage caused by hurricanes along the Texas and Louisiana Gulf Coasts acted as a catalyst to propel the adoption of critical infrastructure policies in Texas and Louisiana (LAHR 2012; TSL 2013a, 2013b). Both of these states have adopted laws requiring state agencies to evaluate installing CHP in new buildings or during major retrofits of existing buildings.

The Maryland EmPOWER Energy Efficiency Act of 2008 set a target reduction of 15 percent below 2007 peak demand and electricity consumption levels by 2015. Baltimore Gas & Electric, Pepco, and Delmarva Power have developed performance-based incentive programs for CHP as a way of meeting the EmPOWER Act's 2015 targets. To qualify for these utility incentive programs, CHP systems had to meet a minimum efficiency of 65 percent. The programs provided eligible CHP systems with a production incentive of $0.07 per kWh for the first

18 months of the system's operation. The program expired in February 2015. Under the program, Baltimore Gas & Electric approved 16 CHP system applications in 2012, with potential annual savings of 102,000 MWh.

Financial Policies

CHP projects are primarily funded through the following financing options (EPA 2012): company earnings or internal cash flow, debt financing, equity financing, lease financing, bonds (for public entities), project or third-party financing, and build-own-operate options such as some energy savings performance contracts (ESPCs). Given the diverse nature of the CHP market, multiple financing options may be desirable to meet the needs of CHP system owners and host facility operators. These financing options include, but are not limited to, commercial banks, energy service companies (ESCOs), third-party ownership, and utility cost recovery. States offer grants, low-interest loans and loan guarantee programs, bonds, rebates, public benefits funds, and production incentives to support CHP deployment. Some states use an emerging approach called commercial property assessed clean energy programs. These programs allow building owners to receive full financing for eligible energy saving measures such as CHP; they are repaid on their property tax assessments, with some having long repayment periods. CHP projects have been financed using all of these approaches.

Spark Spread

A primary consideration for a CHP system's financial feasibility is the spark spread, or the relative difference between the price of fuel for the CHP system to produce power and heat on site and the price of electricity the customer would have purchased from the utility. A company would consider investing in a CHP project if the value of the future stream of cost savings is greater than the upfront equipment investment.

A CHP project's actual cost varies depending on a number of characteristics, including who develops the project (i.e., the local government or a private developer as part of a turnkey arrangement), system capacity, availability and type of fuel, prime mover, and overall system configuration. CHP systems can cost between $670 and $6,500 per kilowatt of installed capacity (EPA 2014a). In addition to system purchase and installation costs, a CHP project will incur other associated costs for conducting preliminary feasibility studies and obtaining permits, and for operation and maintenance. Preliminary feasibility studies, for example, can range from $10,000 to $100,000, and operations and maintenance costs can range from $0.005 to $0.015 per kWh (EPA 2012).

As an example, the New Jersey Board of Public Utilities (NJBPU) offers incentives for CHP and fuel cell systems, which represent a combination of New Jersey Clean Energy Program (NJCEP) and utility incentives. Utilities offer incentives for CHP and fuel cells of up to $1 million, and NJCEP will provide an incentive that meets the combined incentive, up to a maximum of $2 million. Another example is the Vermont Commercial Energy Loan Program, one of four loan programs under the Vermont Sustainable Energy Loan Fund, created in 2013 (VEDA 2015). The maximum loan amount is $2 million. Loan terms and amortization schedules are determined on a case-by-case basis up to 20 years. Interest rates are variable, but may be fixed in some circumstances. Loans may not fund more than 40 percent of a project's total cost. More information on CHP project funding and incentives can be found in Chapter 3, "Funding and Financial Incentive Policies."

Utility Policies

Through state public utility commissions (PUCs), some state utility policies have considered how CHP and other DG technology can be better integrated to provide environmental and economic benefits to customers. These policies include interconnection and net metering standards, standby rates, resource planning and procurement processes such as Integrated Resource Planning (IRP), and excess power sales. CHP systems will often reduce the overall annual volume of purchased electricity, which may affect cost recovery under conventional rate design for utilities. However, CHP systems also produce system benefits by reducing peak demands during periods of high use that strain grid resources. CHP systems can be a highly cost-effective option for reducing grid congestion or improving locational marginal pricing by deploying these smaller generating units closer to load centers.

When viable, states have seen CHP hosts either reduce purchased electricity from the grid or leave the grid entirely by self-generating. This outcome affects regulators and utilities because a significant loss of customers, either leaving the grid or staying in with a reduced share, shifts costs to other customers, thereby requiring these remaining customers to carry the costs of the departing CHP user. States have observed that the challenge for all affected parties is to identify the most equitable arrangement that encourages CHP adoption while ensuring there is no inequitable transfer of costs. When a CHP system exports excess electricity, states or independent system operators have to consider additional issues such as different contractual arrangements, time-of-use rates, and payments for capacity or grid support services. Today, regulators and commissions are evaluating a wide range of conditions to more fully account for the grid benefits provided by CHP and not just the potential impact that self-generators will shift cost recovery or distribution expenses to other customer classes. Some states are adopting "decoupling" policies to address the regulatory objective of increasing DG deployment for resiliency or sustainability goals while recognizing the need for continued investment in traditional grid assets.

Interconnection and Net Metering Standards

Typically, PUCs define the standards for interconnection to the distribution grid, while the Federal Energy Regulatory Commission (FERC) establishes standards for transmission-level interconnection. Technical requirements governing how onsite generators connect to the grid serve an important function, ensuring that the safety and reliability of the electric grid is protected; however, non-standardized interconnection requirements and uncertainty in the timing and cost of the application process have long been a barrier to more widespread adoption of customer-sited generation (SEE Action 2013). As of April 2015, 45 states and Washington, D.C., have adopted some form of interconnection standards or guidelines (DSIRE 2015).

Effective interconnection requirements for CHP projects with no electricity exports include streamlined application timelines and procedures, simplified contracts, appropriate cost-based application fees, well-defined dispute resolution procedures, and the ability to connect to both radial and network grids (SEE Action 2013). More information can be found in Section 7.3, "Interconnection and Net Metering Standards." Examples of some interconnection procedures that have accounted for CHP include the following:

- The Illinois Commerce Commission (ICC) established standard interconnection requirements for DG systems, including CHP. Both fossil-fueled and renewably fueled CHP systems are eligible for standardized interconnection. For DG systems up to 10 MW, the rules set four levels of review for interconnection requests. The ICC adopted IEEE 1547 as the technical standard of evaluation and systems are considered to be lab-certified if the components have been evaluated as compliant with UL 1741 and the 2008 National Electric Code according to the testing protocols of IEEE 1547. The rules also specify the technical screens that may be applied to applications at each level of review as well as time limits for different stages of the evaluation process. Facilities >1 MW must carry liability insurance with coverage of at least $2 million per occurrence and $4 million in aggregate. All systems are required to have an external disconnect switch directly accessible to the utility. The rules also specify a procedure for dispute resolution. For DG systems (including CHP) >10 MW, an interconnection feasibility study and a system impact study will be required. A standard interconnection agreement form is available from the utility, and fees and insurance requirements will be determined on a case-by-case basis.
- Oregon has three categories of interconnection standards that apply to both fossil-fueled and renewably fueled CHP systems: one for net metered systems, one for non-net metered small facilities, and one for

non-net metered large facilities. There are two separate interconnection standards for net metered systems in Oregon: one for the state's two IOUs, Pacific Gas and Electric (PG&E) and PacifiCorp, and another for municipally owned utilities, cooperatively owned utilities, and People's Utility Districts (another form of publicly owned utility under Oregon state law).

Electricity Resource Planning and Procurement Processes

Most states require utilities to engage in a form of electricity resource planning to substantiate that the utility's plans for meeting demand for electricity services are in the public interest. Planning processes vary greatly across states, but they generally fall into four categories: IRP, power plant investment preapprovals through Certificates of Public Convenience and Necessity, default service (also referred to as Standard Offer Service), and long-term procurement planning. These planning processes can consider a variety of energy resources, including supply-side (e.g., traditional and renewable energy sources) and demand-side (e.g., energy efficiency) options. Connecticut, a restructured state, has general statutes that require CHP to be included in the state's energy and capacity resource assessment as well as utilities' procurement plans. In California, utilities must prepare a DG forecast as part of their long-term procurement plans. DG, of which CHP is a subset, must also be considered as an alternative to distribution system upgrades by California's IOUs. Connecticut, Georgia, Iowa, Indiana, Kentucky, Massachusetts, Minnesota, Nebraska, Nevada, Oregon, Utah, and Washington also call out CHP as an option in IRP. Section 7.1, "Electricity Resource Planning and Procurement," provides more information about these and other planning approaches.

Utility Rates

Customers with onsite generation typically require a different set of services, which includes continuing electricity service for the portion of usage that is not provided by the onsite generator, as well as service for periods of scheduled or unscheduled outages. "Partial requirements" is another name for standby or backup service: the set of retail electric products that customers with onsite, non-emergency generation typically desire. This service could be a tariff that replaces the standard full requirements tariff or an additional tariff that applies on top of the standard tariff for certain special types of service. Many of the utilities that provide these services distinguish three types of partial requirements service in their tariffs: supplemental, backup, and maintenance. Some differentiate only between standby and supplemental (EPA 2009).

A review of selected rate tariffs suggests that the better rate designs share common and central characteristics: they are designed to give customers a strong incentive to use electric service most efficiently, to minimize the costs they impose on the system, and to avoid charges when service is not taken (EPA 2009). This means that they reward customers for maintaining and operating their onsite generation. To encourage customer-generators to use electric service most efficiently and minimize the costs they impose on the electric system, standby rates that incorporate some or all of the following features would be helpful (SEE Action 2013):

- Establish as-used demand charges (daily or monthly) for backup power and shared transmission and distribution facilities.
- Reflect CHP customers' load diversity in charges for shared delivery facilities.
- Provide an opportunity to purchase economic replacement power.
- Allow customer-generators the option to buy all of their backup power at market prices.
- Allow the customer to provide the utility with a load reduction plan.
- Offer a self-supply option for reserves.

More information can also be found in Sections 7.2, "Policies That Sustain Utility Financial Health," and 7.4, "Customer Rates and Data Access." Examples of some utility rates that account for CHP either through departing load charges, exit fees, or standby charges are:

- On April 3, 2003, the California Public Utilities Commission (CPUC) issued Decision 03-04-030, outlining a mechanism for granting a range of DG customer exemptions from paying power surcharges known as "exit fees" or "cost responsibility surcharges." A customer with departing load generally refers to utility customers that leave the utility system in part or entirely to self-generate electricity. CPUC tasked the California Energy Commission (CEC) to determine exemptions from exit fee requirements. The following systems are exempt from the exit fee rules:
    - Systems <1 MW that are net metered and/or eligible for CPUC or CEC incentives for being clean and super clean are fully exempt from any surcharge, including solar, wind, and fuel cells.
    - Ultra clean and low-emission systems (defined as generation technologies that produce zero emissions or emissions that meet or exceed 2007 California Air Resources Board [CARB] emission limits) >1 MW that meet Senate Bill 1038 requirements to comply with CARB 2007 air emission standards will pay 100 percent of the bond charge, but no future Department of Water Resources (DWR) charges or utility under-collection surcharges.

  All other customers will pay all components of the surcharge except the DWR ongoing power charges. When the combined total of installed generation reaches 3,000 MW (1,500 MW for renewables), any additional customer generation installed will pay all surcharges.
- States and utilities have provided further direction on customer generation. For example, PG&E defines customer generation as "cogeneration, renewable technologies or any other type of generation that is dedicated wholly or in part to serve all of a portion of a specific customer's load or relies on non-PG&E or dedicated PG&E distribution wires rather than PG&E's utility grid. Reductions in load are classified as customer generation departing load only to the extent that such load is subsequently served with electricity from a source other than PG&E" (PG&E 2015). In January 2012, New Jersey Governor Chris Christie signed NJSA 48:2-21.37, the "Standby Charge Law" concerning the burden of standby charges on DG customers. The law requires the NJBPU to conduct a study to determine the effects of DG, including CHP, on energy supply and demand. The study will also determine whether DG, including CHP, contributed to any cost savings for electric distribution companies. Under the law, the NJBPU must establish criteria for fixing rates associated with the study assessment and require public utilities to file tariff rates according to the new criteria. The NJBPU must also ensure equity between DG customers and other customers.
- In April 2014, the Minnesota Department of Commerce published an analysis of standby rates' policy impacts on CHP opportunities in the state (MDC 2014). The analysis examined how existing rates affect the market acceptance of CHP projects today and presented recommendations that could help reduce the barriers that these factors impose on CHP development in Minnesota. Though the standby suggestions for each utility are somewhat unique, there were certain recurring themes:
    - *Standby rates should be transparent, concise, and easy to understand.* Potential CHP customers should be able to accurately predict future standby charges to assess their financial impacts on CHP feasibility.
    - *Standby usage fees for both demand and energy should reflect time-of-use cost drivers.* Time-of-use energy rates send clear price signals about the utility's cost to generate needed energy. This information can further incentivize the use of off-peak standby services.
    - *The forced outage rate should be used to calculate a customer's reservation charge.* Including a customer's forced outage rate directly incentivizes standby customers to limit their use of backup

service. This approach further links standby use to the price paid to reserve such service, creating a strong price signal for customers to run most efficiently. This approach also involves removing the grace period.

- *Standby demand usage fees should only apply during on-peak hours and be charged on a daily basis.* This rate design would encourage DG customers to shift their use of standby service to off-peak periods when the marginal cost to provide service is generally much lower. It would also allow customers to save money by reducing the duration of outages.
- *Grace periods exempting demand usage fees should be removed where they exist*. Exempting an arbitrary number of hours against demand usage charges sends inaccurate price signals about the cost to provide this service. The monthly reservation cost provides grace period charges for 964 hours of usage regardless of whether a customer needs that level of service. Standby demand usage should be priced as used on a daily and preferably on-peak basis. This method directly ties the standby customer to the costs associated with providing standby service and allows customers to avoid monthly reservation charges by increasing reliability.

These themes are also seen in a 2014 study that outlines best practice recommendations and breaks these practices into three categories: allocation of utility costs, judgments based on statistical methods, and value of customer choice and incentives (RAP 2014). The financial effects of these modifications largely depend on customer-specific metrics, including CHP capacity, operating hours, voltage classification, etc.; the suggested modifications would likely increase each utility's avoided rate (MDC 2014).

Excess Power Sales and Net Metering

Sizing the CHP system to the thermal load in facilities with large thermal needs, such as industrial facilities in the chemical, paper, refining, food processing, and metals manufacturing sectors, can result in more electricity generated than can be used on site. Excess power sales may provide a revenue stream for a CHP project, possibly enabling the project to go forward, and can help achieve state energy goals. For these sales to take place, the CHP system will need to evaluate different contractual arrangements, time-of-use rates, and payments for capacity or grid support services. Several types of programs can provide for excess power sales from CHP systems: programs based on state implementation of the federal Public Utility Regulatory Policies Act (PURPA), net metering, and non-competitive power purchase agreements; feed-in tariffs and variations; and competitive procurement processes (SEE Action 2013). More information can also be found in Section 7.4, "Customer Rates and Data Access."

ACEEE's review of state CHP policies found that sound net metering regulations allowed owners of small DG systems to get credit for excess electricity that they produced on site, gave credit to states that offered at least wholesale net metering to all customer classes, and specifically offered credit to natural gas-fired CHP systems (ACEEE 2014b).

Examples of approaches that encourage CHP include the following:

- The Maine Public Utilities Commission's net metering policy is available to both fossil-fueled and renewably fueled CHP that meets certain efficiency and size requirements. April 2009 legislation (LD 336) amended net metering rules to include high-efficiency micro-CHP systems as eligible. Net metering had been available in Maine from 1987 to 1998 for qualified CHP and from 1987 until April 30, 2009, for other small power production facilities up to 100 kW. Micro-CHP with an electric generating capacity rating of 1 kW to 30 kW must achieve a combined electric and thermal efficiency of at least 80 percent or greater to qualify. In addition, micro-CHP 31 kW to 660 kW must achieve a combined efficiency of 65 percent or greater to qualify.

- All of Maine's electric utilities—IOUs and publicly owned utilities (e.g., municipally owned and cooperatively owned utilities)—must offer net metering to micro-CHP. IOUs are required to offer net metering to shared ownership customers, while publicly owned utilities can offer it. Shared ownership allows for community net metering, where several people invest in an eligible system and are therefore allowed to benefit. IOUs are required to offer net metering to eligible facilities up to 660 kW. Publicly owned utilities are required to offer net metering to customers up to 100 kW and are authorized (although subject to the utility's discretion) to offer net metering to eligible facilities up to 660 kW.
- Net excess generation (NEG) is credited to the following month for up to 12 months; after the end of an annualized period, all NEG is granted to the utility with no compensation for the customer. At its own expense, a utility may install additional meters to record purchases and sales separately. There is no limit on the aggregate amount of energy generated by net metered customers. However, a utility must notify the PUC if the cumulative capacity of net metered facilities reaches 1 percent of the utility's peak demand.

- In 2004, the PUC of Oregon began a thorough investigation into rates, terms, and conditions for PURPA qualifying facilities (Oregon PUC 2007). The PUC also adopted complementary procedures for interconnection and dispute resolution. Its goal was "to encourage the economically efficient development of these [qualifying facilities], while protecting ratepayers by ensuring that utilities pay rates equal to that which they would have incurred in lieu of purchasing [qualifying facility] power." Results to date suggest their approach achieves the policy's intent (SEE Action 2013).
  - Oregon's avoided cost rates recognize the difference in qualifying facility value when a utility is resource-sufficient versus when it is resource-deficient. When the utility does not need large-scale thermal or renewable resources, as may be the case in the early years of the qualifying facility contract, avoided cost rates are based on projected monthly on- and off-peak electricity market prices at the appropriate trading hubs. Conversely, when the utility is resource-deficient, rates are based on the projected cost of a new combined cycle combustion turbine, with its cost and timing vetted in the utility's IRP process. Further, while qualifying facilities may choose fixed avoided cost rates for the first 15 years of the contract, during the last 5 years, the fuel price component of the rates are based on monthly natural gas price indexes. Qualifying facilities also may choose these market-based options for the entire contract term.
  - The regulations that the PUC of Oregon adopted for small and large qualifying facilities uphold the PURPA principle by which utilities may not be required to pay more than avoided costs for qualifying facilities. The PUC's guidance on contract provisions related to creditworthiness, security, default, and insurance also protect ratepayers. Under the state RPS, electric utilities must acquire such resources, and the renewable avoided cost rates are based on the cost of the next large scale renewable resource identified in the utility's IRP (SEE Action 2013).
- In Vermont, fossil-fueled and renewably fueled CHP systems are eligible for net metering. Net metering legislation, which includes provisions for CHP, was enacted for the first time in Vermont in 1998 and has been amended several times, most recently by House Bill (HB) 702 of 2014. HB 702 now allows any electric customer in Vermont to net meter after obtaining a Certificate of Public Good from the Vermont Public Service Board. The bill establishes a process to revise the state's net metering program by January 1, 2017.

The Department of Public Service was charged with preparing a report by October 1, 2014, that evaluates the current state of net metering in Vermont.

- A net metering system meets the size definition provided in the rules; operates in parallel with the electric distribution system's facilities; is intended primarily to offset the customer's own electricity requirements; is located on the customer's premises or, in the case of a group net metering system, on the premises of a customer who is a member of the group; and employs a renewable energy resource or is a qualified micro-CHP system. Net metering is generally available to systems up to 500 kilowatts (kW) in capacity that generate electricity using eligible renewable energy resources, including CHP systems that use biomass. CHP systems that use a non-renewable fuel are allowed to net meter, but are limited to small CHP systems up to 20 kW.
- Net metering is available on a first-come, first-served basis until the cumulative capacity of net metered systems equals 5 percent of a utility's peak demand during 1996 or the most recent full calendar year, whichever is greater. Renewable energy facilities established on military property for onsite military consumption may net meter for systems up to 2.2 MW. NEG is carried forward as a kWh credit to the next month. Any NEG not used within 12 months will be granted to the utility. Net metering is also available under a time-of-use metering arrangement. All renewable energy certificates associated with the electricity produced by the system remain with the customer.

Designing Effective CHP Policies

States have found that the general steps for designing an effective CHP policy are:

- *Assess whether CHP can play a role in achieving state policy objectives.* States have found CHP systems can be attractive to policy-makers and industries because these applications are inherently energy-efficient and produce energy at the point of generation where it is needed. As CHP does not fit neatly into one category based on technology, fuel type, and benefits, states consider a variety of policy options to incorporate CHP benefits. Recent efforts in Alabama, Arkansas, Illinois, Iowa, and Tennessee—where the National Governors Association (NGA) Policy Academy meetings were convened—provided insights into identifying effective policies, taking different approaches based on state stakeholder engagement (NGA 2014).
- *Assess whether there has been increased CHP market development.* Where increased market deployment already exists, it would be helpful to understand the factors that have contributed to its growth and understand its contribution to the state's CHP potential.
- *Assess the state economic potential for CHP.* Where available, a state CHP potential analysis is a valuable tool to asses which sectors have immediate and long-term opportunities. There have been several recent studies that point to the national CHP economic potential and aggregate the state potential in the process (DOE and EPA 2012; McKinsey 2009). The potential varies by state based on the available energy-intensive industries, spark spread (or the difference between grid-purchased electricity and electricity generated at a site with CHP), and existing CHP-favorable policies.
- *Assess the barriers to realizing CHP's potential*. While developing CHP country profiles, the International Energy Agency (IEA) discovered many barriers in the United States that prevent CHP from reaching its full potential (IEA 2008). IEA also determined that targeted policy measures are needed to remove these obstacles and achieve CHP benefits. Common barriers include:
    - Significant upfront financial investments required.

- Economic and market issues related to the difficulty in securing fair value prices (i.e., net metering rates) for CHP electricity that is exported to the grid.
- Regulatory issues related to inconsistent interconnection procedures and backup charges (i.e., standby rates).
- A lack of knowledge about CHP, its benefits, and savings. When CHP's role is not clearly tied to the state economy, public funds expended to promote it may result in inefficient CHP installation or systems that do not have adequate thermal or electric loads, thereby acting as a deterrent to more appropriate CHP applications.
- Regulatory challenges in integrating emission benefits due to CHP's status as combined technologies that include heat and power.

New York's position as a strong CHP market has been a consistent, evolving process strengthened by soundly understanding state market barriers, engaging with CHP stakeholders to better understand their challenges and opportunities, and translating the knowledge gained into policy actions or program efforts among state stakeholders.

- *Assess CHP's contribution to achieving key policy objectives.* Policy analysis helps to provide a better understanding of CHP's role in meeting policy objectives and lays out the process in which these opportunities can be realized. In states where a direct linkage has been shown to a CHP-related policy and project development, CHP's benefits have continued to play a role in state energy and environmental plans, such as those seen in New York, Massachusetts, and Connecticut. States have found that careful planning to relate CHP potential to the appropriate policy drivers can result in win-win situations for states and CHP system owners.

Participants

A variety of participants can play important roles in mobilizing resources and ensuring effective implementation for CHP projects, including:

- *State energy and environmental departments.* Dialogue and engagement between these two agencies can help achieve a better understanding of the environmental benefits provided by a supply-side energy efficiency resource like CHP and can enhance the realization of CHP's potential. These state departments can provide information and technical assistance in planning and permitting CHP systems and also provide financial incentives. For example, under its system benefits charge (SBC) program for the 2012–2016 period, the State of New York has set aside an annual average $15 million budget to reduce barriers and costs and increase market penetration of CHP in New York for both smaller (1.3 MW or less) and larger systems that can provide on-peak demand reduction during summer (NYSERDA 2014).
- *State PUCs.* PUCs help assess utility policies, such as standby rates and portfolio standards, and ensure customers are treated fairly under these policies. State governments can work with state PUCs to obtain information on connecting CHP systems to the electricity grid and to learn about funding opportunities available for CHP projects. Some state PUCs administer programs that offer clean energy options for a targeted customer base or provide financial incentives for DG projects, including CHP.
- *Private developers.* In many states, private developers work with end-use facilities to implement CHP systems. They factor federal, state, and local incentives into successfully developing projects.

- *Manufacturers.* Manufacturers actively ensure that CHP systems are installed and operated in an optimal fashion. In a successfully implemented CHP system, manufacturers are typically part of a partnership between the developer and the consulting firm engaged in project development.
- *Engineering and architectural firms and consultants*. Firms with engineering and architectural expertise play an important role in developing CHP by providing critical knowledge to an end-user who may see the potential but does not possess the requisite expertise to evaluate the CHP opportunity.
- *Private financiers and private equity firms.* As the interest in CHP has increased, private financiers and equity firms have seen the value of financing CHP systems that offer a reliable return on investment, such as systems installed in the commercial and institutional sectors.
- *ESCOs.* ESCOs provide technical expertise on energy efficiency projects and often offer performance contracts, which typically include a guarantee that savings will occur, and that payments for these services will not exceed the monetary value of the savings generated. For example, local governments can contract with ESCOs to purchase and install CHP systems and to obtain operations and maintenance services.
- *Utilities*. Each utility has its own interconnection and net metering rules, which include rules on the rates and charges that apply to CHP. They vary widely by state and utility. Information on state interconnection and net metering rules, which determine whether and how a utility allows customers to connect to the grid, can be accessed through the EPA CHP Partnership (CHPP) website (http://epa.gov/chp/policies/database.html). Utilities offer financial incentives for CHP projects through energy conservation programs and have played a role in the increase of CHP.
- *State code enforcement officials and planning departments.* State governments can work with their code enforcement officials and planning departments to update codes (Virginia DEQ 2004). Some local governments, such as Boston, Massachusetts, and Epping, New Hampshire, have modified zoning ordinances to provide permitting incentives for CHP projects. Planning departments can also be responsible for developing local energy plans that include CHP-specific goals and activities.
- *Nonprofit organizations.* State governments can work with nonprofit organizations to obtain technical or financial assistance for implementing CHP-related activities.

Interaction with Federal Programs

There are several federal programs through which a state can look to incentivize and deploy CHP. These programs include the following:

- *EPA's CHPP.* The EPA CHPP seeks to reduce the environmental impact of power generation by promoting the use of CHP. The CHPP works closely with energy users, the CHP industry, state and local governments, and other clean energy stakeholders to facilitate the development of new projects and to promote their environmental and economic benefits.
- *U.S. Department of Energy (DOE) CHP Deployment Program.* The DOE CHP Deployment Program provides stakeholders with the resources necessary to identify CHP market opportunities and support implementation of CHP systems in industrial, federal, commercial, institutional, and other applications. A key component of the Program is the regional CHP Technical Assistance Partnerships (TAPs), which promote and help transform the market for CHP, WHP, and district energy nationwide. CHP TAPs offer key services, including technical assistance, education and outreach, and market opportunity analyses.
- *DOE State Energy Program (SEP).* DOE SEP provides funding and technical assistance to state and territory energy offices to help them advance their clean energy economy while contributing to national energy

goals. SEP also provides leadership to maximize the benefits of energy efficiency and renewable energy in each state through communications and outreach activities and technology deployment, and by providing access to new partnerships and resources. In 2013, eight states received SEP funds totaling more than $750,000 for CHP-related efforts.

- *EPA Climate Showcase Communities (CSC).* EPA's CSC Program helps local governments and tribal nations pilot innovative, cost-effective, and replicable community-based GHG reduction projects, which include CHP. Fifty communities received CSC funding, including a few CHP applications, and EPA is leveraging the lessons from these projects to help others implement their own actions through peer exchange, training, and technical support.
- *Federal EPA regulations that call out CHP's inclusion*. These inclusions could be called out directly or through the use of OBR for CHP units in New Source Performance Standards and other regulations. For example, the Clean Air Interstate Rule for ozone and fine particulate matter and the Clean Air Mercury Rule allow states to determine the method for allocating allowances. EPA model rules include examples of output-based allocation, including methods to include CHP units.

Interaction with State Policies

As CHP deployment often depends on local policies, favorable state policies play a critical role in its increased use. State CHP policies can be related to environmental, energy, financial, or utility goals, as described in detail in this chapter.

Implementation and Evaluation

Administering Body

The state, local, or tribal environmental agency and energy office are typically responsible for developing and implementing CHP-related policies.

Roles and Responsibilities of Implementing Organization

The following are responsibilities of the state, local, or tribal environmental agency and state energy office:

- Identify and evaluate opportunities for considering CHP-related policies.
- Gather information, develop goals, and develop CHP-related policies and regulations.
- Publicize and implement the CHP-related policy.
- Evaluate the value of the policy in encouraging efficiency, CHP, and emission reductions.

Best Practices: Implementing CHP Policies

The best practices identified below will help states effectively implement their CHP policies. These recommendations are based on the experiences of states that have implemented CHP policies and regulations to encourage CHP.

- Start with internal education to ensure that state energy and environmental regulators understand the benefits, principles, and mechanisms under which the CHP policy will be designed. Ensure that regulators understand why this change is good for state energy and environmental goals.
- Coordinate with other state agencies that can lend support. State energy research and development offices, as well as economic development offices, can provide valuable information on CHP's energy and economic benefits. Their perspective on the importance of energy efficiency and pollution prevention can help formulate policy.
- Apply the policies' principles to new regulations, as appropriate.
- Publicize the new rules and train personnel internally and externally.

Evaluation/Oversight

States evaluate their programs periodically to determine whether their regulations and policies are structured to encourage CHP in line with their objectives. This evaluation helps identify new opportunities for using a CHP policy to encourage energy efficiency and reduce emissions through effective regulatory and program design.

Regulatory programs are routinely reviewed and revised, and occasionally new programs are mandated by state or federal legislation. For example, states are developing revised State Implementation Plans to achieve larger emission reductions and address problems of ozone, fine particulates, and regional haze. States can use this opportunity to evaluate the benefits of energy efficiency in attaining and maintaining air quality goals. Another example is New York's SBC program, established by the state Public Service Commission (PSC) and administered through NYSERDA, which reviews the performance data from systems receiving incentives.

State Examples

Iowa

Iowa was one of four states chosen from around the country to work with the NGA to improve industrial use of CHP and enhance economic development. Iowa's CHP Policy Academy began in October 2012 and continued through April 2013. The NGA supported this interagency effort with technical assistance and expertise, workshop training, in-state visits, and grant funding of $12,000. Iowa has a very diverse manufacturing base, which creates both challenges and opportunities for CHP. The scope of Iowa's CHP Policy Academy was to address CHP across a broad range of industries in order to better define the opportunities, barriers, and types of policies that would facilitate progress in Iowa. In addition, more information about the current status of the existing stock of Iowa CHP was gathered to help utilities and policy-makers assess potential age-related impacts on Iowa's electrical supply/demand balance. This effort aimed to identify potential obstacles to cost-effective, large-scale CHP and to ascertain the best means of bypassing hurdles and facilitating CHP improvements and economic competitiveness in Iowa.

Iowa has several incentives in place that support CHP deployment, as well as others under development. The DOE Midwest Technical Assistance Program has developed a baseline analysis report for the CHP market in Iowa (DOE 2005). It assesses the prevailing environment for CHP systems from the regulatory, private market, and technology perspectives within Iowa. This information may be used to develop educational and market transformation programs.

The Alternate Energy Revolving Loan Program (AERLP) is administered by the Iowa Energy Center and funded by the state's IOUs. The AERLP provides loan funds to individuals and organizations that seek to build commercial, industrial, residential, or utility renewable energy production facilities in Iowa. The Iowa Economic Development Authority, in partnership with the Iowa Area Development Group, is offering low interest loans for energy efficiency improvements, renewable energy projects, energy management, and implementation plans. Loans will have terms of up to 10 years and range from $50,000 to $500,000 with a 1 percent or higher interest rate.

Under the Energy Replacement Generation Tax Exemption, the State of Iowa provides a 100 percent exemption for self-generators and landfill gas systems. This tax is imposed in lieu of a property tax on generation facilities. Facilities with onsite self-generators must wholly own or lease the facility in question and produce electricity solely for their own consumption, except for inadvertent unscheduled deliveries to their electric utility. However, facilities that do not consume all energy on site are not required to pay the replacement tax on energy that is used to operate the facility.

The State of Iowa offers a production tax credit of $0.015 per kWh for energy generated by eligible renewable energy facilities. In addition, Iowa offers $4.50 per million British thermal units of biogas used to generate either electricity or heat for commercial purposes, or $1.44 per thousand cubic feet of hydrogen fuel generated and sold by an eligible renewable energy facility. These credits may be applied toward the state's personal income tax, business tax, financial institutions tax, or sales and use tax. They last for a 10-year period.

In the 2008 *Iowa Climate Change Advisory Council Final Report*, policy recommendation CRE-11 ("Distributed Generation/Co-Generation") includes investment in small-scale DG through incentives or subsidies and the prevention of barriers to both utility and customer investment. It also seeks to ensure access to the grid under uniform technical and contractual terms for interconnection, so that owners know parallel interconnection requirements in advance, and manufacturers can design standard packages to meet technical requirements. The goal of CRE-11 was to deploy 7,500 MWh per year of new distributed renewable generation by 2010, continued each year thereafter; CHP using renewable fuels would be eligible. Policy recommendation CRE-12, "Combined Heat and Power," suggests promoting CHP across Iowa by providing incentives for CHP development. Suggested incentives include tax credits, grants, zoning provisions, and offset credits for avoided emissions. Policy recommendation CRE-13, "Pricing Strategies to Promote Renewable Energy and/or CHP," suggests creating pricing and metering strategies that encourage customers to implement CHP and renewable energy, resulting in overall GHG emissions reductions. This recommendation aimed to achieve a 10 percent shift to renewable energy and/or CHP as a percentage of retail sales.

Iowa has interconnection standards for systems including both fossil-fueled and renewably fueled CHP for rate-regulated utilities (MidAmerican Energy, Interstate Power and Light, and Linn County Rural Electric Cooperative). The standards apply to DG facilities, including CHP, <10 MW that are not subject to the interconnection requirements of FERC; the Midwest Independent Transmission System Operator, Inc.; or the Mid-Continent Area Power Pool. Although standard interconnection rules only apply to systems <10 MW, the rules state that larger facility interconnection should take place using the Level 4 review process as a starting point. The Iowa Economic Development Authority's Energy Office is collaborating with the Iowa Department of Natural Resources to streamline the CHP permitting process to further assess the application of CHP technology in Iowa. Iowa will explore the market potential for CHP in the commercial and institutional sectors, sponsor CHP educational events, and create a guide that will serve as a resource directory for future CHP projects.

Websites:
http://www.iowaenergycenter.org/alternate-energy-revolving-loan-program-aerlp
http://www.iadg.com/services/financial-assistance/iadg-energy-bank.aspx
http://www.iowaeconomicdevelopment.com/Energy/CHP
http://www.iowa.gov/tax/index.html
http://www.iowadnr.gov/Environment/ClimateChange/ClimateChangeAdvisoryCo.aspx
http://www.legis.iowa.gov/DOCS/ACO/IAC/LINC/1-23-2013.Rule.199.15.10.pdf

Kentucky

Kentucky is using a multi-pronged policy approach to advance CHP. It has factored in CHP as part of its efforts to meet the state energy plan's GHG emissions reduction target. It has established financial incentives under its Incentives for Energy Independence Act as well as energy efficiency loans for state government agencies. It also has interconnection standards in place that take CHP into consideration.

CHP's role as an energy efficiency measure has also been considered. It will support the governor's strategy to offset 18 percent of the state's projected 2025 energy demand through efficiency. A 2-year initiative aims to identify policies and programs that will create a better environment for economical usage of CHP.

Governor Steve Beshear announced Kentucky's first comprehensive energy plan, Intelligent Energy Choices for Kentucky's Future, in November 2008 with the ultimate goal of reducing GHG emissions levels to 20 percent below 1990 levels by 2025. As part of this goal, at least 18 percent of the state's projected 2025 energy demand will be offset through efficiency. Governor Beshear plans to have 25 percent of Kentucky's energy needs met through energy efficiency, conservation, and the use of renewable resources. One way Kentucky is increasing energy efficiency is by promoting CHP use through a public/private partnership.

The Incentives for Energy Independence Act was passed in August 2007 and established incentives for companies that build or renovate facilities 1 MW or greater, which use renewable energy to produce electricity for sale. Biomass resources, including CHP, are among the acceptable renewable energy sources. For companies that work on renewable energy facilities, incentives may include the following:

- A tax credit that allows approved facilities to receive a credit up to 100 percent of Kentucky income tax and the limited liability tax for projects that construct, retrofit, or upgrade facilities that generate power from renewable resources.
- A sales tax incentive of up to 100 percent of the Kentucky sales on materials, machinery, and equipment used to construct, retrofit, or upgrade an eligible project.
- As a condition of employment, approved companies may also require that employees whose jobs were created as a result of the associated project agree to pay a wage assessment of up to 4 percent of their gross wages. Employees will be allowed a Kentucky income tax credit equal to the assessment withheld from their wages.
- Advanced disbursement of post-construction incentives.

The maximum recovery for a single project from all incentives, including the income and liability entity tax credit, sales tax refund, and the wage assessment, may not exceed 50 percent of the capital investment.

Through the Green Bank of Kentucky, state agencies may be eligible for three separate energy loan products, depending on the proposed energy efficiency improvements. Renewable energy technologies, including CHP, are eligible for funding under this program as long as the payback period is 15 years or less. Initial funding for the Green Bank of Kentucky was provided by the American Recovery and Reinvestment Act through the Kentucky SEP. The eSELF Revolving Loan is a loan for energy efficiency projects costing between $50,000 and $225,000 that will result in at least a 20 percent energy reduction. The state agency will directly manage improvement projects funded under this loan. The Hybrid Revolving Loan is for energy efficiency projects costing between $50,000 and $600,000. An energy audit or engineering analysis is required, as well as a design and development package. The state agency is responsible for procuring materials and service. The cost of the audit/engineering analysis may be rolled into the loan. The ESPC revolving loan is for comprehensive energy efficiency projects costing more than $600,000 that use an ESPC or ESCO. A detailed industrial energy audit and cost-benefit analysis are required. The cost of the audit/engineering analysis may be rolled into the loan.

The Kentucky PSC has established interconnection standards that apply to renewable CHP. The standards apply to all retail electric suppliers in the state, excluding Tennessee Valley Authority utilities. Kentucky‘s interconnection standards apply only to certain renewables (photovoltaic [PV], wind, biomass, biogas, and small hydro) <30kW.

Kentucky has a two-tiered interconnection process for eligible systems:

- *Level 1.* Level 1 applies to inverter-based systems <30 kW that are certified to the UL 1741 and comply with IEEE 1547. Systems cannot require the utility to make modifications to its system in order to be interconnected. Utilities must notify the customer within 20 business days whether the interconnection application has been approved or denied. No application fees or other related fees apply.
- *Level 2.* Level 2 applies to systems that are not inverter-based, systems that use equipment not certified as meeting UL 1741, or systems that fail to meet the other technical requirements outlined for Level 1 applications. The utility has 30 business days to process a Level 2 application. Utilities may require customers to submit an application fee of up to $100 for processing and inspection purposes. If the utility determines that an impact study is needed, the customer is responsible for costs up to $1,000 for the initial impact study.

Utilities may choose to require an external disconnect switch. In addition, customers must maintain general liability insurance coverage (e.g., a standard homeowner‘s or commercial policy) for their systems. The guidelines also cover procedures for dispute resolution.

In March 2014, a public/private partnership was announced to promote high-efficiency CHP technologies as a means of reducing energy costs and carbon emissions, and as a way to spur new economic growth in Kentucky's industrial and manufacturing sectors. It includes the Kentucky Energy and Environment Cabinet, the Kentucky Pollution Prevention Center at the University of Louisville, and the Kentucky Association of Manufacturers. The partnership will promote the environmental and economic benefits of CHP through education and outreach with the support of the CHP TAP, a voluntary program established by DOE to facilitate and promote CHP technology. The public/private partnership will promote CHP in two phases. The first focuses on education and outreach presented through a series of work group meetings, as well as the development of a policy and implementation plan. The second phase consists of a feasibility study and strategies to increase Kentucky's CHP capacity.

Websites:
http://energy.ky.gov/Programs/Pages/chp.aspx
http://energy.ky.gov/Programs/Documents/Kentucky%20public%20private%20partnership%20to%20advance%20industrial%20energy%20efficiency.pdf
http://migration.kentucky.gov/Newsroom/governor/20081120energy.htm
http://energy.ky.gov/resources/Pages/EnergyPlan.aspx
http://finance.ky.gov/initiatives/greenbank/Pages/default.aspx
http://www.thinkkentucky.com/kyedc/kybizince.aspx
http://www.psc.ky.gov/agencies/psc/Industry/Electric/Final%20Net%20Metering-Interconnection%20Guidelines%201-8-09.pdf

New York

Over the past decade, New York has consistently implemented CHP policies to encourage and support CHP's role in meeting the state's energy, environmental, and reliability goals. New York has promoted CHP expansion through a combination of funding incentives, utility policies and rates, an RPS, and a comprehensive state energy plan. New York's SBC, which supports funding for CHP, was created in 1996 by the New York State PSC, and is currently administered by NYSERDA. The SBC supports energy efficiency, education, outreach, research and development, and low-income energy assistance. It is a surcharge on the bills of customers of New York's six IOUs.

The CHP program's objective in the 2012–2016 SBC plan is to "reduce barriers and costs and increase market penetration of CHP in New York." To achieve this goal, NYSERDA will: 1) implement a pilot program to promote pre-engineered, modular-based CHP systems and break down barriers to broader CHP use in various markets, and 2) provide performance-based payments for custom CHP systems that benefit summer peak demand periods. The SBC plan's budget for these initiatives is $15 million annually.

NYSERDA offers the CHP Acceleration Program to increase market penetration in the commercial and institutional sectors where New York has seen the most opportunities to use CHP and the CHP Performance Program. The CHP Performance Program currently provides incentives for CHP systems with an aggregate nameplate capacity greater than 1.3 MW that provide summer on-peak demand reduction. These incentives are performance-based and correspond to the summer-peak demand reduction (kW), energy generation (kWh), and FCE achieved by the CHP system on an annual basis over a 2-year measurement and verification period.

While the CHP Performance Program covers all of New York State, the CHP Acceleration Program applies to installation sites that pay the SBC surcharge on their electric bill or are located within New York City or Westchester County. The CHP system must also be fueled by natural gas that is subject to the SBC surcharge on gas bills.

The CHP Acceleration Program provides incentives for the installation of prequalified and conditionally qualified CHP systems by approved CHP system vendors in the size range of 50 kW to 1.3 MW. Incentive funds are allocated on a site-by-site, first-come, first-served basis in the order that applications are received until December 30, 2016, or until all funds are committed. An application is not considered received until it has been deemed full and complete by NYSERDA. The maximum incentive per project, including bonuses, is $1.5 million.

The New York State PSC adopted uniform interconnection standards that apply to CHP in 1999. The Standard Interconnection Requirements (SIR) have been amended several times, most recently in February 2014. The SIR applies to New York's six investor-owned, local electric utilities: Central Hudson Gas and Electric, Consolidated Edison (ConEd), New York State Electric and Gas, Niagara Mohawk, Orange and Rockland Utilities, and Rochester Gas and Electric. It includes two sets of interconnection and application procedures: an expedited process and a basic process. Under the expedited process, as amended in 2013, systems up to 50 kW are eligible for a simplified or expedited six-step process. Systems up to 300 kW may be eligible for this provided that the inverter-based system is UL 1741-certified and tested. Systems proposed for installation in underground network areas may need to submit additional information and may be subject to a longer review process. Systems up to 50 kW are not charged an application fee. Applicants must use the basic 11-step interconnection process for all systems greater than 50 kW and up to 2 MW, and for systems greater than 50 kW and up to 300 kW that have not been UL 1741-certified and tested.

New York's original net metering law, enacted in 1997 for PV systems, has been modified several times to include farm-based biogas systems up to 1 MW (A.B. 7987) and residential CHP systems up to 10 kW (A.B. 2442). Another modification (A.B. 7765) extends net metering to fuel cell systems of up to 1.5 MW for non-residential customers. New York's net metering rules apply to all IOUs in the state. Publicly owned utilities are not required to offer net metering; however, the Long Island Power Authority offers net metering using terms similar to the state law.

Most NEG is credited to the customer's next bill at the utility's retail rate. However, micro-CHP and fuel cell NEG is credited at the utility's avoided cost rate. In June 2011, New York enacted legislation (A.B. 6270) allowing eligible farm-based and non-residential customer-generators to engage in "remote" net metering. The law permits eligible customer-generators to designate net metering credits from equipment located on property that they own or lease to any other meter that is both located on property they own or lease and is within the same utility territory and load zone as the net metered facility.

New York customers using natural gas for DG, including CHP, may qualify for discounted natural gas delivery rates. In April 2003, the PSC issued procedures for developing gas-delivery rates that the local gas distribution companies would exclusively apply to gas-fired DG units. Gas for CHP must be separately metered and meet certain load factor requirements (NYSPSC 2014).

New York's RPS includes some renewably fueled CHP as an eligible resource. There are two tiers used to meet the RPS:

- *Main tier.* Eligible resources include methane digesters and other forms of biomass, liquid biofuels, fuel cells, hydroelectric power, PV, ocean power, tidal power, and wind power. NYSERDA can procure main tier resources through auction, requests for proposals, or standard offer contracts. While the main tier seeks to foster the development of additional renewable resources in New York, existing renewable energy facilities will also be eligible if they began operation on or after January 1, 2003.
- *Customer-sited tier*. Eligible resources include fuel cells, PV, solar hot water, wind turbines, digester gas-fueled CHP systems, and methane digesters. Customer-sited tier systems are generally limited to the size of the load at the customer's meter.

The RPS applies to IOUs and targets 30 percent of state electricity consumption to come from eligible resources by 2015. The program provides funding for CHP systems through a combination of capacity- and performance-based incentives. Eligible technologies include, but are not limited to, CHP systems fueled by anaerobic digestion biogas and (in certain regions) systems fueled by renewable biogas (including systems co-fired with renewable biogas). Incentives can be based on either capacity (kW) or output (kWh) and are awarded through competitive solicitations.

In August 2009, then-Governor David Paterson issued Executive Order 24, which established a state goal of reducing GHG emissions 80 percent below 1990 levels by 2050, and created the Climate Action Council to prepare a climate action plan. The plan is intended to be a dynamic and continually evolving strategy to assess and achieve the goal of sustained GHG emission reductions. The November 2010 *Climate Action Plan Interim Report* recognizes CHP as a method for increasing energy efficiency and reducing emissions. CHP is included under policy recommendation RCI-2, "Energy Efficiency Incentives," which promotes whole-building, integrated analysis to identify high performance efficiency measures, including CHP, for existing and new buildings. The report estimates that these policy actions could lead to additional CHP generation capable of producing 890 GWh/year in 2020 and 4,600 GWh/year in 2030. It also estimates that CHP use from 2011 to

2030 could potentially result in 7.1 million metric tons of CO_2 equivalent reductions. Additionally, the report includes recommendation RCI-10, “Rate Restructuring and Flexible Metering,” which promotes improved net metering regulations to facilitate renewable DG and CHP.

Issued in 2009 and updated in 2014, New York’s State Energy Plan provides a framework for the state to meet its future energy needs in a cost-effective and sustainable way, establishes policy objectives, and sets recommendations and strategies to achieve those objectives. In the wake of Superstorm Sandy, the current Draft Plan reiterates the need to encourage DG through additional technical and financial support, and remove any barriers to DG interconnection to the electric grid. The Draft Plan also encourages in-state renewable energy development through its RPS, which has a goal of providing 30 percent of New York’s electricity through renewables. The updated Draft Plan no longer explicitly mentions CHP. To help meet that goal, the Plan recommends the New York State Department of Environmental Conservation “establish regulatory standards to foster increased use of cleaner distributed resources while maintaining air quality and supporting reliability needs.“

In February 2013, New York Governor Andrew Cuomo announced that a $20 million investment would be made towards CHP, specifically those projects aimed at providing continuous power and heat during grid outages. This investment is based on recommendations made by NYS 2100, one of the three commissions Governor Cuomo created in the aftermath of Superstorm Sandy to improve the state’s emergency preparedness and response to natural disasters; it is administered by NYSERDA through the CHP Acceleration Program (NYSERDA, PON 2568). Later, in the spring of 2013, the Governor announced an additional $40 million in funding for large-scale CHP projects, termed the CHP Performance Program. This investment was also due to NYS 2100 recommendations. The funding for large-scale CHP projects (> 1.3 MW) will be available through NYSERDA until all funding is committed or until December 30, 2016. It is for natural gas-fueled CHP systems and CHP feasibility studies. Sites that pay the SBC are eligible for incentives. The base incentives for performance are limited to $2 million or 50 percent of project costs. Bonus incentives of up to an additional $600,000 are available for CHP systems that demonstrate superior energy performance; serve critical infrastructure facilities, including refuge facilities during disaster situations; and for projects located in a targeted zone established by ConEd. Due to flooding risks, CHP systems funded under this program must have all critical components located above the anticipated flood level (Governor’s Press Office 2013).

Websites:
https://www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities/PON-2568-CHP-Acceleration-Program
http://www.nyserda.ny.gov/All-Programs/Programs/Combined-Heat-and-Power-Performance-Program
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http://chp.nyserda.ny.gov/home/index.cfm
http://www.governor.ny.gov/news/governor-cuomo-announces-20-million-combined-heat-and-power-systems-generate-reliable-site

Rhode Island

Rhode Island has instituted a suite of policies and incentives that consider CHP benefits for both the state and energy end-users. There are two statewide plans that factor in CHP's benefits: the state energy plan and state climate change plan. CHP is also factored into the state EERS and environmental regulations, as well as several financial incentives. These include standards for utility system reliability, energy efficiency, and conservation procurement.

The State Planning Council adopted the Rhode Island Energy Plan on August 8, 2002, identifying the state's key energy issues and setting forth policies and actions to deal with them. CHP is incorporated. The Energy Plan lists a number of policy recommendations related to CHP, including economic competitiveness and energy security.

The Rhode Island Greenhouse Gas Action Plan was released in July 2002. One initiative would promote the use of CHP in industry with technical studies, program marketing, and financial incentives. Possible CHP technologies include combustion turbine type systems and internal combustion engines, likely fueled by natural gas. A second initiative would use the same measures to promote CHP use in non-industrial buildings and facilities. Potential CHP technologies include microturbines, fuel cells, combustion turbine type systems, and ICEs likely fueled by natural gas. Multi-building campuses are considered to be especially promising sites for CHP.

Rhode Island enacted energy efficiency standards in 2006, but no specific targets are outlined in the standards. Utilities must submit energy efficiency procurement plans annually and triennially with savings targets that establish standards for system reliability, energy efficiency, and conservation procurement. They must also establish standards for energy supply diversification, DG, demand response, and "prudent and reliable" energy efficiency and energy conservation measures. The state passed legislation in June 2012 requiring utilities to support CHP system installation at commercial, industrial, institutional, and municipal facilities, and requiring each utility to detail how it will do so in its annual plan. Utilities must establish energy efficiency procurement plans that include target percentages for CHP. The state has approved energy efficiency targets for National Grid. National Grid must design its energy efficiency plans with the goal of reducing energy consumption by 1.7 percent in 2012, 2.1 percent in 2013, and 2.5 percent in 2014 (National Grid 2014).

CHP projects in Rhode Island that National Grid electric customers are eligible for are a combination of energy efficiency, performance rebates, and advanced gas technology incentives. The total incentive package cannot exceed 70 percent of total project cost and is subject to budgetary limitations and caps. Customers are allowed to participate in both the energy efficiency and advanced gas technology programs, as long as they meet both sets of requirements.

Performance rebates and energy efficiency incentives include $900/kW per net kW for projects with 55 percent to 59.99 percent efficiency (net kW is nameplate kW output minus auxiliary) and $1,000/kW for projects with 60 percent or greater efficiency. A 25 percent bonus is available to facilities that have implemented (or plan on implementing) energy efficiency measures in the previous 5 years and reduced onsite energy use by at least 5 percent.

The advanced gas technology program is designed to add natural gas load during National Grid's off-peak period, rather than reducing load through conservation efforts. National Grid gives incentives to innovative projects that add non-heating load. The incentive amount is determined by adding the project's margin gain, up to 75 percent of the project's future margin, 75 percent of the project cost, the amount needed to buy down the payback period to 1.5 years, and the remaining advanced gas technology fund balance.

New and existing distributed generators may be subject to emissions limits (lb/MWh) pursuant to state air pollution control Regulation No. 43. Using the avoided emissions approach, the rule allows a CHP system to account for its secondary thermal output when determining compliance with nitrogen oxide, carbon monoxide, and CO_2 emission limits. A CHP system can take into account the secondary thermal output if the power-to-heat ratio is between 4.0 and 0.15 and the design system efficiency is at least 55 percent.

Additionally, Rhode Island has several financial incentives that encourage CHP system installation, such as those provided by Commerce RI through the Rhode Island Renewable Energy Fund and energy efficiency, performance rebates, and advanced gas technology incentives.

Websites:
http://www.energy.ri.gov/energyplan/index.php
http://www.dem.ri.gov/climate/
http://webserver.rilin.state.ri.us/Statutes/TITLE39/39-1/39-1-27.7.HTM
http://www.dem.ri.gov/pubs/regs/regs/air/air43_12.pdf

What States Can Do

States play a critical role in advancing CHP growth through policies and incentives that can take several forms in meeting broader state objectives. States have recognized CHP, district energy, and waste heat recovery as important energy efficiency options in legislation and programs. Where feasible, they have supported expanded technology research, demonstration, and deployment, particularly in emerging biomass and small-to-medium sized applications. While progress has been made, work remains to be done to better encourage CHP development with explicitly supportive policies (ACEEE 2014a). States can help level the playing field for CHP through regulatory and policy changes, including implementing standardized interconnection rules; developing transparent standby rate policies that recognize the benefits of CHP while appropriately compensating the utility for its provided services; encouraging uniform siting and environmental compliance policies; establishing uniform tax policies, which provide incentives to overcome market barriers and promote societal benefits; incorporating CHP in renewable and/or energy efficiency portfolio standards, or exploring other tax incentives, where appropriate; and providing a market solution for excess power produced by systems sized to meet thermal load.

Information Resources

General Information

Title/Description	URL Address
CHP/DHC Country Scorecard: United States. IEA's 2014 U.S. scorecard discusses the status of CHP and district energy in the United States, along with existing barriers and drivers for CHP development.	http://www.iea.org/publications/insights/insightpublications/the-iea-chp-and-dhc-collaborative-chpdhc-country-scorecard-united-states.html
Combined Heat and Power: Frequently Asked Questions. This EPA CHPP fact sheet addresses several frequently asked questions about how CHP works, as well as the costs and benefits associated with CHP.	http://epa.gov/chp/documents/faq.pdf
Combined Heat and Power: A Clean Energy Solution. This 2012 DOE and EPA report provides a foundation for national discussions on effective ways to reach the President's 40 GW CHP target, and includes an overview of the key issues currently impacting CHP deployment and the factors that need to be considered by stakeholders participating in the dialogue.	http://www.epa.gov/chp/documents/clean_energy_solution.pdf
Combined Heat and Power: A Resource Guide for State Energy Officials. This 2013 resource guide from the National Association of State Energy Officials provides State Energy Officials with a technology and market overview of CHP and ways in which they can support CHP through state energy and energy assurance planning, energy policies and utility regulations, and funding/financing opportunities for CHP.	http://www.naseo.org/data/sites/1/documents/publications/CHP-for-State-Energy-Officials.pdf
Combined Heat and Power Playbook. Municipalities interested in deploying CHP and district energy can draw on resources in this document. It delineates which resources are most useful at particular periods of project development and explains how to overcome barriers and challenges.	http://www.aceee.org/sites/default/files/publications/researchreports/ie1404.pdf
Gas-Fired Combined Heat and Power Going Forward: What Can State Utility Commissions Do? This 2014 document from the National Regulatory Research Institute examines barriers in state regulations that obstruct the development of CHP.	http://energy.ky.gov/Programs/Documents/NRRI%20Report-What%20Can%20Commissions%20Do.pdf
Guide to the Successful Implementation of State Combined Heat and Power Policies. This 2013 report from the SEE Action Network provides state utility regulators and other state policy-makers with actionable information to assist them in implementing key state policies that impact CHP.	https://www4.eere.energy.gov/seeaction/publication/guide-successful-implementation-state-combined-heat-and-power-policies
Guide to Using Combined Heat and Power for Enhancing Reliability and Resiliency in Buildings. In the wake of Superstorm Sandy, this 2013 DOE, U.S. Department of Housing and Urban Development, and EPA report discusses opportunities for CHP to contribute to reliability and resiliency, options for CHP financing, and how to determine if CHP is an appropriate fit for various applications.	http://epa.gov/chp/documents/chp_for_reliability_guidance.pdf
The Opportunity for Combined Heat and Power in the United States. This 2013 document from the American Gas Association and ICF International provides a market assessment of CHP potential in the United States, with a focus on impacts to the natural gas industry.	https://www.aga.org/opportunity-chp-us

Federal Resources

Title/Description	URL Address
DOE Deployment Program. Provides stakeholders with the resources necessary to identify CHP market opportunities and supports implementation of CHP systems in all applications. The regional CHP TAPs, which promote and help transform the market for CHP, WHP, and district energy technologies/concepts nationwide, are key to the Program. CHP TAPs offer key services, including technical assistance, education and outreach, and market opportunity analyses.	http://www.energy.gov/eere/amo/chp-deployment http://www.energy.gov/eere/amo/chp-technical-assistance-partnerships-chp-taps
EPA CHPP. The CHPP is a voluntary program seeking to reduce the environmental impact of power generation by promoting CHP use. The Partnership works closely with energy users, the CHP industry, state and local governments, and other clean energy stakeholders to facilitate the development of new projects and to promote their environmental and economic benefits.	http://www.epa.gov/chp/

Information about States

Title/Description	URL Address
Challenges Facing Combined Heat and Power Today: A State-by-State Assessment. This 2011 ACEEE discusses barriers to CHP along with suggestions for how CHP stakeholders can further the development of the CHP market in the United States and individual states.	http://www.aceee.org/research-report/ie111
The 2014 State Energy Efficiency Scorecard. The Scorecard has measured the progress of state policies and programs that save energy while also benefiting the environment and promoting economic growth. Using data vetted by state energy officials, ACEEE ranks states in six categories—utility programs, transportation, building energy codes, CHP, state initiatives, and appliance standards.	http://www.aceee.org/research-report/u1408
Database of State Incentives for Renewables and Efficiency. This website contains extensive information on federal, state, and local programs, policies, and incentives for energy efficiency and renewable energy, including CHP. The database can be searched by program type, including green power programs.	http://www.dsireusa.org
EPA CHPP Policy Portal dCHPP (CHP Policies and Incentives Database). This online database allows users to search for CHP policies and incentives by state or at the federal level.	http://www.epa.gov/chp/policies/database.html

Examples of State Legislation and Regulations

State	Title/Description	URL Address
Arizona	In the Matter of the Notice of Proposed Rulemaking on Electric Energy Efficiency. This document provides the details about the adoption and rules of Arizona's EERS.	http://images.edocket.azcc.gov/docketpdf/0000116125.pdf

State	Title/Description	URL Address
California	Clean Energy Jobs Plan. This document outlines Governor Brown's goals for California's energy future, including the goal to develop 12,000 MW of new distributed energy facilities by 2020.	http://gov.ca.gov/docs/Clean_Energy_Plan.pdf
Connecticut	An Act Enhancing Emergency Preparedness and Response (Substitute Senate Bill No. 23). Section 7 of this Public Act establishes the Microgrid Pilot Program, which provides grants and loans to local distributed energy projects at critical facilities around the state. The program was established in the wake of Hurricane Irene and the October 2011 snowstorm to promote CHP and resiliency for the grid.	http://www.cga.ct.gov/2012/act/pa/pdf/2012PA-00148-R00SB-00023-PA.pdf
Georgia	Electric Service Tariff: Back-Up Service. This document provides the details about Georgia Power's back-up schedule and service, which is available under a tariff rider.	http://www.georgiapower.com/pricing/files/rates-and-schedules/12.30_BU-8.pdf
Louisiana	House Resolution No. 167. This is the resolution passed in 2012 in Louisiana stating that all critical government buildings must evaluate installing CHP in new construction or major retrofits of existing buildings.	http://legiscan.com/LA/text/HR167/id/651999/Louisiana-2012-HR167-Enrolled.pdf
Massachusetts	Massachusetts General Law Chapter 111, Sections 142 A through 142 M. This document contains Massachusetts' output-based emissions regulations, which include conventional emissions limits, emissions limits on small DG, allowance set-asides, allowance trading, and an emissions performance standard. Massachusetts Alternative Energy Portfolio Standard (AEPS). This AEPS describes the statewide CHP program.	https://malegislature.gov/laws/generallaws/parti/titlexvi/chapter111 http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/rps-aps/
Minnesota	Minnesota Climate Change Action Plan: A Framework for Climate Change Action. This document is the final climate change plan issued by the state, which outlines recommendations to the Governor for reducing Minnesota's GHG emissions.	http://www.pca.state.mn.us/index.php/view-document.html?gid=9237
New Jersey	NJPBU Order of Approval in the Matter of a Voluntary Green Power Choice Program (Docket No. E005010001). This document contains final NJPBU approval for the statewide green power program and also includes the document containing the final program description, framework, rules, and technical standards.	http://www.nj.gov/bpu/pdf/boardorders/EO05010001_20050413.pdf
	New Jersey Cogeneration Law (2007). This law exempts qualified cogeneration facilities from sales and use tax for natural gas and provides market access for sale of electricity to affiliated or contiguous users.	http://www.state.nj.us/treasury/taxation/cogennot.shtml

State	Title/Description	URL Address
New Mexico	Renewable Energy Act (S.B.43). This state legislation further clarifies elements of the state RPS and also specifies that sales through the voluntary green pricing programs are in addition to the RPS requirements (see Section 7).	http://www.nmlegis.gov/sessions/04%20Regular/bills/senate/SB0043FSS.HTML
New York	State of New York Public Service Commission: Order and Opinion Regarding Competitive Opportunities for Electric Service (Cases 94-E-0952 et al.). This document contains the original order that established New York's SBC. The second document contains the order for the continuation and expansion of the SBC.	http://www3.dps.ny.gov/pscweb/WebFileRoom.nsf/Web/E05EBC3E5C3E79B385256DF10075624C/$File/doc886.pdf?OpenElement http://www3.dps.ny.gov/pscweb/WebFileRoom.nsf/Web/98254B5953E8F4AC85256DF10075626B/$File/doc9157.pdf?OpenElement
North Carolina	Renewable Energy and Energy Efficiency Portfolio Standard (Senate Bill 3). This is the text of the North Carolina REPS, which defines rules and guidelines to meet the state's renewable energy and energy efficiency goals.	http://www.ncleg.net/Sessions/2007/Bills/Senate/PDF/S3v6.pdf
Oregon	Investigation Related to Electric Utility Purchases from Qualifying Facilities (Docket No. UM 1129). This is the investigation by the Oregon PUC into electric utility purchases from Qualifying Facilities.	http://apps.puc.state.or.us/edockets/docket.asp?DocketID=11114
Texas	Texas House Bill No. 1864. This bill states that critical government buildings must evaluate adding CHP as part of new construction or major retrofits to existing facilities.	http://www.capitol.state.tx.us/tlodocs/83R/billtext/pdf/HB01864F.pdf#navpanes=0
	Texas House Bill No. 3268. This bill requires the commission to adopt a permit by rule for natural gas engines and turbines that are part of a CHP system.	http://legiscan.com/TX/text/HB3268/id/314530/Texas-2011-HB3268-Enrolled.html
Utah	In the Matter of Analysis of an Integrated Resource Plan for PACIFICORP (Docket No. 90-2035-01). This document contains the IRP guidelines established for PACIFICORP by the PSC of Utah.	http://www.airquality.utah.gov/Public-Interest/Current-Issues/Regionalhazesip/RegionalHazeTSDdocs/Utah_PSC_Integrated_Planning_Rules.pdf
Washington	Revised Code of Washington: Voluntary Option to Purchase Qualified Alternative Energy Resources (19.29A.090). This is the enabling legislation for the Washington State Utilities and Transportation Commission green power program.	http://law.justia.com/codes/washington/2005/title19/19.29a.090.html

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ACEEE. 2014b. The 2014 State Energy Efficiency Scorecard. American Council for an Energy-Efficient Economy.	http://www.aceee.org/sites/default/files/publications/researchreports/u1408.pdf

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DOE. 2005. Iowa. Midwest CHP Technical Assistance Partnerships. U.S. Department of Energy.	http://www.midwestchptap.org/states/ia/
DOE. 2013. Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities. U.S. Department of Energy.	http://www.energy.gov/sites/prod/files/2013/11/f4/chp_critical_facilities.pdf
DSIRE. 2015. Summary Tables: Interconnection Standards. Database of State Incentives for Renewables and Energy Efficiency. Accessed April 22, 2015.	http://programs.dsireusa.org/system/program?type=14&category=2&
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EPA. 2012. CHP Project Development Handbook. Combined Heat and Power Partnership. U.S. Environmental Protection Agency.	http://www.epa.gov/chp/documents/chp_handbook.pdf; http://www.epa.gov/chp/project-development/index.html
EPA. 2013a. Calculating Reliability Benefits. Combined Heat and Power Partnership. U.S. Environmental Protection Agency.	http://epa.gov/chp/basic/benefits.html
EPA. 2013b. Guide to Using Combined Heat and Power for Enhancing Reliability and Resiliency in Buildings. U.S. Environmental Protection Agency.	http://www.epa.gov/chp/documents/chp_for_reliability_guidance.pdf
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Title/Description	URL Address
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EPA. 2015d. Portfolio Standards and the Promotion of Combined Heat and Power. Combined Heat and Power Partnership. U.S. Environmental Protection Agency.	http://www.epa.gov/chp/documents/ps_paper.pdf
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Oregon PUC. 2007. Docket No. UM 1129: Investigation Related to Electric Utility Purchases from Qualifying Facilities. The Public Utility Commission of Oregon.	http://apps.puc.state.or.us/edockets/docket.asp?DocketID=11114
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Title/Description	URL Address
SEE Action. 2013. Guide to the Successful Implementation of State Combined Heat and Power Policies. State and Local Energy Efficiency Action Network.	https://www4.eere.energy.gov/seeaction/publication/guide-successful-implementation-state-combined-heat-and-power-policies
TSL. 2013a. HB 1864: Relating to Certain Energy Security Technologies for Critical Governmental Facilities. Texas State Legislature.	http://www.legis.state.tx.us/BillLookup/History.aspx?LegSess=83R&Bill=HB1864
TSL. 2013b. HB 2049: Relating to a Qualifying Cogeneration Facility's Ability to Sell Electric Energy to Multiple Purchasers. Texas State Legislature.	http://www.legis.state.tx.us/BillLookup/History.aspx?LegSess=83R&Bill=HB2049
VEDA. 2015. Vermont Economic Development Authority (VEDA) Rates. Vermont Economic Development Authority.	http://www.veda.org/commercial-loan-rates-fees/
WA Commerce. 2012. Energy Strategy & Biennial Energy Reports. State of Washington Department of Commerce.	http://www.commerce.wa.gov/Programs/Energy/Office/Topics/Pages/EnergyStrategy.aspx
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Chapter 7. Electric Utility Policies

States are adopting new or modifying existing utility policies in order to enable greater investment in energy efficiency, renewable energy, and combined heat and power (CHP). State public utility commissions (PUCs) are aligning electricity resource planning and ratemaking processes to encourage utilities to fully incorporate these resource options into their infrastructure investment and operational decisions. PUCs are also modifying customer electricity rates and interconnection standards to support greater investment by families and businesses in energy efficiency, distributed renewable energy, and CHP. States are also providing policy direction to ensure that new electric grid investments are made and deployed in a manner that maximizes energy efficiency and renewable energy.

This chapter focuses on the authorities that state legislatures have granted to PUCs to regulate electricity rates and reliability, as these authorities directly affect utilities' and customers' investments in energy efficiency, renewable energy, and CHP. Other state agencies, such as air offices, energy offices, and consumer advocates, can work with their PUCs to provide collaborative input and/or formally intervene during policy design and implementation. Some of the policies in this chapter could also apply to municipally and cooperatively owned utilities—which are not subject to PUC regulation in most states—to the extent that states, elected officials, and local boards can direct or encourage these utilities to take action. For more context, see the overview of the U.S. electricity system later in this chapter.

State Policy Options in the *Guide to Action*

Type of Policy	For More Information
Funding	
Funding and Financial Incentive Policies	Chapter 3
Energy Efficiency Policies	
Energy Efficiency Resource Standards	Section 4.1
Energy Efficiency Programs	Section 4.2
Building Codes for Energy Efficiency	Section 4.3
State Appliance Efficiency Standards	Section 4.4
Lead by Example	Section 4.5
Renewable Portfolio Standards	
Renewable Portfolio Standards	Chapter 5
Combined Heat and Power	
Policy Considerations for Combined Heat and Power	Chapter 6
Electric Utility Policies	
Electricity Resource Planning and Procurement	Section 7.1
Policies That Sustain Utility Financial Health	Section 7.2
Interconnection and Net Metering Standards	Section 7.3
Customer Rates and Data Access	Section 7.4
Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration	Section 7.5

Table 7.1 lists examples of states that have implemented policies to incentivize energy efficiency, renewable energy, and CHP through electricity resource planning, ratemaking, terms of service, and direct grid investment. States can refer to this table to identify other states they may want to contact for additional information about their clean energy policies or programs. The *For More Information* column lists the *Guide to Action* section where each in-depth policy description is located.

In addition to the five policy areas covered by this chapter, states are adopting many other policies that maximize the benefits of energy efficiency, renewable energy, and CHP through utility policy approaches. These additional policies are addressed in other chapters of the *Guide to Action* as follows:

- "Funding and Financial Incentive Policies" describes additional ways states provide funding for clean energy supply through grants, loans, tax incentives, and other funding mechanisms (see Chapter 3).
- "Energy Efficiency Policies" presents policies that states have adopted to support cost-effective energy efficiency programs by removing key market, regulatory, and institutional barriers (see Chapter 4).
- "Renewable Portfolio Standards" describes how some states are requiring electric utilities and other retail electric providers to supply a specified minimum percentage (or absolute amount) of customer load with eligible sources of renewable electricity (see Chapter 5).
- "Policy Considerations for Combined Heat and Power" highlights policy options that states are using to capture the environmental, energy, economic, and reliability benefits of CHP technologies (see Chapter 6).

Table 7.1: Electric Utility Policy Options for Supporting Energy Efficiency, Renewable Energy, and CHP

Policy	Description	State Examples	For More Information
Electricity Resource Planning and Procurement	Many states require electric utilities to engage in resource planning through integrated resource planning, pre-approval of large capital investments, and resource procurement processes. These policies provide a mechanism for utilities, regulators, and other stakeholders to assess the long-term costs, benefits, and risks of existing and new supply- and demand-side resources. They also create a more level playing field for energy efficiency, renewable energy, and CHP.	CT, GA, NJ, NV, OR	Section 7.1
Policies That Sustain Utility Financial Health	Traditional regulatory approaches discourage investment in cost-effective demand-side resources that reduce sales. State PUCs can encourage energy efficiency, distributed renewable generation, and CHP by decoupling profits from sales volumes, enabling program cost recovery, and providing performance incentives.	AZ, CA, NV, NY	Section 7.2
Interconnection and Net Metering Standards	Interconnection and net metering rules play a critical role in promoting clean distributed generation (DG) systems such as renewable energy and CHP. Interconnection rules establish system requirements and application procedures, while net metering policies allow DG systems to receive credit for electricity generated on site that is exported to the grid. States can develop interconnection policies and net metering standards that remove barriers and facilitate clean DG.	MA, OR, UT	Section 7.3
Customer Rates and Data Access	Utility rates and other charges can influence the economic attractiveness of energy efficiency, distributed renewables, and CHP. Some rate structures have greater potential for clean energy benefits than others. Providing customers with access to energy usage data can serve a complementary role by helping them make informed and efficient decisions about their energy use.	CA, CT, GA, HI, IL, NY	Section 7.4
Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration	States can take steps to ensure that new investments in electricity distribution infrastructure are planned and operated in a manner that increases energy efficiency and enables high penetrations of renewable energy.	CA, IN, MA, MD, Pacific Northwest	Section 7.5

Overview of the U.S. Electricity System

To understand how these electric utility policies work, it helps to understand the U.S. electric power grid and the roles that states play. As the diagram on page 7-6 shows, the power grid is a complex, interconnected system. Most of the nation's electricity is generated at centralized power plants, transmitted over long distances through high-voltage transmission lines (sometimes across multiple states), and then delivered through local distribution wires to residential, commercial, and industrial end-users.

The system must generate enough electricity supply to meet demand from all end-users and deliver supply through a network of transmission and distribution lines. This balancing act takes place in real time, as the grid is limited in its ability to store excess power for later use. Maintaining this balance is challenging because the need for electric services is dynamic, with demand fluctuating depending on the season, the time, and the weather. Supply may also fluctuate based on operating conditions, as well as on weather conditions and time of day for renewable sources such as solar and wind.

Many companies and other organizations play a role in generating and delivering electricity. These entities are subject to regulations and oversight at the state, regional, and federal levels. States vary in their authorities over the types of power plants and delivery infrastructure that utilities build and maintain, as well as the terms of service for and rates charged by the utilities that deliver power to customers. Regional balancing authorities coordinate the transmission of electricity across states. In some areas of the country, this coordination takes place through organizations known as independent system operators (ISOs) or regional transmission organizations (RTOs). The Federal Energy Regulatory Commission (FERC)[52] approves the RTO/ISO market rules and recognizes the North American Electric Reliability Corporation (NERC)[53] as the national Electric Reliability Organization.

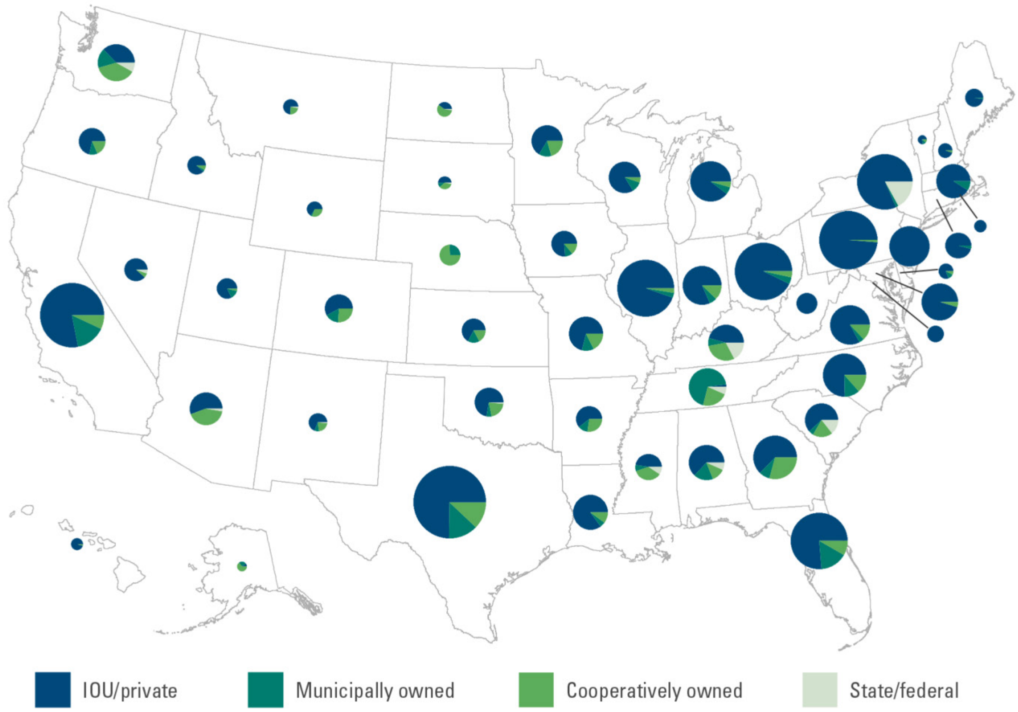
At the distribution system level, where electricity is delivered to retail customers, utility ownership type and state regulatory structure varies. About 75 percent of the nation's electricity is delivered by investor-owned utilities (IOUs)—which are for-profit corporations—or other private entities (Figure 7.1). The remaining electricity is delivered to customers by cooperatively owned utilities; utilities owned by local governments; and other publicly owned entities, including those owned by the federal government. For example, the Tennessee Valley Authority—a federally owned utility—generates electricity that it sells to certain large customers and other utilities. Similarly, four federal Power Marketing Administrations (PMAs) sell electricity generated by federally owned and operated hydroelectric dams in 33 states to other utilities and a few large customers.[54] Figure 7.1 shows how the prevalence of different types of utilities varies by state.

52 Visit http://www.ferc.gov for more information about FERC's roles and responsibilities.

53 Visit http://www.nerc.com for more information about NERC and its eight regional entities.

54 Visit http://www.eia.gov/todayinenergy/detail.cfm?id=11651 for more information about the four federal PMAs.

Figure 7.1: Share of Electricity Delivered to Customers by Utility Ownership Type, 2012



"IOU/private" includes IOUs, retail power marketers, and unregulated utilities. "Cooperatively and municipally owned" includes utilities classified as "cooperative" or "political subdivision."

Source: U.S. Energy Information Administration, Annual Electric Power Industry Report, Form 861, 2012 data.

Role of State Public Utility Commissions

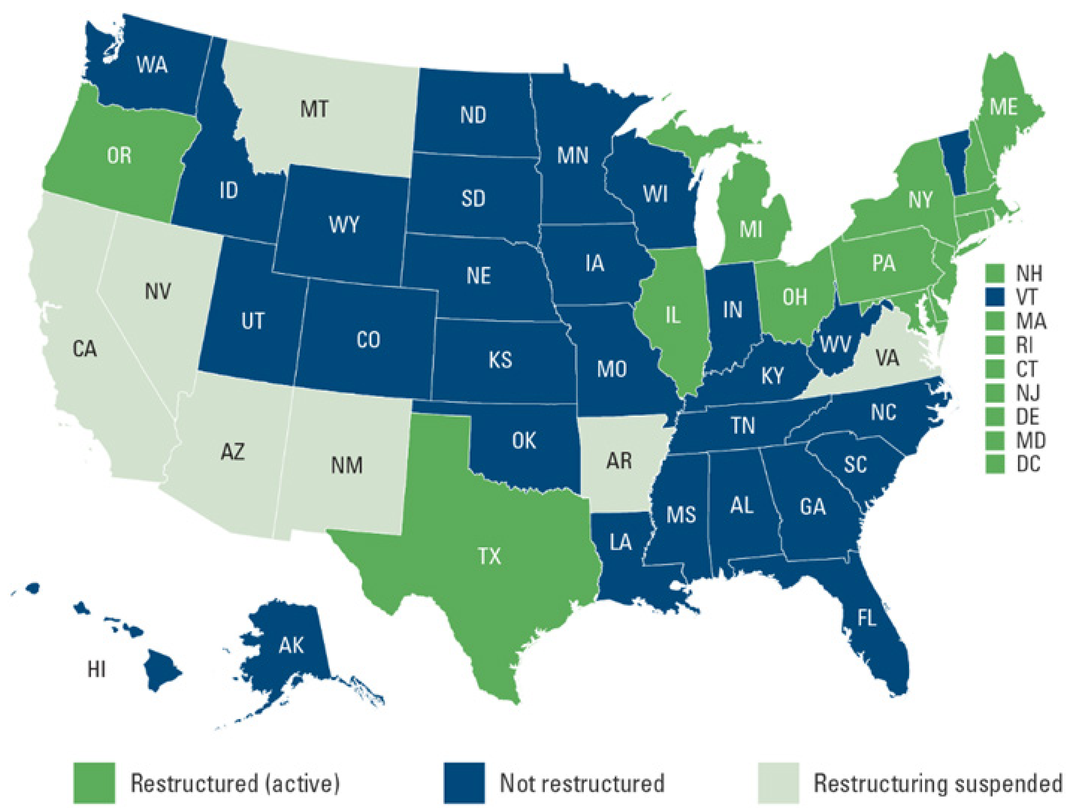
PUCs typically have authority over planning, ratemaking, and terms of service, which can all affect deployment of energy efficiency, renewable energy, and CHP. PUC processes vary by state, according to the authorities granted to them by the state legislature. The regulatory structure for the electricity market is a key difference across states. PUCs have traditionally regulated IOUs that generate, transmit, and distribute electricity. However, in the mid-1990s, some states restructured their electricity markets (also referred to as deregulated or retail choice states), which means that electricity generation may be owned and operated by independent power producers, with the PUC regulating the distribution service that is still provided by IOUs. Figure 7.2 shows these states. Although customers can purchase electricity from competitive suppliers in restructured states, PUCs still approve the rates the IOUs may charge for delivering the electricity to customers, as well as the electricity supply rates for those customers who do not purchase electricity from competitive suppliers.

Utility Costs and Revenues: A Bird's-Eye View

Electric utilities' costs fall into two main categories: *fixed costs*, such as infrastructure, and *variable costs*, such as the fuel used to generate electricity. Utilities recover these costs and earn money through the rates they charge to their customers. Some utilities earn a portion of their revenue through fixed charges, such as flat monthly service fees, but utilities typically earn most of their revenue through variable charges—that is, a charge per kilowatt-hour of electricity delivered. If a utility relies on volumetric charges to pay for a substantial portion of its fixed costs, as is often the case, the utility will have an incentive to increase electricity sales instead of decreasing them (e.g., by investing in energy efficiency). Section 7.2 discusses state policies that sustain utility financial health while increasing investment in energy efficiency, distributed renewable energy, and CHP.

PUCs typically have less authority over publicly and cooperatively owned utilities, though some states do regulate their rates to customers and oversee their electricity resource planning processes. For example, TVA has little to no direct state oversight, but the utility transmits electricity supply to 155 local distribution utilities that are subject to state requirements. Although municipally and cooperatively owned utilities may not be subject to the same PUC regulations as IOUs, they are overseen by elected local officials and/or boards of directors that require some form of public disclosure of the utility's performance and investment decisions.

Figure 7.2: Electricity Market Regulatory Structure by State



Source: U.S. Energy Information Administration, http://www.eia.gov/electricity/policies/restructuring/restructure_elect.html. Status as of April 2015.

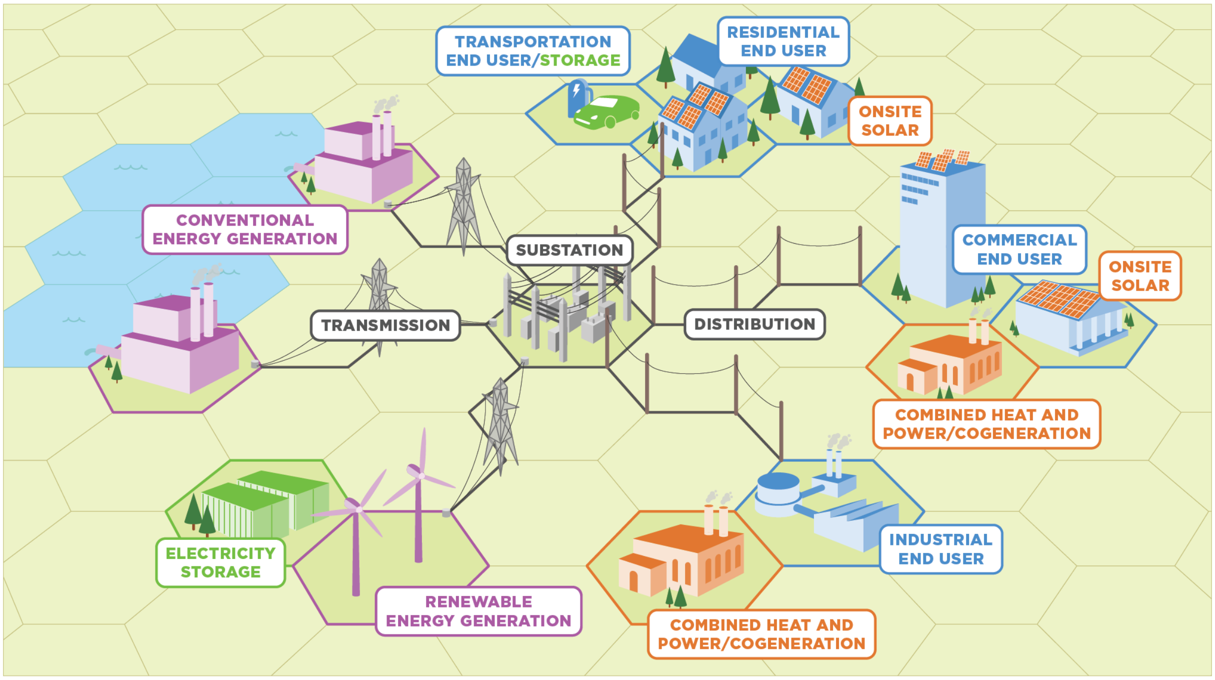
Role of State Environmental Agencies

Regardless of utility ownership and electricity market structure, state air agencies and other environmental regulators have authority over the electric power sector because of its substantial environmental impacts. The carbon dioxide emitted from generating electricity accounts for about one-third of all the nation's greenhouse gas emissions—more than any other activity. Most of the United States' electricity is generated by burning fossil fuels, which also emits other forms of air pollution that contribute to environmental problems such as acid precipitation, regional haze, and smog. Electric power generation can also require large quantities of water for cooling, discharge warmer water into local water bodies, and produce waste.[55]

[55] For more information on the environmental impact of electricity generation, see www.epa.gov/energy.

Figure 7.3: A Quick Guide to the U.S. Electric Power Grid: How Electricity Is Generated and Delivered to Customers

The U.S. electricity system is a complex network of power plants, transmission and distribution lines, and end-users of electricity. This system is called the **electric power grid**.



CENTRALIZED GENERATION

The United States generates most of its electricity at centralized power plants, which are usually located away from end-users. In 2013, most U.S. electricity generation came from **conventional sources**, including coal, natural gas, and other fossil fuels (67%), and nuclear power (19%). **Renewable sources** include hydroelectricity (7%) and wind and solar (6%). Large wind and solar installations are considered centralized generation, and their share of total generation is projected to increase.

DISTRIBUTED GENERATION

Distributed generation refers to technologies that generate electricity at or near where it will be used, such as **onsite solar panels**, **combined heat and power**, and diesel generators. Distributed generation may serve a single structure, such as a home or business, or be part of a system such as a microgrid at an industrial complex, military base, or college campus. When connected to the grid, onsite solar and combined heat and power have the potential to support delivery of clean, reliable power to additional customers and to reduce electricity losses along transmission and distribution lines. Distributed sources produce far less electricity than centralized power plants, but their use is growing.

STORAGE

Thermal and electricity storage technologies can be used to improve reliability, save excess power for when it is needed, and reduce costs. Though not widespread today, storage options are increasingly being used to support renewable energy generation. Electric vehicles may be used for storage if they charge when power demand from the rest of the grid is low (e.g., at night) and feed power back into the grid when demand is high.

DELIVERY

Once electricity is generated at a centralized power plant, it travels long distances through a series of interconnected high-voltage **transmission** lines. **Substations** "step-down" high-voltage power to a lower voltage, sending the lower voltage electricity to consumers through a network of **distribution** lines.

END-USERS AND ENERGY EFFICIENCY

U.S. electricity use is approximately evenly split among **residential**, **commercial**, and **industrial** customers. The **transportation** sector accounts for a small fraction of electricity use, though this may increase due to electric vehicles. End-users can meet some of their needs by adopting energy-efficient technologies and practices. In this respect, energy efficiency is a resource that reduces the need to generate electricity.

7.1 Electricity Resource Planning and Procurement

Policy Description and Objective

Summary

Most states require utilities to engage in a form of electricity resource planning to substantiate that the utility's plans for meeting demand for electricity services are in the public interest. Planning processes vary greatly across states, but are most commonly accomplished through processes that consider costs, benefits, and risks over the long term, including integrated resource planning or integrated resource plans (IRP) and power plant investment preapprovals through a Certificate of Public Convenience and Necessity (CPCN).[56]

As part of electricity resource planning, utilities compare options for meeting customer demand for electricity services. Electricity resource planning includes power plants, electricity delivery, and end-use demand.

State public utility commissions (PUCs) include electricity resource planning as part of docketed proceedings[57] that encourage public involvement and transparency. The PUC's role is to review and evaluate plans, and its goals include providing reliable, least cost electricity service to customers. Incorporating energy efficiency, renewable energy, and combined heat and power (CHP) in electricity resource planning is consistent with these goals.

Electricity resource planning decisions are typically long-term in nature, having implications for decades. Effective planning and procurement policies may help parties evaluate the impact of market changes and regulations on existing and new electricity resources, and mitigate short-term cost fluctuations by developing robust and diverse resource portfolios that include energy efficiency, renewable energy, and CHP.

For utilities that own and operate electricity generation, transmission, and distribution, resource planning may be part of both IRP and planning for discrete resource approvals (such as through CPCN). For load-serving utilities in restructured electricity markets, resource planning also informs how these utilities procure electricity supply for default customers (i.e., those who do not purchase electricity from competitive electricity suppliers). For more information on electric utility ownership and electricity market structures, see the electricity grid overview provided in the introduction to Chapter 7.

A successful electricity resource planning approach typically includes:

- Rigorous and meaningful participation of diverse stakeholders, including the utility, utility regulators, consumer advocates, and environmental advocates.
- Development and vetting of key analysis factors, such as demand forecasts, commodity price forecasts, and available resource options.

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[56] The CPCN dates back to the 1870s and is a legal term that applies to regulatory regimes governing public service industries (Jones 1979). While most states continue to call this legal process "CPCN," some use the abbreviation "CCN" and others use a different name altogether. In Minnesota, for example, the process is referred to as Advance Determination of Prudence and in Vermont it is referred to as Certificate of Public Good.

[57] Here, a docketed proceeding refers to the process through which a utility formally files a request or a proposed plan with the state PUC. The PUC reviews the submission and ultimately makes a final determination. When the initial submission is filed, the PUC opens a docket where the initial filing and subsequent stakeholder comments, amendments, revisions, and decisions are stored. PUCs typically make these dockets accessible to the public electronically.

- Use and vetting of one or more correctly scaled and structured electricity system models.

This chapter discusses several policy options to encourage decision-makers to consider all resources in electricity resource planning. The information presented about these policies and their implications is based on the experiences and best practices of states that have implemented planning policies, as well as other sources, including local, regional, and federal agencies and organizations; research foundations and nonprofit organizations; universities; and utilities (SEE Action 2011; Synapse 2013; Tellus 2010).

Objective

Most states require electric utilities to engage in transparent and public planning processes to achieve a mix of energy resources that cost-effectively and reliably meet customers' demand for electricity service in the near- and long-term with due consideration for state priorities and risk. Given the economic, environmental, and other benefits of energy efficiency, renewable energy, and CHP, states are adopting specific policies to encourage utilities to more fully incorporate these resources into their plans. Utilities have expertise in electricity resource planning, but other stakeholder perspectives are also useful to ensure that broader public interests are served.

Benefits

By adopting policies to fully integrating energy efficiency, renewable energy, and CHP into electricity resource planning, states help ensure that utilities consider a broad range of electricity resource options and avoid investment in more expensive electricity supply or delivery infrastructure that may not be consistent with state objectives for least cost and reliable electricity service. In addition, increasing the penetration of low- or no-emission resources may reduce the cost to comply with existing and future environmental regulations. Utilities, their customers, and the public benefit from a more diverse resource mix that leverages the multiple benefits of energy efficiency, renewable energy, and CHP (see Chapter 1, "Introduction and Background"). They also benefit from greater certainty that utility regulators will allow the recovery of costs from investing in energy efficiency, renewable energy, and CHP.[58]

Background on State Electricity Resource Planning

States use rate case proceedings to set electricity rates that allow utilities to recover costs, such as fuel procurement, operational, maintenance, and capital expenses. In a traditional rate case, a utility must prove that investments and commitments made on behalf of ratepayers were reasonable. The utility must also consider any resource portfolio or performance standards that the state might have in place (see p. 7-7-20 for additional discussion). Electricity resource planning and resource procurement processes are designed to mitigate the utilities' risk of planning imprudence; share information; and offer regulators, consumers, and other stakeholders an opportunity to influence utility decisions.

From the late 1980s through the mid-1990s, IRP processes were common in the electric industry. With vertically integrated[59] electric utilities responsible for generation, transmission, and distribution services for their customers, integrated resource planning was a useful tool for developing the most efficient resource

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[58] Cost recovery is determined in separate proceedings that typically allow cost recovery when a utility's investment decisions are demonstrated to be in the public interest (usually least cost/least risk).

[59] Vertical integration refers to a situation where the same entity (a utility) owns and operates generating units (power plants), transmission lines, and distribution of electricity to customers. Some states and utilities still largely follow this model, while others have decoupled generation, transmission, and distribution through restructuring. See the introduction to Chapter 7, "Electric Utility Policies," for more discussion about various types of utilities and market structures.

portfolio. In 1992, 36 states had IRP requirements in place. After electricity market restructuring, the prevalence of ratepayer-funded energy efficiency programs declined significantly as the focus of resource planning shifted to short-term commitments. States either rescinded their IRP regulations or ceased requiring utilities to comply with them. However, many states are returning to IRP processes as a tool to ensure a variety of public goals.

Today, most states require one or more forms of electricity resource planning. Planning requirements differ significantly from state to state, and even within a state. Some regulations require that utilities use distinct methods of analysis or consider specific resources in planning. To the extent that utilities must create more than one resource plan in the same state in order to comply with separate regulations, they may have different processes for creating those plans, and thus they may arrive at significantly different conclusions, despite being governed by the same regulators. The varying definitions of electricity resource planning processes generally fall into four categories: IRP, discrete resource approvals through CPCN, default service (also referred to as Standard Offer Service), and long-term procurement planning (LTPP). Table 7.1.1 summarizes these policies, and Table 7.1.2 identifies which policies are in place in each state. Descriptions of each policy follow. Some of these policies are specific to either regulated or restructured (sometimes called deregulated) states; see the introduction to Chapter 7 for an overview of these concepts.

Table 7.1.1: Electricity Resource Planning and Procurement Strategies at a Glance

Strategy	Overview	Applicability	Legal Status
Integrated Resource Planning	Integrated resources planning results in utility plans for meeting forecasted annual peak and energy demand through a portfolio of supply-side and demand-side resources over a specified future period.	With some exceptions, IRP rules typically apply to generation and transmission owners in regulated states.	State PUCs conduct a formal review of IRPs, but these reviews are generally not legally binding.
Discrete Resource Approvals Through a CPCN	A CPCN is a docketed proceeding before a state utility commission in which a utility provides justification for a large capital investment in generation or transmission infrastructure.	A CPCN is required for owners of generation and transmission projects. It occurs in both regulated and restructured states, as required by state law.	A CPCN proceeding is a litigated process. An approval gives permission, but does not require, a utility to take the requested action.
Default Service	Default service provisions—also known as Standard Offer Service—ensure that load-serving utilities procure electricity for those customers who have not elected to choose a competitive energy provider.	Default service applies to distribution-only utilities operating in restructured states.	Procurement of electricity for default service customers is required by law.
LTPP	LTPP refers to utility plans that solicit market-based supply offers over a shorter time period than traditional IRPs.	LTPP applies to distribution-only utilities operating in restructured states.	In states where it occurs, LTPP is required by law.

Table 7.1.2: States with Electricity Resource Planning Processes, as of December 2014

State	Integrated Resource Planning	Discrete Resource Approvals Through a CPCN	Default Service	LTPP
Alabama	a	✓		
Alaska	b			
Arizona	✓			
Arkansas	✓	✓		
California			✓	✓
Colorado	✓	✓		
Connecticut	✓		✓	✓
Delaware	✓		✓	
District of Columbia			✓	
Florida		✓		✓c
Georgia	✓	✓		
Hawaii	✓			
Idaho	✓			
Illinois	✓		✓	✓
Indiana	✓	✓		
Iowa	✓d			
Kansas		✓		
Kentucky	✓	✓		
Louisiana	✓	e		
Maine			✓	
Maryland		✓	✓	
Massachusetts			✓	✓
Michigan	✓		✓	✓
Minnesota	✓	✓		
Mississippi	✓	✓		
Missouri	✓			
Montana	✓			
Nebraska	✓			
Nevada	✓	✓		
New Hampshire	✓		✓	
New Jersey			✓	
New Mexico	✓	✓		
New York			✓	
North Carolina	✓	✓		
North Dakota	✓	✓		
Ohio			✓	
Oklahoma	✓	f		
Oregon	✓		✓	
Pennsylvania			✓	
Rhode Island			✓	
South Carolina	✓			
South Dakota	✓			
Tennessee	g			

Table 7.1.2: States with Electricity Resource Planning Processes, as of December 2014

State	Integrated Resource Planning	Discrete Resource Approvals Through a CPCN	Default Service	LTPP
Texas			✓	✓
Utah	✓	h		
Vermont	✓	✓		i
Virginia	✓			
Washington	✓			
West Virginia		✓		
Wisconsin		✓		
Wyoming	✓	✓		

Note: Planning requirements vary by state.

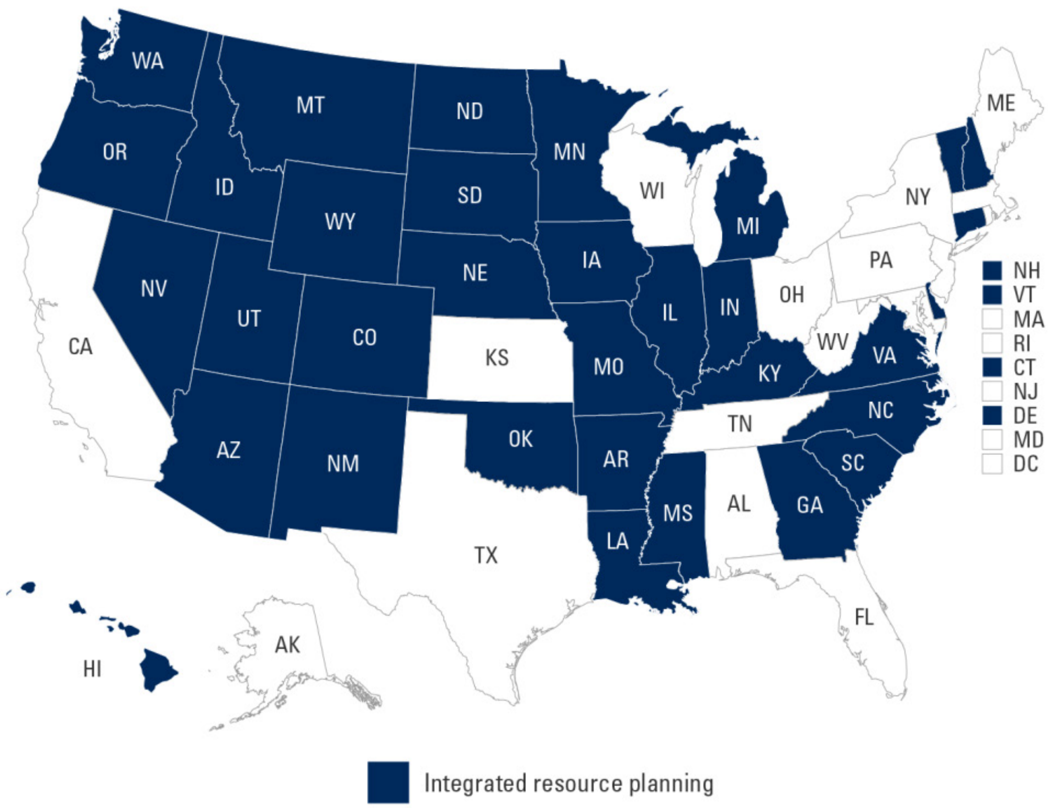
a As a subsidiary of the Southern Company, Alabama Power (the state's largest electric supplier) engages in integrated resource planning. The Public Service Commission (PSC) has not formally adopted an integrated resource planning standard, but notes that it has "ongoing knowledge of and involvement in Alabama Power's IRP process" (Alabama PSC 2007).
b As a response to a directive from the Alaska Legislature, the Alaska Energy Authority produced a regional IRP in 2010, but there is no formal process or IRP rule.
c Ten-year site plans (generation expansion and site planning) are presented to the PSC on an annual basis.
d There is no statute or rule relating to integrated resource planning; however, the Iowa Utilities Board may request a resource plan on an as-needed basis, and utilities do file them as part of docketed proceedings.
e Utilities may voluntarily file with the PSC for preapproval to construct new resources or modify existing resources.
f Utilities may voluntarily file with the PSC for preapproval to construct new resources or modify existing resources.
g While there is no IRP rule, the Tennessee Valley Authority (TVA) has voluntarily participated in integrated resource planning. TVA's most recent resource plan was released in March 2011; the plan prior to that one was released in 1995. TVA plans to start the process again in 2015.
h Utilities may voluntarily file with the PSC for preapproval to construct new resources or modify existing resources.
i Vermont's Sustainable Priced Energy Enterprise Development Program establishes a mechanism for the rapid procurement of renewable power by state utilities.

Source: Research conducted for EPA's Energy and Environment Guide to Action by Synapse Energy Economics

Integrated Resource Planning

IRPs are utility plans for meeting forecasted annual peak and energy demand, along with some established reserve margin, through a portfolio of supply-side and demand-side resources over a specified future period. As of early 2015, integrated resource planning is required or present in more than 30 states, including most vertically integrated states. See Figure 7.1.1 for a map of states with integrated resource planning, and see the introduction to Chapter 7 for an indication of which states have vertically integrated utilities. IRP processes vary in their degree of rigor, stakeholder feedback process, and degree to which they are subject to regulatory scrutiny. In states that conduct integrated resource planning, the process provides an opportunity to examine how energy efficiency, renewable energy, and CHP affect utility operations, customer costs, system reliability, and risk. State PUCs generally do not require or enforce specific findings or outcomes as part of the IRP development or vetting process. Thus, IRPs are generally not legally binding. Instead, regulatory commissions have formal proceedings to approve the content of the IRP, acknowledge that IRP processes were followed, or both. These proceedings differ by state. State PUCs may expect or require that significant deviations from IRPs be justified in rate cases or preapproval processes. IRPs do not negate the need for discrete resource approvals and should form the framework for other resource processes and decisions. Table 7.1.2 shows that many states have provisions for both integrated resource planning and discrete resource approvals, such as CPCNs.

Figure 7.1.1: States That Require IRPs



Source: Research conducted for EPA's Energy and Environment Guide to Action by Synapse Energy Economics, updated from Synapse 2013.

Discrete Resource Approvals

Discrete resource approval refers to a proceeding before a state utility commission in which a utility provides justification for a large capital investment in generation or transmission infrastructure. If the utility succeeds in justifying their investment, they are granted a CPCN. Some regulatory commissions or state statutes require that significant power plant additions, new plants, or large capital investments above a certain threshold go through this process. At least one state (Vermont) also requires large and lengthy power purchase contracts to get such an approval because of the potential financial risk and impact on customers. As of early 2015, at least 19 states have some form of CPCN (see Table 7.1.2), although not all states regularly exercise these statutes. Some states (such as Louisiana and Utah) without these statutes offer a parallel voluntary process. These processes maintain many of the same analytical and planning elements of integrated resource planning, but they include regulatory review by intervenors[60] rather than an interactive and potentially contested stakeholder process. Unlike integrated resource planning, CPCN processes are not a utility forum for gathering and disseminating information. Rather, they are a mechanism for utilities to justify discrete actions prior to regulatory approval. CPCNs are litigated processes argued before a state's public utility commissioner or

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[60] Intervenors might include attorneys general, industrial groups, generation owners, transmission owners, land owners, consumer advocates, environmental groups, and other citizen action groups.

hearing official. CPCNs are legally binding and enforceable: a utility that obtains a CPCN from a PUC has generally proven, to the satisfaction of that PUC, that a plan is prudent.

The definition of when a CPCN is required differs from state to state. States that require CPCN or a similar proceeding for the acquisition of large new capital investments include Georgia, Indiana, Kentucky, Minnesota, West Virginia, and Wisconsin, among others. A CPCN provides the opportunity for state entities to ensure that energy efficiency, renewable energy, and CHP are considered on par with other capital investments. For example, the Vermont PUC requires this comparison as part of its discrete resource approval process, called a Certificate of Public Good.

A CPCN does not necessarily guarantee that a utility will recover the costs of a capital investment in rates; instead, it establishes that the choice to move forward with a capital investment is prudent at the cost, or cost range, established in the plan. To mitigate the risk of not recovering capital investments in rates after a project is in service, some states allow for preapproval or cost riders, through which utilities can begin recovering costs prior to the project being constructed. Even in this situation, the utility's project management is subject to review to ensure that any money wasted through poor project oversight is not charged to customers. Preapproval dockets are often coupled with CPCNs in a litigated process. By ensuring recovery, preapproval processes shift the risks inherent in planning to ratepayers; preapprovals generally release the utility from further regulatory review of discrete projects, unless costs are above utility expectations. States that have exercised preapproval or cost riders for generation additions include Indiana, Georgia, Kentucky, Kansas, Wisconsin, and West Virginia; other states may have unexercised provisions.

State Energy Planning Processes

States also maintain a regular or occasional executive or legislative-driven statewide energy planning process, wherein the state reviews policies and practices targeted towards specific outcomes such as resource utilization, economic development, or climate or other environmental goals. These plans may be completely independent of utilities—examining long-term and general policy measures with a particular end-goal—or may explicitly engage utilities and require companies to meet specific performance requirements (NASEO 2013a). By early 2013, at least 20 states were updating existing state energy plans or developing new plans, and at least 45 states will have operational state energy plans (NASEO 2013b). In addition, states may also conduct a form of planning to inform the development of specific state policies, such as renewable portfolio standards; energy efficiency resource standards; and funding levels for energy efficiency, renewable energy, and CHP programs.

Default Service

In restructured states, customers still have their electricity *delivered* by a regulated utility that operates the distribution network (i.e., a load-serving utility), but they may be able to choose the *source* of their electricity by comparing products and rates from a variety of companies. This process is known as retail choice, and the suppliers are called competitive retail suppliers (or something similar). Default service provisions ensure that load-serving utilities procure electricity for those customers who have not elected to choose a competitive retail supplier. In many of these states, default service is the primary supply option for residential and small commercial and industrial customers. As of April 2015, 15 states and Washington, D.C., offered whole or partial retail choice (EIA 2015) (see Figure 7.2 in the introduction to Chapter 7). Virginia and Oregon offer limited retail choice to large customers (Oregon 2001; Virginia 2007). Though retail choice has been an option for customers in these states for many years, the majority of residential load in these jurisdictions is served through procurement by a regulated utility (Aspen 2008).[61]

[61] Texas is one exception, as retail choice is required in this state. Eligible residential customers must choose a competitive supplier or they will be assigned one; however, customers in utility service areas outside of the Electric Reliability Council of Texas are not eligible, and municipally and cooperatively owned utilities may opt out of the program.

Default service requirements vary among jurisdictions. However, one common theme across requirements is the use of laddered contracts to minimize exposure of the default service load to price volatility. Under the ladder structure, only a fraction of the default service load is exposed to current market prices. Default service procurement typically reviews supply for periods as short as 6 months, or as long as 5 years. Therefore, default service planning requirements typically do not require long-term assessments of supply options outside the procurement period.

In some states such as Illinois and Maine, default service requirements specifically require that default service products meet state renewable portfolio standard (RPS) requirements. Because regulatory commissions approve default service rates, additional policies may be recommended in regulatory proceedings that could provide further price and stability benefits to customers. These could include cost-effective energy efficiency, renewable energy, and CHP carve-outs for a portion of the load dedicated to long-term contracts.

Long-Term Procurement Planning

LTPP requires that utilities prepare plans soliciting market-based electricity supply offers over a shorter time period than traditional integrated resource planning (typically 10 years or fewer). State policies that promote renewable energy resources have led to a return to these long-term resource planning practices, even in some restructured states with default service. When retail competition was introduced, utilities halted long-term planning efforts and relied on market competition to keep electricity prices low. However, when RPS policies began to be introduced, renewable resources often had higher capital costs and costs of delivered energy than conventional generation, and investors were hesitant to support these projects without guaranteed cost recovery well beyond the default service procurement window. As a result, regulators in many states began to require that utilities engage in LTPP. Unlike IRPs, procurement plans must often be updated every year. While some states like California allow load-serving utilities to own generation, LTPP processes usually evaluate purchases[62] for capacity and energy, as well as energy efficiency and other demand-side management programs. Default service states and states engaging in LTPP processes are shown in Table 7.1.2.

States with Existing Policies to Encourage Energy Efficiency, Renewable Energy, and CHP in Electricity Resource Planning

In addition to requiring resource planning, many states have enacted laws that require or encourage utilities to incorporate energy efficiency, renewable energy, and/or CHP into electricity resource planning. These policies range from requirements that all cost-effective energy efficiency be incorporated into planning to assessing the long-term risks and costs of new and existing fossil-generation stations. Electricity resource planning can be accomplished through a variety of modeling mechanisms, tuned to specific questions, as well as utility and regulatory requirements. The use and design of planning models are generally guided by best practices rather than explicit policies. With this in mind, the policies discussed in Table 7.1.3 also include those that states have taken to ensure that energy efficiency, renewable energy, and CHP are fairly considered in modeling. The last three policies are designed to ensure that planning processes are rigorous and lead to the actions for which they are intended.

[62] "Purchases" are distinguished from "acquisitions" with regard to the ultimate ownership of the resource. In an acquisition, the utility takes ownership of a resource and responsibility for that resource through its lifetime. A purchase agreement is a financial transaction for access to energy and/or capacity or other services through a specified time period.

Table 7.1.3: Policies States Use to Integrate Energy Efficiency, Renewable Energy, and CHP in Electricity Resource Planning and Procurement

Policy	Description	State Examples
Require third-party energy efficiency potential studies.[a]	Require, or have required, utilities to commission energy efficiency potential studies as part of planning process, or perform a statewide study for use in planning.	AR, CA, IA, IN, MA, OR, WI
Mandate all cost-effective energy efficiency in planning.	Require that utilities plan for all achievable cost-effective energy efficiency, or demonstrate that all supply-side and demand-side resources have been evaluated on a consistent and comparable basis.	CA, IN, MA, OR, Northwest[b]
Update assumptions for renewable energy capacity value, and supply and integration costs.	Require or explicitly note that renewable energy costs and attributes change over time, and should be kept up to date.	AZ
Quantify reasonably expected environmental regulations.	Have policies requiring cost consideration for future environmental regulations.	IN, OR, WY
Tie investment decisions to planning process and follow up on action plans.	Require that integrated resource planning result in an action plan with resource activities the utility intends to undertake over the next 2 to 4 years. Test investment decisions against integrated resource planning results.	IN, OR
Leverage existing knowledge from state utility and environmental regulators.	Have mechanisms for coordinating environmental permitting and utility electric planning.	CA, CT
Promote meaningful stakeholder involvement.	Provide funding opportunities for public interest stakeholders and intervenors in planning cases.	IN, ME, NY, OR, WI

States have also required one or more utilities to perform their own energy efficiency potential studies for use in planning processes. Example states include CA, CO, GA, IA, ID, IL, KS, KY, MA, MI, MN, MO, NM, NV, NY, OR, PA, TN, TX, UT, VT, WA, WI, and WY.

The Northwest Power and Conservation Council is mandated by the Northwest Power Act to incorporate all cost-effective energy efficiency into its regional electricity resource planning across Idaho, Montana, Oregon, and Washington.

Require Third-Party Energy Efficiency Potential Studies

Energy efficiency potential studies investigate new savings opportunities for specific measures and end-uses, customer segments, building types, and costs (see Chapter 2, "Developing a State Strategy," for details). While these studies are often used to develop short-term savings targets and budgets, they may also be used to inform utilities and policy-makers of long-term energy savings opportunities, which may then be used in utility integrated resource plans or long-term resource plans at the state or regional level. For example, the Northwest Power and Conservation Council (NWPCC) conducts energy efficiency potential studies for the entire region as part of its regional power plans, which seek "an electrical resource strategy that minimizes the expected cost of, and risks to, the regional power system over a long period of time" (NWPCC 2010b). Comprehensive energy efficiency potential studies provide the basis for setting near-term planning expectations and reasonable long-term trajectories in resource plans. For instance, Efficiency Maine Trust, the efficiency program administrator in Maine, commissioned energy efficiency potential studies to develop multi-year efficiency plans and goals (EMT 2012). Groups that specialize in the development of these studies are able to leverage experiences of multiple states, including those that have already evaluated achieved savings (PSC Wisconsin 2014; Vermont DPS 2011).

Mandate All Cost-Effective Energy Efficiency in Planning

Energy efficiency can provide a long-term, reliable, and low risk electricity resource. Efficiency avoids near-term energy and emissions, and it also avoids long-term capacity and transmission expansion requirements (see Chapter 1 for information on energy efficiency benefits). Some states have required utilities to develop long-term electricity resource plans that rigorously review opportunities to acquire and pursue all cost-effective energy efficiency. In some states, a comprehensive estimate of the avoided energy cost (as well as capacity and emissions) is used to characterize the amount of energy efficiency that is cost-effective (AESC 2013).[63] Other states, such as Oregon, require that "to the extent that a utility controls the level of funding for conservation programs in its service territory, the utility should include in its action plan all best cost/risk portfolio conservation resources for meeting projected resource needs, specifying annual savings targets" (OPUC 2007). In 2003, California adopted a "loading order" for new resource requirements, which gives significant preferential treatment to energy efficiency as the primary mechanism for reducing and meeting new demand (California 2003).

Energy Efficiency Avoided Costs

To evaluate energy efficiency programs, states require the development of avoided costs to quantify energy efficiency benefits. Avoided costs are what would have been spent in the absence of the energy efficiency.

Avoided costs incorporated into planning processes include projected costs for electricity. Some states have expanded avoided costs to include emissions compliance, price effects, other resources (such as fuels and water), renewable energy certificates, transmission and distribution costs, and/or other non-energy benefits.

Update Assumptions for Renewable Energy Capacity Value and Supply and Integration Costs

As the market for renewable energy technologies expands, manufacturing and installation costs decline. Projecting a flat present-day cost and performance for renewable energy options may be an overly conservative estimate, undervaluing the likely contribution and benefit of these resources over the period of the electricity resource plan. In particular, if outdated costs and performance data are used, the plan may not even reflect contemporary costs—much less the expected declining costs in the future. In a recent review, the National Renewable Energy Laboratory (NREL) found that "most [interviewed] utilities had forecast a declining cost curve in their planning assumptions, only to see the actual costs decline much more steeply than anticipated" (NREL 2013). In a 2011 IRP, Portland General Electric found a significant decline in the cost of wind since its 2009 IRP (PGE 2011). In a 2011 IRP, Idaho Power asserted that declining solar photovoltaic (PV) costs would likely make this resource a more significant part of its portfolio in the future (Idaho Power 2011).

Quantify Effects of Reasonably Expected Environmental Regulations

Environmental regulations that are already promulgated and implemented may impose known costs or operating restrictions. Predicting the impact of regulations that are not yet finalized can be more difficult, but is still a critical element of prudent planning.[64] Oregon rules require utilities to account for regulatory compliance costs for carbon dioxide (CO_2) and criteria pollutants (OPUC 2007). Arizona requires that utilities

[63] For this reason, avoided costs are extremely important to an IRP, as they help determine the amount of customer demand that can be met by energy efficiency and the amount that must be met by supply-side resources. Assumptions about costs for energy efficiency and demand response should be updated frequently to ensure that the amount of cost-effective energy is accurately represented as costs for these measures decline over time.

[64] For example, PacifiCorp states that with regard to integrated resource planning, "in parallel to administration of the Regional Haze rules, state agencies and EPA must also ensure compliance with other environmental regulations including the recently enacted Mercury and Air Toxics Standards (MATS), and emerging regulations for coal combustion residuals (CCR) handling and storage, Clean Water Act §316(b) cooling water intake rules, and effluent limitation guidelines (ELG). The Company must therefore assess not only currently known obligations, but must also assess reasonably foreseeable compliance obligations in its analyses" (PacifiCorp 2013).

"analyze and address in their plans environmental impacts related to air emissions, solid waste, and other environmental factors and reduction of water consumption and to address the costs for compliance with current and projected environmental regulations" (AZCC 2010). Similarly, draft integrated resource planning rules in Indiana require an analysis of how the plan conforms to the "utility-wide plan to comply with existing and reasonably expected future state and federal environmental regulations" (IURC 2012). Planning processes give utilities the opportunity to work with both the state and the stakeholder community as they address future environmental regulations.

Tie Investment Decisions to Planning Processes and Follow Up on Action Plans

Resource planning processes should be tied to anticipated real actions and activities performed by electric service providers. In many IRPs, the resulting near-term plan is termed the action plan, an explicit list of activities and procurements that the utility intends on completing based on the IRP. In some states, the approval of an IRP implies approval of near-term utility actions; in other states, approval of an IRP signals that the IRP's intent is reasonable, but the actual decisions may be contested at a later date, such as through a CPCN process. Regardless of the intent, states have found that utilities file action plans to make explicit their intent following planning proceedings, and states follow up on action plans to assess if the planning process has resulted in expected outcomes. State requirements for action plans vary. Georgia requires that utilities provide "a description of the major research projects and programs the utility will continue or commence during the ensuing three-year period, and the reasons for their selection" (Georgia 1997). At a more detailed level, Arizona requires that "with its resource plan, a load-serving entity shall include an action plan, based on the results of the resource planning process, that: (1) includes a summary of actions to be taken on future resource acquisitions, (2) includes details on resource types, resource capacity, and resource timing, and (3) covers the three-year period following the Commission's acknowledgement of the resource plan" (AZCC 2010).

Leverage Existing Knowledge from State Utility and Environmental Regulators

Some states leverage existing knowledge and expertise between utility regulators and environmental regulators to help inform utility plans. Permits issued by environmental regulators may explicitly shape utility actions and planning outcomes. Therefore, states have found significant benefits from enhanced dialogue between utility and environmental regulators (RAP 2013). In particular, this communication can help inform coherent, multi-pollutant-aware permitting processes, help PUCs respond and prepare for existing and emerging environmental regulations, and ensure that decisions from agencies do not work toward cross-purposes.

States that explicitly coordinate utility and environmental regulators do so using a wide variety of mechanisms. In 2011, the Oklahoma Corporation Commission opened an inquiry to examine current and pending federal environmental regulations, drawing on expertise from state environmental regulators and stakeholders (OCC 2011). Similarly, Oregon has opened a planning process with public input for the Clean Power Plan; comments by Oregon Department of Environmental Quality were submitted in cooperation with the Department of Energy and PUC (ODEQ 2014). In a more formal move, the Colorado Clean Air Clean Jobs Act explicitly requires the approval of the state Department of Public Health and Environment, and requires that "the Commission shall not approve a plan except after an evidentiary hearing and unless the Department has determined that the plan is consistent with the current and anticipated requirements of the federal [Clean Air] Act" (Colorado 2010). Recognizing the value of collaboration, the Connecticut Department of Energy and Environmental Protection (CT DEEP) was created in 2011, merging the Department of Environmental Protection, the Department of Public Utility Control, and energy policy staff from other areas of state government. The new DEEP oversees the roles of utility and environmental regulators to "integrate energy and environmental policies and programs in a more systematic, proactive and coherent manner" (CT DEEP 2014). CT DEEP and the

Connecticut Energy Advisory Board are required to prepare a statewide Comprehensive Energy Strategy every 3 years (CT DEEP 2013).

Promote Meaningful Stakeholder Involvement

States have found it useful to consider mechanisms of funding or supporting public interest and environmental interest intervenors in utility planning procedures. Stakeholder processes can help ensure that the concerns of ratepayers and environmental advocates are taken into consideration, and often represent some of the strongest, continually engaged parties advocating energy efficiency, renewable energy, and CHP options. Some states offer intervenor funding through application, where funding is drawn from regulated utilities. In Oregon, the PUC establishes an agreement wherein energy utilities provide "financial assistance to organizations representing broad customer interests" (OPUC 2012a). Wisconsin provides for intervenor funding for individuals or organizations that are affected by the proceeding, have a material interest, and are unable to participate if not otherwise funded (WI PSC 1995). In Indiana, the Utility Rate Payer Trust was established through the settlement of litigation regarding a canceled project; the Trust is overseen by a five-member committee (IN OUCC 2013). Typically, intervenor funds are allocated to public interest groups who advocate for views not adequately represented by utility or large industrial consumers.

Designing Effective Electricity Planning Policies

In many states, specified planning and procurement processes help to level the playing field for energy efficiency and clean energy supply. This section describes key components of an effective planning and procurement process, including participants, timing and duration, and consideration of key factors that can affect the results of utility planning analyses.

Participants

Planning is not typically conducted in a vacuum: utilities engage with stakeholders, intervenors, regulators, and the public through either collaborative or litigated processes. Various electric system planning and procurement processes engage a range of participants, including those who conduct, review, and ultimately approve the process.

- *Utilities.* Load distribution companies (LDCs) and utilities can either be investor-owned utilities (IOUs), municipal government entities, cooperatively owned utilities run by industrial and residential consumers, or even federal entities (as in the case of the Tennessee Valley Authority [TVA] and Bonneville Power Association). Generally, rates and costs at IOUs are regulated by state PUCs, while a municipal government operates and oversees municipally owned utilities; member-owners oversee cooperatives. Under most circumstances, IOUs have the greatest degree of state oversight through integrated resource planning, CPCNs and preapproval dockets, and ultimately rate cases. In some states, municipally and cooperatively owned utilities may not be required to submit plans for state review (except environmental permitting).
- *Regional transmission organizations (RTOs)*. RTOs are responsible for the reliability and adequacy of the transmission system, which directly affects the planning process. Adequacy needs focus on load forecasting and studies to address retirements and new resources. Reliability needs focus on regional and specific planning studies commissioned by the RTO. State agencies often engage and participate at the committee and sub-committee levels within the RTO.
- *State PUCs*. State PUCs and their technical staff oversee, engage in, and/or monitor most state planning processes, including integrated resource planning, CPCN, and—in retail-choice states—default service or similar procurement proceedings. PUCs are concerned with costs, risks, rate impacts, reliability, and

continuity of service. Many PUCs do not have direct knowledge of environmental regulatory matters or permitting processes, and may rely on utilities and other regulated entities to present that information. The PUCs' primary enforcement mechanism is the regulation of rates and financial incentives or penalties to utilities. PUCs generally have a wide range of latitude in these matters.

- *State environmental regulators.* State environmental managers and air offices have extensive expertise in the regulation of effluents and emissions. Their responsibilities, which include permitting and setting emissions standards for electricity generators, influence utility electricity resource decisions. Environmental regulators may also be able to provide information about proposed or pending environmental regulations. Thus, some states have found benefits in strengthening relationships and communication between environmental regulators and PUCs.
- *State legislatures, governors, and energy offices.* Elected state representatives may create state policies that either incentivize or require particular actions from LDCs (such as an energy efficiency resource standard [EERS] or RPS) or generators (such as carbon regulation in the Regional Greenhouse Gas Initiative and California), or provide guidance or requirements to PUCs (such as the guaranteed recovery of rates for environmental expenditures). State representatives and governors may not directly engage in specific utility plans. In some states, the governor is indirectly represented through the Attorney General's office or a state ratepayer advocate, and/or through the participation of state energy offices, which are charged with implementation of state policies and aligning those policies with those enacted at PUCs.
- *Stakeholders and intervenors.* Where planning and procurement processes occur, they are reviewed, commented upon, and/or audited by a variety of stakeholders and intervenors. In most states, a consumer advocate office represents the interests of residential (and sometimes commercial) ratepayers; these advocates may or may not have an interest or opinion regarding the procurement of energy efficiency, renewable energy, and CHP. Industrial consumers are actively engaged in state planning processes, usually to minimize impacts on large consumers. Finally, environmental advocacy groups are increasingly engaged in both statewide planning processes and specific utility planning proceedings, including integrated resource planning, CPCN, preapproval, and default service dockets.

Timing and Duration

Both integrated resource planning and portfolio management for default services occur on a regular planning and/or solicitation cycle, which can range from 1 to 5 years depending on the state. CPCN and preapproval dockets are triggered by specific utility actions, changes in commodity or market prices, or regulatory compliance obligations, and do not necessarily adhere to a regular or predictable schedule. IRPs typically take anywhere from a half year to a full year to complete, depending on the stakeholder engagement processes, and in certain instances can extend into the next IRP cycle. In contrast, docketed processes—such as CPCN, preapprovals, and default service proceedings—may pass through a regulatory proceeding in as few as 3 months to as long as 6 months or more.

Planning and portfolio management typically requires reviewing decisions and investments with long lives or extended spending; portfolio costs and risks are thus reviewed over a long term, from 10 to 30 years. In IRPs, short-term "action plans" usually include specific near-term actions or investments that are likely to result from the IRP. These action plans range from 1 to 5 years forward from the IRP.

Some states provide or require intracycle IRP updates or reviews, in which prices, regulatory conditions, and model results are updated and checked.[65]

Interaction with State, Regional, and Federal Policies

Utility and electricity generator operations, planning, and financial decisions are governed by state and federal rules and regulations. In addition, RTOs and independent system operators (ISOs) engage in regional transmission planning that may affect utility decisions. States have found it useful to consider these state, regional, and federal policies in electricity resource planning. In turn, findings from electricity resource planning are also considered in the design and implementation of related policies. Standard planning practice requires that utilities and generators follow legal requirements for emissions, system reliability, renewable procurement, and efficiency investments, among other considerations.

Energy Efficiency Resource Standards and Renewable Portfolio Standards

Some states maintain EERSs and/or RPSs, or minimum requirements for utilities (see Section 4.1, "Energy Efficiency Resource Standards," and Chapter 5, "Renewable Portfolio Standards"). Because these standards generally represent a rule of law governing utility operators, states require their inclusion in electricity resource planning. States have also found it useful to consider and model pending portfolio or efficiency standards or goals, although pending or voluntary measures may be modeled as a sensitivity or uncertainty instead of as the reference case. Some states require that EERSs and/or RPSs be treated as a floor, rather than as a default procurement level that utilities should meet but not exceed. For example, Oregon requires that utilities seek all cost-effective energy efficiency regardless of whether the utility or a third party administers efficiency programs.[66] Utility planning processes can also consider other state policies that may be in place, such as interconnection and net metering standards that govern the integration of onsite generation resources (see Section 7.3, "Interconnection and Net Metering Standards"), as well as other policy types discussed elsewhere in this chapter.

Environmental Regulations

States typically require that utility resource planning include existing state and federal environmental regulations governing utility or generator operations. Including proposed, pending, and emerging regulations in utility planning ensures that social and environmental costs are reasonably anticipated and their effects quantified. In return, electricity resource planning can sometimes help to inform environmental planning, as some environmental compliance plans leverage electricity resource planning to find a reasonable least cost mechanism for meeting environmental requirements. For example, recent experience in regional haze planning in some western states has sought alternative compliance measures requiring tradeoffs between generators. EPA recently approved a Regional Haze State Implementation Plan (SIP) revision in New Mexico that calls for unit shutdowns at San Juan Generating Station and lower cost compliance at remaining units rather than more stringent controls across all units (EPA 2014b). This plan resulted from utility planning that indicated a lower cost for an equally rigorous alternative SIP than the original promulgated Federal Implementation Plan.

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[65] For example, utilities in South Carolina must submit IRPs to the PSC every 3 years and update them annually (South Carolina 2011).

[66] The Oregon PUC's "Investigation into Integrated Resource Planning" mandates that utilities "Determine the amount of conservation resources in the best cost/risk portfolio without regard to any limits on funding of conservation programs" (OPUC 2007).

Regional Transmission Planning

RTOs and ISOs engage in long-term transmission planning. Decisions regarding the maintenance or enhancement of transmission facilities have important consequences for the development of generation and energy efficiency resources. Electricity resource planning may consider not only the generation resources that are available with the existing transmission system, but also those that could be accessible via new or upgraded transmission lines. Planning processes can also consider whether costly transmission upgrades and enhancements can be deferred or avoided due to increased energy efficiency, distributed renewable energy, and CHP. The transmission planning process requires that the RTOs/ISOs understand which resources are likely to be available in future years, including energy efficiency, renewable energy, and CHP. In some regions, such as ISO New England (ISO-NE), energy efficiency programs are explicitly considered in transmission planning. States engage in RTO/ISO planning via representatives on market rules committees and by providing feedback in regional transmission plans.

Consideration of Key Factors in Analysis

States have found that the most effective planning processes require appropriate treatment and documentation of key assumptions used in utility analyses. Key assumption categories that may significantly alter planning analysis results are discussed below. Many assumptions used in planning are considered proprietary by utilities, potentially including load forecasts, fuel price forecasts, costs of demand- or supply-side resource options, transmission costs, emissions costs, models, and more. States differ as to what information they require to be made public. In the case of proprietary data, only those intervenors signing protective agreements are granted access to these data.

Load Forecast

A load forecast (annual peak and energy) plays a key role in determining the need for new and existing resources, as well as the type of those resources; it provides the fundamental basis for any energy planning process. For example, a utility that expects to retire a power plant can forecast customer demand first and then assess electricity supply options to determine whether all retirements must be replaced with new, similarly sized generators in order to meet demand.

In vertically integrated states, the utility often develops its own demand projection. Because a utility's demand forecast is so important to the resulting resource plan, states may require utilities to base forecasts of future load on realistic assumptions about local demographic changes and local economic factors (i.e., the movement of industry and housing), and to fully document these assumptions. Forward-looking resource requirements can change quickly, based on changing economic realities, energy prices, and projection methods. Frequent updates to load forecasts allow for reasonable planning.[67]

In states with restructured electricity markets, demand projections are developed jointly between utilities and RTOs. This regional long-term load forecast is one foundation to help ISOs/RTOs determine the need for future transmission projects. Some regions, like New England, develop load forecasts of peak demand and energy requirements based upon econometric models. ISO-NE's forecasts of annual energy for New England as a whole and for each individual state and load zone is based on previous usage along with real electricity price,

[67] In 2009, the Michigan Planning Consortium conducted a load forecasting survey for the Michigan Public Service Commission designed to help improve the planning process for electricity infrastructure projects. Survey responses were received from ITC, Wolverine, Detroit Edison, Consumers Energy, Indiana Michigan, Michigan South Central Power Agency, Alepna Power, ATAC, PJM, and MPPA. When asked about load forecast frequency, the majority of respondents said that load forecasts are updated at least annually and some more frequently (MPC 2009).

real personal income, gross state product, and heating and cooling degree days. ISO-NE adjusts its forecast based on its expectations of energy efficiency program effects (ISO-NE 2014a).

Regulatory Environment

Numerous policies and regulations that affect electric utilities have been promulgated at the federal, regional, and state levels, with several others either proposed or under consideration. As previously discussed in this section, key policies interacting with electricity resource planning include EERSs, RPSs, environmental regulations, and regional transmission planning. These policies and regulations, both individually and in combination, have the potential to dramatically change the electric power industry. Existing rules may affect utility operations in the present, and rules that have been proposed or that are under consideration will likely affect utilities at some future date.

Because electricity resource planning examines and evaluates scenarios over the long-term—inclusive of any rules or regulations that will affect a utility over the planning period—several states effectively require utilities to analyze the impact of promulgated, proposed, planned, and emerging environmental regulations on the costs, benefits, and risks of proposed resource portfolios.[68] In 2013, Georgia Power Company submitted an IRP evaluating plant decommissioning and new plant additions; the utility's analyses detailed how future regulatory considerations could affect financial decisions made in 2013 (Georgia Power 2013).

States have found that consideration of these rules may result in a utility including an emissions allowance price in its analysis, planning for the installation of one or more pollution control technologies, changing the operations of one or more generating units, or procuring alternative types of supply- and demand-side resources needed to meet demand.

Supply Options

Across resource types, capital costs, operation and maintenance expenses, and variable fuel costs, if any, will vary. How often the resource will generate electricity, as well as how new or modified generation assets are financed, can also affect supply option inputs. States have found that electricity resource planning provides an opportunity to examine a wide range of options for meeting consumer requirements, including traditional generating resources, energy efficiency, renewable energy, CHP, and storage options. Resource planning may, by default, review only traditional resources and either exclude or make *a priori* assumptions for renewable energy supply options based on either regulatory requirements or a premise of achievable outcomes.

Improvements in renewable energy technologies have driven capital costs down while increasing the capacity factors of these intermittent resources (ACEEE 2014). The installed costs of solar PV modules continued their precipitous decline through 2013: the cost of residential and commercial modules dropped another 12 to 15 percent from 2012 costs, while achieving efficiencies of 14 to 16 percent; meanwhile, installed prices dropped by more than a third from 2009 to 2013 for utility-scale PV projects, while the capacity factor across all utility-scale projects has grown to 27.5 percent (LBNL 2014c).[69] The evolution of wind projects has been no different: nationwide, wind projects averaged a capacity factor of 32.1 percent from 2006 to 2013, even reaching 38 percent in the Interior in 2013. Meanwhile, costs have continued to fall, both for project developers—the capacity-weighted average installed cost of projects in 2013 dropped to $1,750/kilowatt—and for power purchasers. According to the U.S. Department of Energy (DOE), "wind PPA [power purchase agreement] prices

[68] This rule may not be reflected in written regulation, but experienced state regulators have recognized that a failure to account for impending regulations puts ratepayers and utility decisions at risk.

[69] The project-level range of capacity factors is 16.6 to 32.8 percent (LBNL 2014d).

have reached all-time lows," falling to an average of $25/megawatt-hour (MWh) nationwide (LBNL 2014a). Nevertheless, many of these resources may still be overlooked in utility resource planning.

To ensure reasonable planning, many states require that utilities: 1) not place limits on renewable energy options without rigorous justification, and 2) examine non-traditional resources such as CHP, onsite generation, and demand-side management with the same rigor as traditional resources. For example, Oregon requires that utility IRPs consider a full range of resource options, typically including renewable energy, storage, and traditional fossil generation.[70]

The availability and costs of raw materials and skilled labor, construction schedules, and future regulations can all present uncertainties. Because these cost uncertainties can affect technologies in different ways, states have found it useful to require utilities to model a range of possible costs and construction lead times for supply alternatives. In addition, some states require utilities to evaluate supply technologies that are not currently feasible from a cost perspective, but may become so later during planning periods, which typically last a decade or more. Hawaii, for example, requires that utilities consider all feasible supply- and demand-side resource options available within the years encompassed by the IRP horizon (Hawaii PUC 2011).

Some states have found that when significant renewable energy procurement is planned, utilities might have concerns about the integration of variable resources. In these cases, planning for renewable integration may be a critical component of achieving more substantial renewable energy. Renewable energy integration studies are engineering documents that help specify what types of other system resources are required to stabilize energy delivery and transmission. The results of these studies may partially guide supply choices and/or the costs of incremental renewable energy. Arizona Public Service, for example, analyzed and presented integration costs for renewable resources in the portfolios it evaluated in its 2012 IRP (APS 2012).

Finally, economic retirements of existing resources are part of electricity system planning. Some states have found it useful to require utilities to consider retiring and replacing existing resources with a single resource or a portfolio of resources. In a 2013 IRP, Georgia Power Company evaluated the economic benefit of maintaining and retrofitting each of its existing coal-fired generators against a replacement option. Since 2011, PacifiCorp (a northwestern utility) has evaluated the economics of select coal units in addenda to IRPs.[71]

Demand-Side Resources

Some states require electricity resource planning to include an evaluation of energy conservation and/or efficiency. However, the extent to which demand-side resources are actually considered varies from state to state. A number of utilities consider energy efficiency as a competitive resource relative to supply-side options in their long-term planning, but others assume either a regulatory minimum or a series of modest efficiency goals. States with rigorous energy efficiency planning—such as Massachusetts,[72] Minnesota,[73] and

[70] Oregon PUC Order 07-002 on IRP Guidelines requires "identification and estimated costs of all supply-side and demand-side resource options, taking into account anticipated advances in technology" (OPUC 2007).

[71] For example, see PacifiCorp's 2013 IRP Update regarding Cholla Unit 4 (PacifiCorp 2014).

[72] Massachusetts requires that electric and gas distribution utilities acquire all available cost-effective energy efficiency resources under An Act Relative to Green Communities (Massachusetts 2008). These utilities are also required to file 3-year energy efficiency plans with the Department of Public Utilities on a triennial basis beginning in 2012.

[73] Minnesota's Next Generation Energy Act of 2007 (Minnesota Statutes 216B.241) established an energy savings goal of 1.5 percent of average retail sales for each electric and gas utility beginning in 2010. Utilities must file Conservation Improvement Program (CIP) plans every 3 years, detailing programs offered to assist residential and business customers to become more energy-efficient. Utilities report their actual CIP spending and savings on an annual basis.

Washington[74]—require utilities to submit efficiency potential studies, budgets, savings targets, and evaluations for approval by regulatory commissions.

States have found that credible and independent energy efficiency potential studies of demand-side resources can be critical to state and utility plans and acceptance. These studies identify and examine the technical, economic, and achievable potential of new energy efficiency within a market. These data inform decision–makers, and the outcome of an energy efficiency potential study may be incorporated directly into electricity resource planning and state energy planning processes.

Some states require all cost-effective energy efficiency to be included in electricity resource planning. The mechanism by which energy efficiency is valued is highly relevant to its incorporation in planning. If only utility costs are assessed, some states have found it reasonable to review only utility benefits (i.e., the ability of energy efficiency to avoid higher cost supply options), but if both utility and participant costs are assessed, planning processes may also review participant and societal benefits. Massachusetts, a leading state for implementing energy efficiency, requires the Total Resource Cost test as part of its 3-year planning process (MA DPU 2009). For more information on cost-effectiveness tests, see Section 4.2, "Energy Efficiency Programs."

Transmission and Distribution

As discussed in the electricity grid overview in the introduction to Chapter 7, utilities rely on an extensive network of transmission and distribution lines in order to deliver electricity to customers. States generally require utility electricity resource planning to reflect constraints in existing transmission (and sometimes distribution) systems; these constraints may limit the location or types of supply resources that can be added to (or removed from) the system. In highly constrained systems (i.e., where transmission is binding through multiple hours of the year), resource planning may be oriented around overcoming such constraints through transmission improvements, demand-side management, and strategically placed generators. For example, Indianapolis Power and Light used the PROMOD IV model to analyze five possible locations for a new gas-fired combined cycle generating unit. The model examined the potential transmission congestion costs associated with each location to help determine the optimal location for siting the new generating unit (IPL 2013). Models will vary in the extent to which they represent specific localized transmission constraints. Modeling also typically assumes additional cost and construction timing if new interconnection infrastructure is required, such as new transmission lines to reach new wind farms.

Transmission constraints may play a role in procuring renewable energy, particularly when utilities consider how to integrate more significant blocks of variable renewable energy (such as wind and solar). Such questions are generally addressed through technical integration studies. Because demand-side management programs generally do not require transmission (as they are implemented at load, rather than across wires), states have found that these programs can pose a significant quantifiable benefit for transmission constraints—a benefit that can be considered in resource procurement and planning.

[74] Washington voters passed Initiative 937 in 2006, which calls for electric utilities serving more than 25,000 customers to undertake all cost-effective energy conservation. This Initiative was enacted into law as the Energy Independence Act. Qualifying utilities must pursue all available energy efficiency that is cost-effective, reliable, and feasible. Utilities are required to identify efficiency potential through 2019, submit reviews and updates every 2 years for the subsequent 10 years, and establish and meet biennial conservation targets (WA Initiative 2006).

Planning can also account for, and accommodate, inevitable generator outages and transmission failures. RTOs typically review supply, demand, and transmission infrastructure to estimate a "planning reserve margin," a measure of how much the system must be overbuilt to maintain reliability under adverse conditions.

Commodity Prices

The expected future prices of fuel, electricity purchased from regional markets, and emissions can influence the economic consideration of existing and new resources, and thus the relative economics of avoiding those resources through the use of energy efficiency, renewable energy, and/or CHP (see text box on p. 7-7-16 for further discussion of avoided costs). In some regions, energy efficiency, renewable energy, and CHP must compete in an open market; the degree to which these resources are considered competitive depends on commodity price assumptions.

- *Fuel prices*. The economic viability and hourly dispatch of power plants is highly sensitive to fuel price forecasts. Fuel prices represent an important, if not primary, component of the overall cost of generation for facilities using gas, coal, or biomass, as well as the relative competitive value of clean energy resources that do not consume fuel. Because prices change over time, sometimes dramatically, an up-to-date fuel price forecast is critical. In some states, utilities review multiple third-party fuel price projections and present a range of potential outcomes. For example, the Wisconsin Public Service Company incorporates regular updates to its fuel price forecasts; PacifiCorp updates its fuel price forecasts on a quarterly basis (PacifiCorp 2005; WI PSC 2011).
- *Electricity and capacity market prices.* Electricity market prices refer to the wholesale cost of energy (in $/MWh) available to resources that either sell on an open spot market or sell to other utilities. In organized markets (PJM, Midcontinent ISO [MISO], ISO-NE, Electric Reliability Council of Texas, California ISO, and Southwest Power Pool), past market prices are published (PJM 2015). In other regions, market prices are implied, but represent the price that a utility could command by selling its excess energy to a neighboring utility. Capacity prices refer to the wholesale cost of maintaining capacity (in $/megawatt [MW]) for the purposes of meeting peak load. In PJM, ISO-NE, and, to a lesser extent, MISO, capacity is sold on a wholesale market.[75] Energy prices are directly related to fuel prices, but an electricity system model is required to derive market prices. States have found value in updating energy price forecasts with fuel prices. Capacity market prices are established through different mechanisms, and are the subject of continued debate.[76]

Modeling Approach

All electricity system plans require some level of electricity system modeling. Electric system models are designed to answer different types of questions, from large-scale regional or national models, to highly detailed electricity generator-specific dispatch simulation models. In general, larger scale, long-term models[77] are designed to evaluate different federal or regional policies and forecast how these policies will affect multiple electricity generators. Simulation dispatch models (also commonly referred to as "production cost" models) are designed to determine how one or more individual generators will dispatch into the electricity grid on an hourly (or even 15 minute) basis over a period of months, and how specific generators compete against each other. Policy-scale models simplify dispatch and individual unit operations, and detailed models generally

[75] See for example: PJM (2014), ISO-NE (2014b), and MISO (2012).

[76] Recent rule changes by the Federal Energy Regulatory Commission, for example, may significantly change the future of capacity prices in regions with an open capacity market.

[77] For example of larger scale, long-term models, see EPA (2014a) and EIA (2014).

look at shorter, well-defined timeframes and conditions. Between these two extremes are models designed to determine what types of generators a utility may want to invest in, called capacity expansion models, and models designed to review how uncertainty in forecast prices or conditions affects individual generators.

Integrated resource planning, CPCN, default service, and LTPP are not restricted to the use of one of these models, although capacity expansion models are commonly used to evaluate which resource choices best meet customer requirements for a utility. In some states, models are used in sequence to define regional outcomes, then electricity market prices, and then individual electric generating unit (EGU) behaviors. Each model will have its own strengths and weaknesses when it comes to answering a particular question or reflecting particular behaviors of the power system. It is important to note that almost all of the models used for these purposes are licensed by model vendors and require significant expertise to operate and vet. Input assumptions about individual generating units (such as ramping ability or maintenance outages) may be considered proprietary information. Thus, while models are the framework in which assumptions are used, they are often also the most complex and opaque components of utility planning. Model structures are discussed in more depth in EPA's Technical Support Document entitled "Projecting EGU CO_2 Emission Performance in State Plans" (EPA 2014c). For examples of how various states have applied models for integrated resource planning, see the Lawrence Berkeley National Laboratory's "Survey of Western U.S. Electric Utility Resource Plans" (LBNL 2014b).

IRP and CPCN Outcomes

IRPs are designed to produce a single "preferred" set of resources to serve customer requirements, including new resources, changes to existing resources, and demand-side resources expected to be required over the planning period. Capacity expansion modeling typically results in one or more sets of suitable resource mixes for a utility—i.e., resources that meet customer requirements and, under some set of circumstances, are least cost. Further analyses of these resource mixes, which examine total cost, risk and uncertainty, and (sometimes) rate impacts, produce a single preferred portfolio. Portfolios are evaluated under different scenarios, which represent distinct policy or risk outcomes, and different sensitivities, which represent uncertainty around specific input variables. In its 2011 IRP, for example, PacifiCorp defined input scenarios for portfolio development, examining alternative transmission configurations, types of CO_2 regulation, and renewable resource policies. Sensitivity cases that were analyzed included varying fuel costs, load forecasts, and demand-side management resource availability. PacifiCorp modeling resulted in 100 simulation runs, and top resource portfolios were determined after an examination of the resulting portfolio costs (PacifiCorp 2011). The short-term investments and utility changes either indicated or implied by this portfolio may be translated into an "action plan," which describes the next steps to be pursued by the utility and/or regulators.

CPCN evaluation structures are designed to review the costs, benefits, and risks of a discrete action or set of actions, such as the acquisition of a new resource or significant modification of an existing resource. The planning and analysis of CPCNs are very similar to IRPs, except that rather than resulting in one or more sets of suitable resource mixes, the purpose of the CPCN is to estimate the utility and/or customer cost with and without the acquisition of the resource under scrutiny. Instead of producing a set of resource mixes, the CPCN reviews a set of discrete resource options and again views them through the filter of total cost, risk and uncertainty, and (sometimes) rate impacts. In 2011, for example, Northern States Power in Wisconsin filed an application requesting a CPCN for a proposed upgrade to the existing transmission line system, adding a new 161 kV line to the existing 69 kV line between two of its substations (NSPW 2011). The company's application detailed the preferred route for the lines, two alternate routes, and the projected costs, impacts, and benefits of the project. The final outcome from a utility's CPCN application is the selection of the resource and recommendation for the CPCN.[78]

Implementation and Evaluation of Electricity Resource Planning

Much of electricity planning consists of ensuring that the right framework and assumptions are in place to develop a reasonable and cost-effective plan. Planning implementation is the development of these assumptions and the vetting of the framework—a process that is effective when utilities, regulators, and other stakeholders are involved in implementation.

Administering Body

In most states, the utility is generally responsible for implementing the planning or procurement policy. State PUCs oversee the utility planning processes in their states. Typically, the commissions solicit comments and input as they develop planning and procurement practices from a wide variety of stakeholders, including generation owners, default service providers, competitive suppliers, consumer advocates, renewable developers, environmental advocates, and energy efficiency advocates. The utility regulator may also play a role in reviewing and approving utilities' planning procedures, selection criteria, and competition solicitation processes. PUCs in different states take different roles in the IRP process. In some states, such as Oregon, California, Indiana, and Georgia, the review and evaluation of IRPs are conducted in a docketed forum, in which commission staff and stakeholders are able to both issue formal or informal discovery and comment on the IRP's assumptions and construction. Electricity procurement for default service customers and larger scale CPCN processes are almost always docketed, litigated proceedings, with supporting testimony and a multiple-month schedule of discovery and fact-finding, pre-filed testimony, and often oral argument. PUCs make the final determination of whether default service and/or CPCN are acceptable.

Cooperatively owned utilities and municipal electric boards may not be subject to formal state PUC oversight. In the case of cooperatively owned utilities, boards appointed by member-customers are charged with supervision; municipal governments that supply electric services regulate their own utilities. In rare cases, such as in Kentucky, the PUC reviews and regulates cooperatively owned utilities (KY PSC n.d.). The TVA has little or no state administration, although the utility delivers to 155 local distribution companies that are subject to state requirements.

Evaluation

State PUCs may review a variety of metrics in evaluating the outcome of a utility plan. "Least cost" is generally the dominant factor in consideration, although PUCs will consider reliability implications, short-term rate implications, and price stability. Least cost generally refers to the lowest long-term system cost discounted to present day dollars. As such, the definition requires the consideration of long-term costs, and may be highly dependent on forecasts for commodity prices and expected future regulations. Utilities seek to generally prepare plans that are consistent with PUC requirements and preferences.

States vary in the extent to which they review elements of the utility planning process. In some states, such as Oregon and Nevada, PUCs conduct a rigorous review of IRP assumptions and processes; in other states, such as Indiana and Kentucky, the state allows stakeholders to probe utility plans through formal or informal discovery

[78] CPCNs are typically applications put forth by utilities seeking approval of particular actions. As such, utilities have typically conducted a planning process they consider complete, opened to scrutiny under a litigated proceeding. Therefore, a utility only files an application that supports and recommends the CPCN.

and a comment process (Indiana 2014; Kentucky 1995). IRPs may be approved, approved with conditions, or sent back to utilities to revise their assumptions or processes. Some states do not require formal review of IRP processes or results.

PUCs rarely require a look-back period or post-hoc review of utility plans, recognizing that actions perceived to be least cost at one point in time may shift with changing circumstances. In rate cases (not planning dockets), utilities are required to show that investments and commitments were prudently incurred—i.e., the utility conducted reasonable planning at the time that the investment was made. To the extent that a utility action is found to be imprudent, PUCs may opt to penalize utilities for damages incurred (i.e., the cost difference between a reasonable course of action and the utility's decision) and/or issue a penalty for poor management. In 2012, the Oregon PUC found that a utility decision to install emissions controls was imprudent because reasonable utility planning should have otherwise found that the EGU was not economical to retrofit; the PUC imposed a $17 million penalty for poor management and an imprudent decision (OPUC 2012b). In an Indiana CPCN process, the PUC granted a utility permission to proceed with an emissions retrofit, but penalized the utility $10 million for having conducted a poorly executed planning process (IURC 2013).

Updates and Progress Reports

Regulators sometimes require utilities to submit electricity resource plans and progress reports at regular intervals. These plans and reports describe in detail the assumptions used, the opportunities assessed, and the decisions made when developing resource portfolios. Regulators carefully review these plans and either approve them or recommend changes needed for approval.

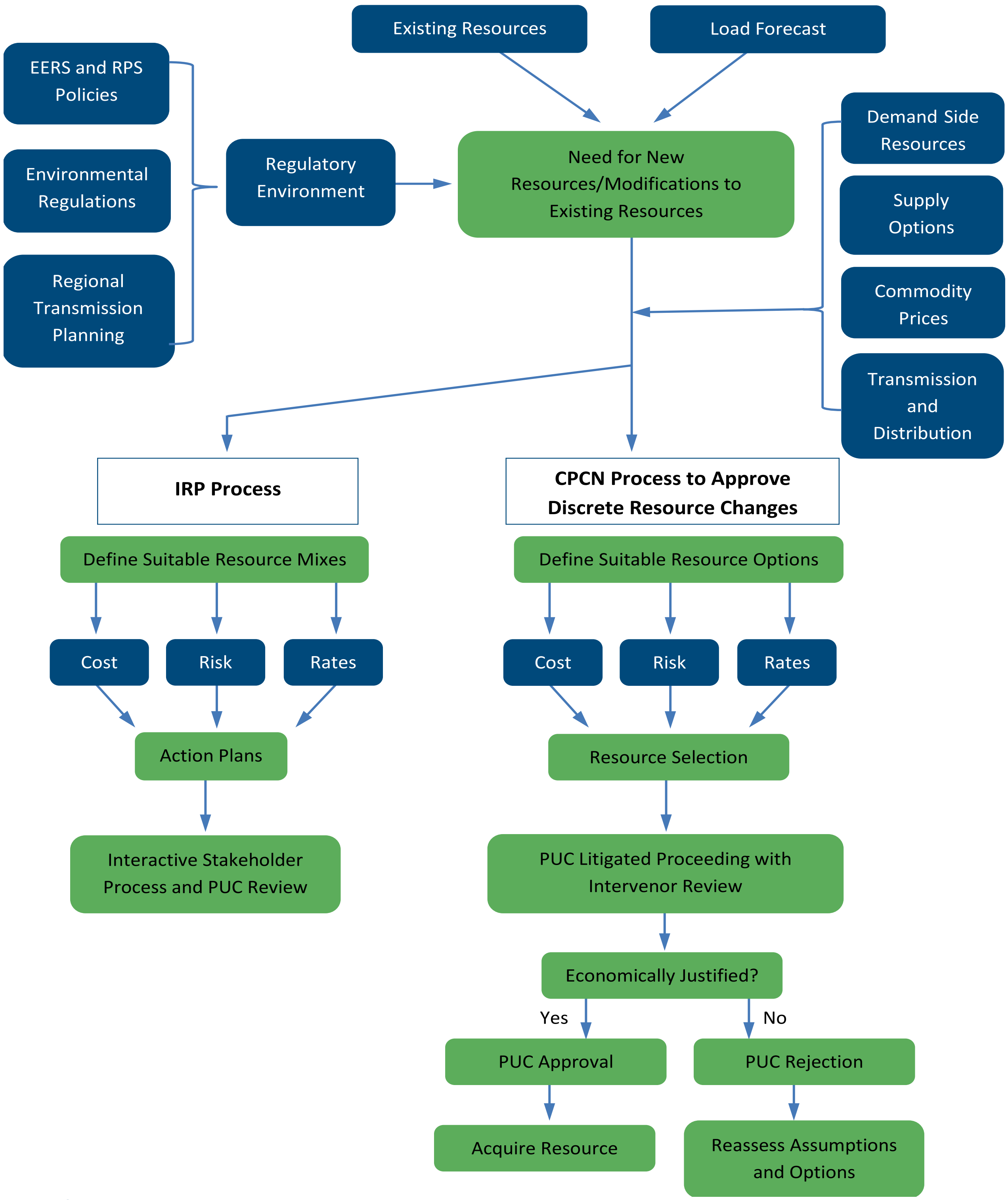
Oregon requires utilities to submit biennial IRPs and annual IRP updates (OPUC 2007). Similarly, the Iowa Utilities Board requires companies to submit annual reports on their energy efficiency and load management programs (Iowa 2014). The NWPCC's 2005 plan calls for monitoring key indicators that could affect the plan, such as loads and resources, conservation development, cost and availability of wind generation, and climate change science. This monitoring will inform IRPs developed by the utilities in the NWPCC region (NWPCC 2010b).

Applying Electricity Resource Planning Results

Integrated resource planning provides a mechanism for vetting and reviewing utility planning procedures, but it does not necessarily require specific utility actions. While some states require utility actions (such as resource acquisitions) to be consistent with IRPs, there are no states in which this requirement holds absolutely. Changing circumstances, forecast assumptions, and strategic decisions may cause a utility to deviate substantially from an IRP. Thus, IRPs are not generally considered enforceable. CPCN, including preapproval processes, carries the expectation that a specific action will be taken. However, the outcome of a CPCN process is usually permission, not a requirement, to proceed. In April 2011, for example, Louisville Gas and Electric and Kentucky Utilities filed a joint IRP which included the need for new gas-fired combined cycle generating units in 2016, 2018, and 2025 (LGE 2011a). Later that year, the Public Utilities Commission approved the companies' application for CPCN to construct one of those combined cycle units at the Cane Run generating station (LGE 2011b). The utilities began construction of the unit, and reported in their 2014 IRP that it is scheduled to come online in 2015 (LGE 2014).

In some cases, CPCN may be granted with conditions; in particular, CPCNs that are a result of settlement, rather than litigation, may carry requirements from other parties, such as a minimum purchase of renewable energy or an energy efficiency target. For example, in 2014, the Public Service Company of New Mexico offered a settlement by which the affected utility would acquire incremental renewable energy to attenuate opposition to a CPCN request (NM PRC 2010). Figure 7.1.2 provides a flow chart of IRP and CPCN long-term electricity resource planning, illustrating the differences in how the results of these processes are applied.

Figure 7.1.2: Flow Chart of Long-Term Planning Processes



Source: Synapse 2013

State Examples

Nevada IRP

Under section 704 of the Nevada Revised Statutes, Nevada requires that each electric utility submit an IRP every 3 years. The state PUC prescribes the plan's contents, which must include, but are not limited to, the methods used to forecast electric demand and determine the best combination of supply- and demand-side resources to meet consumer needs. Utility plans must include: 1) an energy efficiency program for residential customers with new solar thermal energy sources; 2) a comparison of several scenarios that look at different combinations of supply- and demand-side resources, at least one of which much be a low carbon intensity scenario; and 3) a plan for expanding transmission facilities to serve PUC-designated renewable energy zones. After a utility has submitted its plan, a hearing shall be convened to determine the plan's adequacy. The PUC determines whether the plan adequately forecasts load and energy efficiency savings, and whether it considers the benefits of improvements in efficiency, power pooling, power purchases, renewable generation including cogeneration, other types of generation facilities, and other transmission facilities. The PUC may give preference to resources that provide the greatest economic and environmental benefits to the state and provide the greatest opportunity for creating new jobs. After a utility has filed its plan, the PUC may accept the plan as filed or specify those areas of the plan that it finds to be inadequate. Utilities then have the opportunity to file an amendment to their resource plans.

Senate Bill No. 123 amended these statutes in 2013 to require that utilities also file a comprehensive emissions reduction and capacity replacement plan, reducing emissions from coal-fired electric generating plans and replacing that capacity with capacity from renewable facilities. The plan must provide for the retirement of 300 MW by the end of 2014, an additional 250 MW by the end of 2017, and an additional 250 MW by the end of 2019. Simultaneously, each utility must issue a request for proposals for 100 MW of renewable energy by 2014, an additional 100 MW by 2015, and an additional 100 MW by 2016. The utility must begin constructing an additional 50 MW of renewable energy to be owned by that utility before the end of 2017. These emissions reduction plans are subject to PUC review, and the PUC may accept the plan or recommend a modification or amendment if any portion of the plan is deemed inadequate.

Georgia Power Company IRP and CPCN

In 2011, Georgia Power submitted an application to decertify two coal units and authorize power purchase agreements, supported by an IRP. As an example of how different planning processes can work together, the Georgia PUC required the utility to update its IRP prior to allowing further expenditures at existing units. In 2013, Georgia Power submitted a revised IRP, expressly requesting further decertifications, demand-side management programs, fuel cost increases, and other approvals. The IRP became the basis for the Company's rate case filed later that year. In the rate case, many of the costs considered in the 2013 IRP were addressed through an environmental cost recovery rider, transforming the rate case into a pre-determination proceeding, similar to a CPCN.

Oregon IRP

In Oregon, investor-owned gas and electric utilities file individual least cost plans or IRPs with the PUC every 2 years. The plans, required since 1989, cover a 20-year period. The primary goal is to acquire resources at the least cost to the utility and ratepayers in a manner consistent with the public interest. These plans are expected to provide a reasonable balance between least cost and risk. By filing these plans, the utilities hope that in future proceedings the PUC will not reject, and prevent utilities from recouping, some of the costs associated with resource acquisition.

Connecticut IRP

Connecticut Public Act No. 11-80 requires the CT DEEP to develop a statewide IRP in conjunction with the Connecticut Energy Advisory Board and the state's electric distribution companies. After reviewing the state's energy and capacity needs, the CT DEEP must create a plan for procuring energy resources that seeks to minimize resource costs, maximize customer benefits, and lower the price of electricity over time. Energy resources include, but are not limited to, conventional and renewable generating facilities, energy efficiency, load management, demand response, CHP, DG, and other emerging technologies. Resource needs are to be met first with all available energy efficiency and demand reduction resources that are cost-effective, reliable, and feasible. The state IRP should include an assessment of: 1) energy and capacity requirements for the next 3, 5, and 10 years; 2) how best to eliminate demand growth; 3) how best to level the state's electric demand through reductions in peak demand and load shifting to off-peak periods; 4) the impact of current and proposed environmental standards; 5) any energy security or economic risks associated with energy resources; and 6) estimated lifetime costs and availability of energy resources.

The CT DEEP is required to hold a public hearing on the completed IRP and consider all written and oral comments on the proposed plan. The commissioner may approve or reject the plan with comments. The procurement manager of the Public Utilities Regulatory Authority will then develop and hold public hearings on a procurement plan in consultation with the electric distribution companies, ISO-NE, and the Connecticut Energy Advisory Board. Every 2 years, the CT DEEP must report to the General Assembly on progress toward plan implementation, as well as any recommendations about the process.

New Jersey Energy Master Plan

New Jersey state law requires an Energy Master Plan (EMP) to be revised and updated at least every 3 years to address the production, distribution, consumption, and conservation of energy in the state. The law requires the EMP to include both long-term objectives and interim measures consistent with and necessary for achieving the long-term objectives. The EMP considers the full scope of energy service delivery in the state, including energy sources that are regulated by the Board of Public Utilities (such as electric and natural gas IOUs) and those that are not (NJ EMP n.d.).

Like the previous EMP in 2008, the 2011 EMP recognized "what the State can do directly to affect the reliability and cost of energy; what the State is constrained to do indirectly to influence the decisions of PJM, the FERC, and power plant owners and developers; and what factors are outside the State's control" (NJ EMP 2011). While the goals, targets, and policies put forth in the plans are not, by themselves, enforceable in practice, the plans serve as guidance for narrower resource planning processes. For example, policy direction and targets from the plans are fed into the process for determining funding levels for the state's energy efficiency and renewable energy incentive programs.

Northwest Power and Conservation Council

The Sixth Northwest Conservation and Electric Power Plan was issued in February 2010, making it the most recent plan released by the NWPCC. The plan is intended to mitigate risks that stem from uncertainties such as climate change policy, fuel prices, and economic growth. The Sixth Plan includes recommendations to ensure the reliability and efficiency of the power system.

Improving energy efficiency is a top priority because it is predicted to be the least financially risky resource, has no ongoing fuel costs or dependence on foreign imports, and reduces demand on the Northwest's hydroelectricity industry while supporting reliable and affordable electricity service. If implemented, these improvements could fulfill 85 percent of the region's increased energy needs over the next 20 years, as well as defer investments from what are currently expensive low-carbon technologies or less clean energy resources (NWPCC 2010b). The NWPCC has also illustrated energy efficiency's sustainability over time by reducing electricity demand by an average of 3,900 MW between 1978 and 2008. In addition, they have identified 6,000 MW of available new efficiency, demonstrating the future viability of this resource (NWPCC 2010a).

Additional recommendations include developing cost-effective renewable energy, such as wind. The plan advises improving power system operations to incorporate new wind energy as well as enhance its efficiency and flexibility. The plan also encourages the construction of natural gas-fired plants to meet local needs, reduce dependence on coal, ensure sufficient backup power, and meet carbon-reduction targets. Lastly, the plan recommends researching the potential of new technologies, such as smart-grid technology or carbon sequestration, for future development and long-term stability of the region's power system (NWPCC 2010b).

What States Can Do

Action Steps for States

Most states already have some form of electricity resource planning processes. These states may be able to take action to ensure that energy efficiency, renewable energy, and CHP are consistently considered along with other resource options. Actions for states that already have electricity resource planning processes include:

- Remove barriers to fair consideration of available energy efficiency resources by using third-party energy efficiency potential studies and mandating all cost-effective energy efficiency in planning.
- Update key assumptions for renewable energy so that values for current and future capacity availability and costs reflect current market conditions.
- Require utilities to assume both existing and reasonably expected future EERS and RPS policies, as well as environmental regulations, in their electricity resource modeling.
- Ensure that the resource planning process is tied to investment decisions or other enforceable actions.
- Leverage existing knowledge from state utility and environmental regulators.
- Increase transparency in planning processes—for example, by presuming that all information should be public unless demonstrated to be proprietary or protected business information.
- Promote meaningful stakeholder input, including input from consumer advocates and non-governmental organizations that promote energy efficiency, renewable energy, and CHP.

For states that do not yet have long-term electricity resource planning processes in place, state legislation can be used to direct the state PUC to require planning. For examples of IRP state statutes, see the information resources listed at the end of this section. DOE also offers grant funding and technical assistance to state governments, including energy offices and PUCs, to facilitate the sharing of state best practices and to conduct stakeholder processes that help establish electricity resource planning.[79]

[79] For more information on technical assistance available through DOE, visit http://www.energy.gov/ta/state-local-and-tribal-technical-assistance-gateway. Funding opportunities available to assist states in electricity resource planning may be made available through the State Energy Program (http://energy.gov/eere/wipo/state-energy-program).

States can also work through their state legislatures and/or utility regulators to establish new electricity resource planning processes or make statutory changes that remove barriers to fair consideration of all resource options.

Increasing State Agency Coordination in Electricity Resource Planning

Energy planning can affect the work of a variety of state government agencies, and many of these agencies can provide valuable input to the planning process. Thus, many states have found benefits in fostering more interagency communication and collaboration.

A useful first step is to determine who plays a role and what mechanisms currently exist for interagency collaboration. As the *Participants* section on page 7-18 explains, state agencies may already participate in planning as regulators (e.g., PUCs in rate-based cases such as IRP, CPCN, and default service cases; air regulators in permitting) or as intervenors or stakeholders (e.g., a consumer advocate or attorney general's office representing ratepayers, or a Department of Energy representing state policy).

In one example of fostering coordination, the Commonwealth of Massachusetts brought its environmental and energy offices together under the Executive Office of Energy and Environmental Affairs in 2007. However, even without combining agencies, utility and environmental regulators can find many opportunities to coordinate. For example, PUC staff can alert environmental managers about ongoing planning processes and engage them to vet long-term environmental outcomes; environmental regulators can similarly alert PUC staff and ratepayer advocates about air and water permit applications. Such coordination can be mutually beneficial to both agencies as decisions made by one state entity can have significant implications on other regulatory bodies. In some cases, utilities pursue air or construction permits prior to pursuing a CPCN or preapproval, thus creating a situation in which long-term planning is necessarily compressed by permit deadlines, or constraining potential outcomes for utility regulators. In the inverse situation, utility regulators may not be aware of impending, or even ongoing, environmental regulatory requirements that pose financial risks or costs. Utility regulatory decisions may have substantial effects on a state's ability to pursue energy efficiency, renewable energy, and CHP alternatives.

Information Resources

Resources on Integrating Energy Efficiency, Renewable Energy, and CHP into Electricity Resource Planning

Title/Description	URL Address
Resource Planning Model: An Integrated Resource Planning and Dispatch Tool for Regional Electric Systems. This 2013 report for NREL introduces a capacity expansion model, the Resource Planning Model, with high spatial and temporal resolution that can be used for mid- and long-term scenario planning of regional power systems.	http://www.nrel.gov/docs/fy13osti/56723.pdf
Using Integrated Resource Planning to Encourage Investment in Cost-Effective Energy Efficiency Measures. This 2011 report for the State and Local Energy Efficiency Action Network summarizes the benefits of IRP processes as a mechanism to encourage cost-effective energy efficiency, and provides best practices on how to develop IRPs and other similar planning processes that promote energy efficiency.	https://www4.eere.energy.gov/seeaction/sites/default/files/pdfs/ratepayer_efficiency_irpportfoliomanagement.pdf
Energy Efficiency Participation in Electricity Capacity Markets: The US Experience. This 2014 paper summarizes the rules governing how efficiency resources participate in the ISO-NE and PJM capacity markets, the result of that participation, and lessons learned to date.	http://www.raponline.org/document/download/id/7303
Guide to Resource Planning with Energy Efficiency. This guide from the National Action Plan for Energy Efficiency, published in 2007, describes key issues, best practices, and main process steps for integrating energy efficiency into resource planning.	http://www.epa.gov/cleanenergy/documents/suca/resource_planning.pdf
Treatment of Solar Generation in Electric Utility Resource Planning. This 2013 technical report from NREL captures utility-provided information about how utilities approach long-range resource planning, methods and tools utilities use to conduct resource planning, and how solar technologies are considered in the resource planning process.	http://www.nrel.gov/docs/fy14osti/60047.pdf
Incorporating Energy Efficiency into Western Interconnection Transmission Planning. This 2014 report documents the energy efficiency-related analyses developed by Lawrence Berkeley National Laboratory for the Western Electricity Coordinating Council's Transmission Expansion Planning and Policy Committee 2011 and 2012 study cycles.	http://emp.lbl.gov/sites/all/files/lbnl-6578e.pdf
A Guidebook to Expanding the Role of Renewables in a Power Supply Portfolio. This 2004 report prepared for the American Public Power Association's Demonstration of Energy-Efficient Development Program describes a suggested process and analytic approach to aid utility managers in expanding the role of renewable resources in their energy supply portfolios.	http://apps2.eere.energy.gov/wind/windexchange/pdfs/power_supply_guidebook.pdf
Edison Electric Institute/Natural Resources Defense Council (EEI/NRDC) Joint Statement to State Utility Regulators. This February 2014 statement by the EEI and NRDC provides recommendations to utilities for innovative technologies that enhance grid performance while lowering emissions, including net metering and energy efficiency measures.	http://docs.nrdc.org/energy/files/ene_14021101a.pdf

Title/Description	URL Address
A Brief Survey of State Integrated Resource Planning Rules and Requirements. This 2011 document by Synapse Energy Economics, Inc., provides an overview of IRP rules in each state, as well as a general discussion of LTPP.	http://www.cleanskies.org/wp-content/uploads/2011/05/ACSF_IRP-Survey_Final_2011-04-28.pdf

Additional Resources Related to Electricity Resource Planning

Title/Description	URL Address
Best Practices in Electric Utility Integrated Resource Planning: Examples of State Regulations and Recent Utility Plans. This 2013 report by Synapse Energy Economics, Inc., provides utilities, commissions, and legislatures with IRP guidance by offering best practice examples.	http://www.synapse-energy.com/sites/default/files/SynapseReport.2013-06.RAP_.Best-Practices-in-IRP.13-038.pdf
Integrated, Multi-pollutant Planning for Energy and Air Quality (IMPEAQ). This 2013 paper represents the Regulatory Assistance Project's (RAP's) early-stage effort to develop a model process that states, local agencies, and EPA can use to comprehensively and simultaneously reduce all air pollutants (criteria, toxic, and greenhouse gases). IMPEAQ adheres to integrated resource planning principles by trying to identify least cost pathways to reduce emissions.	http://www.raponline.org/document/download/id/6440
Best Practices in Electric Utility Integrated Resource Planning: Examples of State Regulations and Recent Utility Plans. This 2013 report describes IRP requirements in three states that have recently updated their regulations governing the planning process, and it reviews the most recent resource plan from the largest utility in each of those states.	http://www.raponline.org/document/download/id/6608
Projecting EGU CO2 Emission Performance in State Plans This Technical Support Document to EPA's 2014 Clean Power Plan Proposal includes a discussion of modeling structures used in utility planning.	http://www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-projecting-egu-co2emission-performance.pdf
EPA Power Sector Modeling. This website provides information and documentation on EPA's application of the Integrated Planning Model (IPM) to analyze the impact of air emissions policies on the U.S. electric power sector.	http://www.epa.gov/powersectormodeling/
Assessment of Demand-Side Resources within the Eastern Interconnection. This 2013 guide, prepared for the Eastern Interconnection States' Planning Council and National Association of Regulatory Utility Commissioners, is an assessment of demand-side resources and their existing and forecasted deployments within the eastern United States. The guide was commissioned to improve understanding of how demand-side resources will affect the needs of future transmission development throughout the Eastern Interconnection.	http://communities.nrri.org/documents/68668/9f3dc4d3-485a-4d54-aad6-80964c932c5e
Utility Scenario Planning: "Always Acceptable" vs. the "Optimal" Solution. This paper describes the concept of Utility Scenario Planning, which is a tool similar to integrated resource planning in which utilities identify sharply different "scenarios" of the future and then seek to define a resource strategy that is most successful in addressing all of those potential futures.	http://www.nrri.org/documents/317330/c1f34184-faf6-4585-8d6f-04587d7da2f9
2013 Carbon Dioxide Price Forecast. This report provides a reasonable range of future price estimates for CO_2 for use in utility integrated resource planning and other electricity resource planning analyses.	http://www.synapse-energy.com/sites/default/files/SynapseReport.2013-11.0.2013-Carbon-Forecast.13-098.pdf

Title/Description	URL Address
A Brief Survey of State Integrated Resource Planning Rules and Requirements. This 2011 report, prepared for the American Clean Skies Foundation, provides an overview of state integrated resource planning rules and identifies for each state the planning horizon, frequency with which plans must be updated, and the resources required to be considered.	http://www.synapse-energy.com/sites/default/files/SynapseReport.2011-04.ACSF_.IRP-Survey.11-013.pdf
Portfolio Management: Design Principles and Strategies. This presentation, part of a 2003 portfolio management workshop hosted by RAP, provides background information and outlines design choices and strategies for effective portfolio management.	http://www.raponline.org/document/download/id/241
State Generation and Transmission Siting Directory. This EEI directory provides siting process summaries for Washington, D.C., and all 50 states.	http://www.eei.org/issuesandpolicy/transmission/Documents/State_Generation_Transmission_Siting_Directory.pdf

State IRP Statutes

State	Title/Description	URL Address
Arizona	Arizona Corporate Commission Decision No. 71722, in Docket No. RE-00000A-09-0249. June 3, 2010.	http://images.edocket.azcc.gov/docketpdf/0000112475.pdf
Arkansas	Arkansas PSC. Resource Planning Guidelines for Electric Utilities. Approved in Docket 06-028-R. January 4, 2007.	http://www.apscservices.info/pdf/06/06-028-r_57_1.pdf
Colorado	Colorado PUC. 4 CCR 723-3, Part 3: Rules Regulating Electric Utilities. Decision No. C10-1111. Docket No. 10R-214E. November 22, 2010.	https://www.dora.state.co.us/pls/efi/efi_p2_v2_demo.show_document?p_dms_document_id=81364
Delaware	Delaware Electric Utility Retail Customer Supply Act of 2006. Delaware Code, Title 26, Chapter 10 Section 1007(c)(1)	http://delcode.delaware.gov/title26/c010/index.shtml
Georgia	Georgia Public Service Commission. General Rules. 515-3-4-.06 Integrated Resource Plan Filing Requirements and Procedures. Amended.	http://rules.sos.state.ga.us/docs/515/3/4/06.pdf
Hawai'i	Public Utilities Commission, State of Hawaii, A Framework for Integrated Resource Planning. March 9, 1992. Revised: March 14, 2011.	http://www.hawaiianelectric.com/vcmcontent/IntegratedResource/IRP/PDF/IRP_Framework_March_2011.pdf
Idaho	Idaho Public Utilities Commission Order No. 22299, in Case No. U-1500-165.	http://www.puc.idaho.gov/search/cases/electriccases.html
Indiana	Indiana Administrative Code 4-7-1: Guidelines for Integrated Resource Planning by an Electric Utility. New draft rules have been proposed in docket IURC RM 11-07, but are on hold due to the rulemaking moratorium currently in effect in Indiana.	http://www.in.gov/legislative/iac/title170.html (status updates for the IRP update rule making can be found here: http://www.in.gov/iurc/2673.htm)
Kentucky	Integrated Resource Planning by Electric Utilities. Relates to KRS Chapter 278.	http://www.lrc.ky.gov/kar/807/005/058.htm
Louisiana	Louisiana Public Service Commission Corrected General Order. Docket No. R-30021. Decided at the Commission's March 21, 2012, Business and Executive Session.	http://lpscstar.louisiana.gov/star/ViewFile.aspx?Id=95a4e806-45b4-4d5d-ae07-dd088a447363

State	Title/Description	URL Address
Minnesota	Resource Planning; Renewable Energy planning requirements: MN Statute §216B.2422. Utility planning requirements: MN Administrative Rules Chapter 7843. "Utility Resource Planning Process."	Statute available at: https://www.revisor.mn.gov/statutes/?id=216B.2422 Rule available at: https://www.revisor.mn.gov/rules/?id=7843
Missouri	Rules of Dept. of Economic Development. Division 240-PSC. Chapter 22—Electric Utility Resource Planning (4 CSR 240.22).	http://www.sos.mo.gov/adrules/csr/current/4csr/4c240-22.pdf
Montana	Montana's Integrated Least-Cost Resource Planning and Acquisition Act (§§ 69-3-1201-1206, Montana Code Annotated). For traditional utilities: Administrative Rules of Montana 38.5.2001-2016, adopted by the Montana PSC. Least Cost Planning – Electric Utilities. For restructured utilities: Administrative Rules of Montana 38.5.8201-8227, adopted by the Montana PSC. Default Electric Supplier Procurement Guidelines.	Code, Title 69: http://leg.mt.gov/bills/mca_toc/69_3_12.htm Rules, Chapter 38.5: http://www.mtrules.org/gateway/ChapterHome.asp?Chapter=38.5
Nebraska	Nebraska Revised Statute 66-1060.	http://nebraskalegislature.gov/laws/statutes.php?statute=66-1060
Nevada	Nevada Revised Statutes 704.741.	http://www.leg.state.nv.us/nrs/NRS-704.html
New Hampshire	Title XXXIV Public Utilities, Chapter 378: Rates and Charges, Section 38: Least Cost Energy Planning.	http://www.gencourt.state.nh.us/rsa/html/NHTOC/NHTOC-XXXIV-378.htm
New Mexico	New Mexico Administrative Code, Title 17, Chapter 7, Part 3. "Integrated Resource Plans for Electric Utilities.	http://164.64.110.239/nmac/parts/title17/17.007.0003.htm
North Carolina	North Carolina Utilities Commission Rule R08-60: Integrated Resource Planning and Filings.	http://ncrules.state.nc.us/ncac/title%2004%20-%20commerce/chapter%2011%20-%20utilities%20commission/04%20ncac%2011%20r08-60.pdf
North Dakota	North Dakota PSC Order issued on January 27, 1987 in Case No. 10,799. Amended on March 11, 1992 in Case No. PU- 399-91-689.	URL not available.
Oklahoma	Title 165: Oklahoma Corporation Commission. Chapter 35: Electric Utility Rules, Subchapter 37: Integrated Resource Planning.	http://www.occeweb.com/rules/Ch%2035%20Electric%20Rules%20eff%209-12-2014%20Searchable.pdf
Oregon	Oregon PUC Order No. 07-002, Entered January 8, 2007.	http://apps.puc.state.or.us/orders/2007ords/07-002.pdf
South Carolina	Established in: Public Service Commission of South Carolina Order No. 91-885 in Docket No. 87-223-E. October 21, 1991. Authority: South Carolina Code of Laws, Title 58, Chapter 37, Section 58-37-40.	PSC Order: http://dms.psc.sc.gov/pdf/orders/DF4FC4A9-EB41-2CB4-D44614AD02D02B8D.pdf SC Code: http://www.scstatehouse.gov/code/t58c037.php

State	Title/Description	URL Address
South Dakota	Utility plan requirement: South Dakota Legislature 1977, Ch. 390, § 23. Chapter 49-41B-3. Facility plan requirement: Administrative Rule Chapter 20:10:21, Energy Facility Plans.	Utility plan: http://legis.sd.gov/Statutes/Codified_Laws/DisplayStatute.aspx?Type=Statute&Statute=49-41B-3&cookieCheck=true Facility plan: http://legis.sd.gov/Rules/DisplayRule.aspx?Rule=20:10:21&cookieCheck=true
Utah	Report and Order on Standards and Guidelines. Docket No. 90-2035-01. In the Matter of Analysis of an Integrated Resource Plan for PacifiCorp. Issued June 18, 1992.	http://www.airquality.utah.gov/Public-Interest/Current-Issues/Regionalhazesip/RegionalHazeTSDdocs/Utah_PSC_Integrated_Planning_Rules.pdf
Vermont	Vermont Statutes, Title 30 (30 V.S.A.), Chapter 5, Sub-chapter 1, Section 218c, Least Cost Integrated Planning.	http://legislature.vermont.gov/statutes/section/30/005/00218c
Virginia	Definitions (Code of Virginia § 56-597). Contents of Integrated Resource Plans (Code of Virginia § 56-598). Integrated Resource Plan Required (Code of Virginia § 56-599).	Section 597: http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+56-597 Section 598: http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+56-598 Section 599: http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+56-599
Washington	Washington Administrative Code 480-100-238: Integrated Resource Planning.	http://apps.leg.wa.gov/wac/default.aspx?cite=480-100-238
Wyoming	Wyoming Public Service Commission Rule 253 (submitted July 22, 2009), and associated Guidelines for Staff Review.	Rule: http://legisweb.state.wy.us/ARULES/2009/AR09-043.htm Guidelines: http://psc.state.wy.us/htdocs/electric/ElectricIRPGuidelines7-10.pdf

State CPCN Rules and Statutes

State	Title/Description	URL Address
Alabama	Certificate of Convenience and Necessity - When Required; Application; Issuance (ALA Code § 37-4-28).	http://codes.lp.findlaw.com/alcode/37/4/1/37-4-28
Arizona	Compliance by Utility; Commission Order (Arizona State Legislature Title 40-360.07).	http://www.azleg.state.az.us/FormatDocument.asp?inDoc=/ars/40/00360-07.htm&Title=40&DocType=ARS
Arkansas	City of Paragould v. Arkansas Utilities Co. (70 F.2d 530).	http://leagle.com/decision/193460070F2d530_1412.xml/CITY%20OF%20PARAGOULD%20v.%20ARKANSAS%20UTILITIES%20CO
Colorado	Colorado Public Utilities Commission: Rules Regulating Electric Utilities (4 CCR 723-3, §3102)	http://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=5738&fileName=4%20CCR%20723-3
Connecticut	Certificate of Environmental Compatibility and Public Need. Transfer. Amendment. Excepted Matters. Waiver (CT Gen Stat § 16-50k).	http://law.justia.com/codes/connecticut/2012/title-16/chapter-277a/section-16-50k

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Florida	Environmental Cost Recovery (Florida Statute 366.8255).	http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0300-0399/0366/Sections/0366.8255.html
Georgia	Actions Prohibited Without a Certificate of Public Convenience and Necessity (O.C.G.A. 46-3A-3).	http://law.justia.com/codes/georgia/2010/title-46/chapter-3a/46-3a-3
Idaho	Certificate of Convenience and Necessity (Idaho Statute 61-526.	http://www.legislature.idaho.gov/idstat/Title61/T61CH5SECT61-526.htm
Indiana	Necessity for Certification (Ind. Code §8-1-8.5-2)	http://codes.lp.findlaw.com/incode/8/1/8.5/8-1-8.5-2
Iowa	Electric Power Generation and Transmission (Iowa Code 476A).	http://coolice.legis.iowa.gov/cool-ice/default.asp?category=billinfo&service=iowacode&ga=83&input=476A
Kansas	Electric Public Utilities; Power, Authority, and Jurisdiction of State Corporation Commission (Kansas Statute 66-101). *Applies only to nuclear generation.*	http://www.kslegislature.org/li/b2015_16/statute/066_000_0000_chapter/066_001_0000_article/066_001_0001_section/066_001_0001_k/
Kentucky	Certificate of Convenience and Necessity Required for Construction Provision of Utility Service or of Utility–Exceptions–Approval Required for Acquisition or Transfer of Ownership–Public Hearing on Proposed Transmission Line mission–Severability of Provisions (Kentucky Statute 278.020).	http://www.lrc.ky.gov/Statutes/statute.aspx?id=14042
Maryland	Article – Public Utilities (§ 7-207).	http://mgaleg.maryland.gov/webmga/frmstatutestext.aspx?pid=&tab=subject5&stab=&ys=2015rs&article=gpu&section=7-207&ext=html&session=2015rs
Minnesota	Certificate of Need for Large Energy Facility (Minnesota Statute 216B.243).	https://www.revisor.mn.gov/statutes/?id=216B.243
Mississippi	Certificate of Public Convenience and Necessity Required; Exceptions; Complaints Prompting Hearing As to Adequacy of Service (MS Code § 77-3-11).	http://law.justia.com/codes/mississippi/2013/title-77/chapter-3/article-1/section-77-3-11/
Nebraska	Electric Generation Facilities and Transmission Lines; Approval or Denial of Application; Findings Required; Regional Line or Facilities; Additional Consideration (Nebraska Revised Statute 70-1014).	http://nebraskalegislature.gov/laws/statutes.php?statute=70-1014
Nevada	Specific Requirements for Electric Companies (NAC 703.185).	http://www.leg.state.nv.us/nac/NAC-703.html
New Mexico	New Construction; Ratemaking Principles (NM Stat § 62-9-1)	http://law.justia.com/codes/new-mexico/2011/chapter62/article9/section62-9-1

State	Title/Description	URL Address
New York	Article 10: Siting of Major Electric Generating Facilities.	http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/d12e078bf7a746ff85257a70004ef402/$FILE/Article10LawText%20.pdf
North Carolina	Certificate for Construction of Generating Facility; Analysis of Long-Range Needs for Expansion of Facilities; Ongoing Review of Construction Costs; Inclusion of Approved Construction Costs in Rates (G.S. § 62-110.1).	http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_62/GS_62-110.1.html
North Dakota	Chapter 49-03: Electric Utility Franchise.	http://www.legis.nd.gov/cencode/t49c03.pdf?20141029133026
Ohio	Basis for Decision Granting or Denying Certificate (Ohio Revised Code 4906.10).	http://codes.ohio.gov/orc/4906.10
South Carolina	Utility Facility Siting and Environmental Protection Act (Title 58-33).	http://www.scstatehouse.gov/code/t58c033.php
West Virginia	Requirements for Certificate of Public Convenience and Necessity (West Virginia Code § 24-2-11).	http://www.legis.state.wv.us/wvcode/ChapterEntire.cfm?chap=24&art=2&section=11
Wisconsin	Regulation of Public Utilities (Wisconsin Statute 196).	http://docs.legis.wisconsin.gov/statutes/statutes/196.pdf
Wyoming	Certificate of Convenience and Necessity; Hearings (WY Stat § 37-2-205).	http://law.justia.com/codes/wyoming/2013/title-37/chapter-2/article-2/section-37-2-205/

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7.2 Policies That Sustain Utility Financial Health

Policy Description and Objective

Summary

Although aggressive energy efficiency and clean distributed generation programs help utilities diversify their portfolio, lower costs, and meet customer needs, some utilities may face important financial disincentives to adopting these programs under existing state regulatory policies. State regulators can establish or reinforce several policies to help curb these disincentives, including addressing the throughput incentive, ensuring program cost recovery, and defining shareholder performance incentives.

Public utility commissions (PUCs) in leading states are refining traditional utility policies to better align the utility financial interest with state and customer interest in affordable, reliable electricity service that minimizes environmental impacts.

As part of their business model, utilities take on financial commitments and incur risks in support of infrastructure investments and procurement plans (see Section 7.1, "Electricity Resource Planning and Procurement"). If the state PUC finds in a rate case or otherwise that such costs and risks are prudent, the costs are recovered in customer rates. Investor-owned utilities also need to remain profitable to their shareholders; their failure to do so can affect their stock price and bond ratings, as well as the cost of capital for future investments made on behalf of customers.

Traditional regulatory approaches link the recovery of utility investment and operating costs to the volume of electricity (kilowatt-hours [kWh]) sold to customers. Most retail rates are "volumetric," meaning that fixed and variable costs are recovered incrementally for each unit of energy sold. This creates an incentive to maximize the volume of sales across the wire (the "throughput" incentive) and a disincentive to invest in energy efficiency, distributed renewable energy, or combined heat and power (CHP), all of which reduce sales volume.[80] Decoupling revenue from sales volumes, ensuring program cost recovery, and providing shareholder incentives linked to program performance can help "level the playing field" for utility resource investments by creating an economically based comparison between supply- and demand-side resource alternatives that can yield a lower cost, cleaner, and more reliable energy system.

Objective

The objective of these policies is to align utilities' financial interests with state policy goals of advancing energy efficiency, distributed renewable energy, and CHP. Policies can provide complementary cost recovery and performance incentives for well-run and well-performing energy efficiency and distributed generation (DG) installation and promotion, as well as address potential financial disincentives utilities may face by eliminating or minimizing the throughput incentive embedded in traditional ratemaking.

Benefits

As part of a broader suite of energy efficiency, renewable energy, and CHP policies, well-designed financial incentive structures for utilities can encourage them to actively support these demand-side resources. States with existing policies to support the utility's financial health, such as cost recovery, revenue decoupling, and

[80] The effect of this linkage is exacerbated in the case of distribution-only utilities, as the revenue impact of electricity sales reduction is disproportionately larger for utilities without generation resources.

shareholder incentives, have the highest per capita investment in energy efficiency programs.[81] Encouraging the effective delivery of cost-effective energy efficiency and clean DG resources reduces a utility's need to expand existing facilities or to build more expensive, new central station power plants or transmission and distribution infrastructure, thus maximizing the value of a utility's existing gas or electric capacity. Energy efficiency and clean DG programs can also lower overall electric system costs and customer bills, among other benefits (RAP 2013).

Background on Utility Incentive Structures

The majority of electric utility costs are for capital-intensive equipment such as wires, poles, transformers, and generators. State PUCs determine how these costs may be recovered through proceedings known as rate cases. Utilities recover most of these fixed costs based on the volume of energy they sell. As a result, between rate cases, utilities have an incentive to encourage higher electricity sales (relative to forecast levels) in order to maximize how much electricity flows across their wires. This ensures recovery of fixed costs and maximizes allowable earnings; however, it also creates a disincentive for investing in energy efficiency or DG during the time between rate cases. In some states, regular (usually quarterly) adjustments, often known as fuel adjustment clauses, ensure recovery of variable costs, such as those for fuel. These clauses create an even greater disincentive for investing in energy efficiency.

Ratemaking could address this disincentive, for example, by allowing more frequent true-ups to rates to reflect actual sales and actual fixed cost revenue requirements. Another option is to shift a greater portion of fixed costs out of variable per-kWh charges into fixed customer charges. In both cases, this disincentive would be removed or minimized. However, energy efficiency options would only be able to better compete with alternative supply options in the frequent true-up case. A simplified illustration of this decoupling rate effect is shown in Table 7.2.1.

Separate, supplemental shareholder incentive policies, such as performance-based return on equity guarantees, could then operate more effectively without the disincentive that standard ratemaking practices otherwise impose on utilities. Frequent true-ups and shareholder incentives are more desirable than charging customers a high fixed

Table 7.2.1: Simplified Illustration of Decoupling Rate Effect

Rates and fixed cost recovery during initial period			
	Sales at Forecast	Sales Below Forecast	Sales Above Forecast
Sales Forecast	100 kWh		
Fixed Cost[a]	$6.00		
Variable Cost[b]	$0.04 per kWh		
Total Variable Cost	$4.00	$3.80	$4.20
Total Costs [Fixed + Variable]	$10.00	$9.80	$10.20
Authorized Rate [Costs Sales Forecast]	$0.100 per kWh		
Actual Sales	100 kWh	95 kWh	105 kWh
Actual Revenues	$10.00	$9.50	$10.50
Fixed Cost Recovery [Revenue - Cost]	Even $0.00	Under ($0.30)	Over $0.30
Rates in next period after decoupling true up			
	Sales at Forecast	Sales Below Forecast	Sales Above Forecast
Sales Forecast[c]	100 kWh		
Total Costs[c]	$10.00		
Revenue Requirement [Total Costs - Fixed Cost Recovery]	$10.00	$10.30	$9.70
New Authorized Rate [Revenue Requirement Sales Forecast]	$0.100 per kWh	$0.103 per kWh	$0.097 per kWh

[a] Fixed costs include return on rate base.
[b] Variable costs include operating costs of power plants.
[c] Assumes values from initial period for illustrative purposes.

Sources: NRDC 2004; PG&E 2003

[81] In 2010, seven of the 10 states with the highest per capita investment in electric energy efficiency programs, as well as eight of the 10 states with the highest per capita investment in natural gas energy efficiency programs, had decoupling in place or had adopted decoupling as state policy (NRDC 2012).

charge each month because they provide more flexibility for addressing differences in short- and long-term costs. A high monthly customer charge can also diminish customers' incentives for energy efficiency and onsite generation.

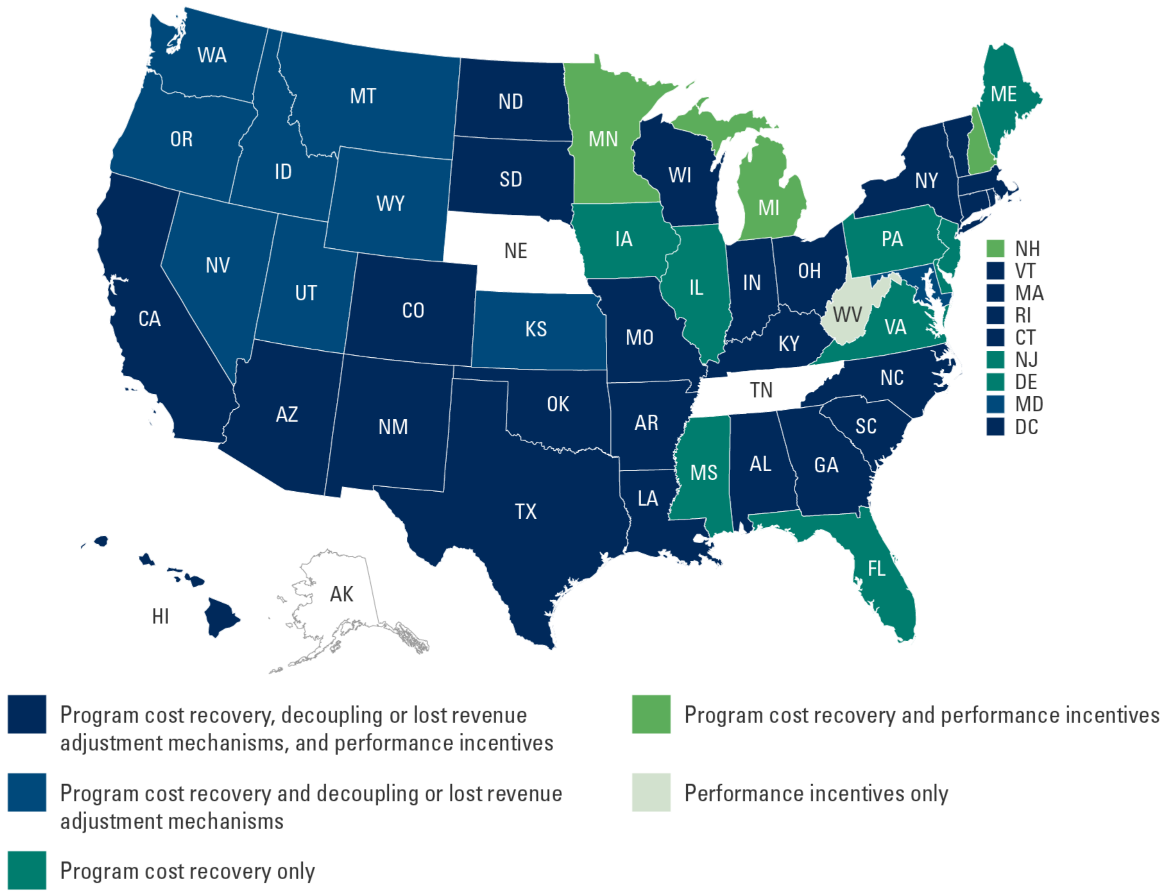
States with Utility Incentive Policies for Demand-Side Resources

States have developed three policies to level the playing field for demand-side resources through improved utility rate design:

- *Remove disincentives*. Some states have removed structures that discourage energy efficiency and clean DG implementation using revenue decoupling methods that seek to break the link between revenues and sales volumes. Some have alternatively established lost revenue recovery policies that are designed to recover lost margins for utilities as sales fall due to the success of energy efficiency programs. These two mechanisms can have significantly different effects and thus deserve careful consideration.
- *Recover costs.* Many states have given utilities a reasonable opportunity to recover energy efficiency and clean DG program implementation costs by incorporating program costs into utility base rates, providing riders or surcharges on bills, or establishing balancing accounts to prevent under-recovery of expenses. Cost recovery alone, however, does not remove the financial disincentive needed to further expand a utility's commitment to maximizing energy efficiency and clean DG.
- *Reward performance.* Some states have created shareholder incentives for implementing high-performance energy efficiency and, less frequently, clean DG programs. These incentives usually take the form of savings performance targets—in which incentives are paid when a utility achieves some fraction of proposed energy savings—or shared savings policies, in which utilities are compensated when they can demonstrate that energy efficiency programs resulted in net benefits (calculated as program costs netted against avoided supply-side costs) for ratepayers. In the past, states have implemented a bonus rate of return policy, in which utilities are allowed an increased return on investment for energy efficiency investments if the programs demonstrate measured or verified success; however, the bonus rate of return is rarely used now.

States with these three approaches, especially those with all three policies, have utilities supportive of policies to encourage demand-side energy efficiency, renewable energy, and CHP. Most states have had or are reviewing at least one of these forms of decoupling and incentive policy. Figure 7.2.1 shows the status of state implementation of financial incentive policies as of 2014.

Figure 7.2.1: Electric Utility Regulatory Financial Incentive Policies by State, 2014



Note: The sources update state status on a rolling basis, so this map reflects policies in place as of late 2013 to mid-2014, depending on the state. This map does not include states with pending legislation. As of September 2014, Delaware, Mississippi, and Virginia had pending decoupling or lost revenue adjustment mechanism legislation. Mississippi and Montana had pending performance incentive legislation.

Sources: ACEEE 2014; Edison Foundation 2013

Remove Disincentives through Decoupling or Lost Revenue Adjustment Policies

Traditional electric and gas utility ratemaking policies have caused financial disincentives for utilities to support energy efficiency and distributed renewable energy. This misalignment can be remedied through policies that decouple utility revenues from sales or lost revenue adjustment mechanisms (LRAMs).

Decoupling is an alternative means of eliminating lost revenues that might otherwise occur with energy efficiency and DG resource implementation. It is a variation of more conventional performance-based ratemaking (PBR). Under conventional ratemaking, a utility’s rates are fixed until the next rate case occurs at an undetermined future point in time. Under conventional PBR, a utility’s rates are typically set for a predetermined number of years (e.g., 5 years). This type of PBR is referred to as a “price cap” and is intended to provide utilities with a direct incentive to lower cost (and thereby increase profits) during the term of the price cap.

Decoupling is a variation of conventional PBR, and it is sometimes referred to as a particular form of "revenue cap." Under this approach, a utility's *revenues* are fixed for a specific term, in order to match the amount of anticipated costs incurred plus an appropriate profit. Alternatively, a utility's revenues per customer could be fixed, or some other revenue adjustment system can be used, thus providing an automatic adjustment to revenues. If the utility can reduce its costs during the term through energy efficiency, DG, or other system efficiencies, it will be able to increase its profits. Furthermore, if a utility's sales are reduced by any means, including efficiency, DG, weather, or economic swings, under-collections will be recovered from customers and the utility's revenues will not be affected. The effect is symmetrical; unexpectedly higher sales and the resulting higher revenues will return money to customers. This approach eliminates the throughput incentive and does not require an accurate forecast of the amount of lost revenues associated with energy efficiency or DG. It does, however, result in the potential for rate or price variation, reflecting an adjustment to the relationship between total utility revenue requirements and total electricity or gas consumed by customers over the defined term. Such rate adjustments, or true-ups, are a fundamental aspect of the rate design resulting from decoupling profits from sales volumes.

LRAMs allow a utility to directly recoup the lost revenue associated with not selling additional units of energy due to the successful reduction of electricity consumption by energy efficiency or DG programs. The amount of lost revenue is typically estimated by multiplying the fixed portion of the utility's prices per kWh by the energy savings from energy efficiency programs or the energy generated from DG. This amount is then directly returned to the utility. Some states have adopted these policies, but experience has shown that LRAMs can result in utilities being allowed more lost revenues than the energy efficiency program actually saved. This is because the lost revenues are often based on projected savings. Furthermore, because utilities still earn increased profits on additional sales, this approach does not fully remove the throughput incentive, and it provides a disincentive for utilities to implement additional energy efficiency or to support independent energy efficiency activities. In summary, unlike other decoupling approaches, the LRAM approach provides limited incentives, does not fully address the throughput incentive, and does not influence efficient utility operations companywide.

Another approach, known generically as straight fixed variable (SFV) ratemaking, involves an alternative rate structure that allows utilities to recover a larger share of their fixed costs through fixed charges to their customers. Ordinarily, utilities recover a sizable portion of their fixed costs (e.g., generators, transformers, wires, and poles) through variable charges (i.e., charges per unit of energy consumed), while the monthly per-customer charge collects costs strictly associated with connecting customers to the system. In contrast, SFV rate structures allocate all current fixed costs to a per-customer charge that does not vary with consumption. Related alternatives use a consumption block structure, which allocates costs across several blocks of commodity consumption and typically places most or all of the fixed costs within the initial block.

SFV and similar rate designs can provide significant earnings stability for a utility in the short run. Like revenue decoupling, these alternative rate structures do not provide a direct incentive for utilities to encourage customers to invest in energy efficiency, distributed renewables, or CHP, but do reduce the throughput incentives that encourage utilities to promote increased sales. However, these alternative rate designs can create problems because fixed costs can be very high, and allocation of fixed charges may impose ability-to-pay issues on lower income customers and thus be seen as regressive. SFV designs also reduce a customer's incentive to undertake efficiency improvements because the associated bill savings will be reduced. Further variable charges under an SFV design may fall to levels below the cost of new supply resources, which could lead to increased supply costs if customers are motivated to consume more electricity under such a rate design.

Table 7.2.2 compares the pros and cons of decoupling and lost revenue recovery mechanisms, as well as alternative rate structures. As the table illustrates, decoupling appears to be the simplest and most comprehensive approach to aligning utility incentives with investment in energy efficiency. While it requires more effort to establish a complete decoupling policy, it avoids the downsides of lost revenue and SFV approaches.

Table 7.2.2: Comparison of Policies for Removing Disincentives to Energy Efficiency Investment

Policy	Pros	Cons
Revenue decoupling: Policy that sets the utility's revenues at a fixed amount for a specific term to match the amount of anticipated costs incurred plus an appropriate profit.	o Revenue decoupling weakens the link between a utility's sales and margin recovery. This reduces utility reluctance to promote energy efficiency, including building codes, appliance standards, and energy efficiency programs. o Through decoupling, the utility's revenues are stabilized and shielded from fluctuations in sales. Some have argued that this, in turn, might lower utility risk and cost of capital (CA Energy Consulting 2007; Delaware PSC 2007).[a] The degree of stabilization is a function of adjustments made for weather, economic growth, and other factors (some regulations do not adjust revenues for weather or economic growth-induced changes in sales).[b] o Decoupling does not require an energy efficiency program measurement and evaluation process to determine the level of under-recovery of fixed costs.[c] o Decoupling has low administrative costs relative to specific lost revenue recovery policies. o Decoupling reduces the need for frequent rate cases and corresponding regulatory costs. o States have experience implementing revenue decoupling over several years.	o Rates (and in the case of gas utilities, non-gas customer rates) can be more volatile between rate cases, although annual caps can be instituted (Graceful Systems 2012). o Where carrying charges are applied to balancing accounts, the accruals can grow quickly. o The need for frequent balancing or true-up requires regulatory resources; however PUC resources to implement decoupling are much less than those required to conduct more frequent rate cases. o
Lost revenue recovery mechanisms: Policy that allows a utility to recoup lost revenue associated with not selling additional units of energy.	o Removes disincentive to energy efficiency investment in approved programs caused by under-recovery of allowed revenues. o	o Does not remove the throughput incentive to increase sales. o Does not remove the disincentive to support other energy saving policies. o Complex to implement given the need for precise evaluation; will increase regulatory costs if it is closely monitored. o Proper recovery (no over- or under-recovery) depends on precise evaluation of program savings.

Table 7.2.2: Comparison of Policies for Removing Disincentives to Energy Efficiency Investment

Policy	Pros	Cons
Alternative rate structures: Policy that allows utilities to recover a larger share of their fixed costs through fixed charges to their customers.	o Removes the utility's incentive to promote increased sales. o May align better with principles of embedded cost-causation. o Administratively simple.	o May not align with cost-causation principles for utilities, especially in the long run. o Creates issues of income equity. o Movement to an SFV design significantly reduces customer incentives to reduce consumption by lowering variable charges. High fixed charges can also lead to customer disconnection from the electric grid.

[a] The design of the decoupling policy can address risk-shifting through the nature of the adjustments that are included. Some states have explicitly not included weather-related fluctuations in the decoupling policy (the utility continues to bear weather risk). In addition, recognizing that utility shareholder risk decreases with decoupling, some decoupling plans include provisions for capturing some of the risk reduction benefits for consumers.

[b] The impact of decoupling in eliminating the throughput incentives is lessened as the scope of the decoupling policy shrinks.
Note, however, that as the various determinants of sales, such as weather and economic activity, are excluded from the policy, the need for complex adjustment evaluation methods increases. In any case, an evaluation process should nevertheless be a part of the broader energy efficiency investment process.

Source: Derived from NAPEE 2007.

As an example, California's original decoupling policy, an Electric Rate Adjustment Mechanism (ERAM), was in place between 1982 and 1996 and was successful in reducing rate risk to customers and revenue risk to the major utility companies (LBNL 1993). California dropped its decoupling policy in 1996 when electric utility restructuring was initiated and retail competition was introduced. When competition did not deliver on its promise, California brought back a decoupling approach as part of a larger effort to reinvigorate utility-sponsored energy efficiency programs. Conversely, Minnesota tried a lost revenue approach and met strong customer opposition because there was no cap on the total amount of revenues that could be recovered.

While decoupling is a critical step in optimizing energy efficiency benefits, states have found that decoupling alone is insufficient.[82] Most states therefore add one or both related approaches: assurance for energy efficiency program cost recovery and shareholder/company performance incentives to reward utilities for maximizing energy efficiency investment where it is cost-effective. Furthermore, as stated above, states that seek aggressive energy efficiency and DG deployment typically have a suite of policies in place to drive utility investment, such as energy efficiency and renewable energy resource standards.

Program Cost Recovery

Appropriate opportunity for cost recovery is an important element of utility energy efficiency and clean DG programs and all other utility costs. The extent to which this is a real risk for utilities depends upon the ratemaking practices in each state. Nonetheless, the perception of the risk can be a significant barrier to utilities, regardless of how real it is. Under traditional ratemaking, utilities might be unable to collect any additional energy efficiency or DG expenses that are not already included in the rate base. Similarly, under a price cap form of PBR, utilities might be precluded from recovering new costs incurred between the periods

[82] For example, see Cadmus (2013).

when price caps are set. However, traditional ratemaking can nonetheless allow program cost recovery for well-performing energy efficiency or DG programs, if desired. If revenue caps are in place, well-performing program costs can be included as part of the overall revenue requirement in the same way that supply-side fixed costs are usually included in revenue requirements. If energy efficiency/DG programs do not meet minimum performance criteria, then these costs could be excluded from revenue requirements and would therefore not be passed on to ratepayers.

Regulatory mechanisms can be used to overcome program cost recovery concerns. These mechanisms assure utilities that investments in cost-effective energy efficiency and DG resources will be recovered in rates, independent of the form of ratemaking in place. Under traditional ratemaking, an energy efficiency or DG surcharge could be included in rates and adjusted periodically to reflect actual costs incurred. Under a price cap form of PBR, energy efficiency and DG costs could be excluded from the price cap and adjusted periodically to reflect actual costs incurred.

Many states with restructured electric industries have introduced a public benefits fund (PBF) that provides utilities with a fixed amount of funding for energy efficiency and DG, thus eliminating this barrier to utilities. For example, in 2005, the New York Public Service Commission (PSC) approved a proposal in a Consolidated Edison Company (Con Edison) rate case that included, among other demand-side measures, demand-side management (DSM) program cost recovery through a PBF. In New Hampshire, the state Public Utilities Commission (PUC) allocates funding to several approved, core energy efficiency programs administered by the state's utilities.

Shareholder/Company Performance Incentives

Under traditional regulation, utilities may perceive that energy efficiency or clean DG investment conflicts with their profit targets. However, states are finding that once the throughput incentive is addressed, utilities are more likely to look at cost-effective energy efficiency and clean DG as a potential profit center and an important resource alternative to meet future customer needs. Utilities earn a profit on approved capital investment for generators, wires, poles, transformers, etc. Incentive ratemaking can allow for greater profit levels on energy efficiency or DG resources, recognizing that many benefits to these resources, such as improved reliability or reduced emissions, are not otherwise explicitly accounted for.

States such as California, Massachusetts, and New Hampshire are using profit or shareholder incentives to make returns on energy efficiency and clean DG investments sufficient enough to support serious consideration when compared with conventional supply-side investments. While implementing such policies can be contentious, the intent is that with throughput incentives removed, utilities can be rewarded with incentives stemming from superior program performance. Such incentives include a higher rate of return on capital invested in energy efficiency and clean DG, or equivalent earnings bonus allowances. Rewards require performance; independent auditing of energy efficiency/DG program effectiveness can drive the level of incentive. The savings that result from choosing the most cost-effective resources over less economical resources can be shared between ratepayers and shareholders, giving ratepayers the benefits of wise resource use while rewarding management for the practices that allow these benefits to be secured.[83]

[83] The utility industry uses the term "shared savings" in several ways. Alternative meanings include, for example, the sharing of savings between an end-user and a contractor who installs energy efficiency measures. Throughout this *Guide to Action*, "shared savings" refers to shareholder/ratepayer sharing of benefits arising from implementation of cost-effective energy efficiency/DG programs that result in a utility obtaining economical energy efficiency/DG resources.

Implementing a package of incentive regulation initiatives might include: 1) stakeholder discussion of the issues, 2) state commission rulemaking or a related initiative proposing a change from traditional ratemaking, and 3) clear and comprehensive direction from the state commission establishing the explicit rate structure or pilot program structure to be put in place.

Designing Effective Utility Incentives for Demand-Side Resources

Participants

A number of stakeholders are typically included in the design of decoupling and incentive regulations:

- *State legislatures*. Utility regulation broadly affects all state residents and businesses. State energy policy is affected by and affects utility regulation. Legislation may be required to direct the regulatory commission to initiate an incentive regulation investigation or to remove barriers to elements like periodic resetting of rates without a comprehensive rate case. Legislative mandates can also provide funding and/or political support for incentive regulation initiatives. By the same token, legislative initiatives can limit the ability of utility commissions and utilities to institute or benefit from regulatory incentives that support energy efficiency and DG.
- *State PUCs*. State PUCs have the greatest responsibility to investigate and consider incentive regulations. Staff and commissioners oversee the stakeholder processes through which incentive regulation issues are discussed. PUCs may have specific statutory direction, or they may implement "common good" laws. PUCs are the ultimate issuers of directives implementing incentive regulation packages for regulated gas and electric utilities.
- *Consumer counsels/advocates*. Most states have a standing "Office of Peoples Counsel" or similar organization whose mission is to represent consumer interests in PUC and court proceedings. Typically staffed by attorneys and regulatory specialists, consumer advocate offices regularly intervene in rate cases and related proceedings to represent typical residential ratepayer interests.
- *State energy offices/executive agencies.* State policies on energy and environmental issues are often driven by executive agencies at the behest of governors' offices. If executive agency staff are aware of the linkages between utility regulatory and ratemaking policies, it may be more likely that executive agency energy goals can be fostered by successful utility energy efficiency and clean DG programs. Attaining state energy and environmental policy goals hinges in part on the extent to which incentive regulation efforts succeed.
- *Energy efficiency providers*. Energy efficiency providers have a stake in incentive regulation initiatives. In some states, they contract with utilities to provide energy efficiency program implementation. In other states, energy efficiency providers such as Vermont's "Efficiency Vermont" serve as the managing entity for delivering energy efficiency programs.
- *DG developers*. DG developers, like energy efficiency providers, are affected by any incentive regulation that reduces throughput incentives, as they are likely to be able to work more closely with utilities to target the locations that maximize the benefits that DG can bring by reducing distribution costs. DG developers can benefit from net metering and other policies that reduce barriers to cost recovery.[84]

[84] See Section 7.3, "Interconnection and Net Metering Standards," and Section 7.4, "Customer Rates and Data Access," for more information.

- *Utilities*. Vertically integrated utilities and distribution or distribution-transmission-only utilities are affected to the greatest degree by incentive regulation, as their approved revenue collection mechanisms are at the heart of incentive regulation issues.
- *Environmental advocates*. Energy efficiency, distributed renewable energy, and CHP resources can provide low-cost environmental benefits, especially when targeted to locations requiring significant transmission and distribution investment. Environmental organizations can offer perspectives on using energy efficiency, distributed renewable energy, and CHP as alternatives to supply-side options.
- *Other organizations*. Other organizations, including local governments; third-party program administrators; and energy efficiency, distributed renewable energy, and CHP industry stakeholders, can provide cost-effectiveness information as well as perspectives on other complementary policies.

Best Practices: Designing Effective Incentive Regulations for Gas and Electric Utilities

The best practices identified below will help states develop effective incentive regulations to support implementation of cost-effective energy efficiency, distributed renewable energy, and CHP.

- Survey the current regulatory landscape in your state and neighboring states.
- Determine if and how energy efficiency, distributed renewable energy, and CHP are addressed in rate structures. In particular, determine if traditional ratemaking formulas exist. Do they create obstacles to promoting energy efficiency, distributed renewable energy, and CHP?
- Gather information about potential incentive rate designs for your state.
- Assemble key stakeholders and provide a forum for their input on utility incentive options.
- Clarify specific objectives and underlying rationale for motivating utility actions.
- Devise an implementation plan with specific timelines and objectives.

Interaction with Federal, Regional, and State Policies

Incentive regulation is closely intertwined with almost all state-level energy policy involving electric and gas utility service delivery, since it addresses the fundamental issue of establishing a means for a regulated utility provider to recover its costs. The following state policies will be affected by changing to a form of incentive regulation:

- *Resource portfolio standards.* As discussed in Section 4.1, energy efficiency resource standards (EERSs) set numerical, multiyear targets for total energy savings. EERSs drive efficiency investment and program planning from these top-down targets, often for periods of 5 to 10 years or more. Renewable portfolio standards, discussed further in Chapter 5, set targets for renewable electricity acquisition, which may include energy efficiency, distributed renewable energy, and CHP.
- *Electricity planning and procurement policies*. These are an important complement to utility incentives because they can provide vertically integrated utilities (through use of integrated resource planning) and distribution-only utilities (through use of portfolio management) with a long-term planning framework for identifying the quantity and type of energy efficiency, distributed renewable energy, and CHP resources to pursue.
- *PBFs.* Also known as system benefits charges, PBFs may eliminate the need for—or provide another way of addressing—cost recovery. PBF funding approaches are discussed in Section 4.2, "Energy Efficiency Programs."
- *PBR*. PBR includes a host of mechanisms that can help achieve regulatory objectives. Many are tied to specific elements of ratemaking, such as price caps (i.e., a ceiling on the per unit rate charged for energy), revenue caps (i.e., a ceiling on total revenue), or revenue per customer caps. Many states already use

energy efficiency performance rewards. Typically, all PBR mechanisms are established with the goal of rewarding utility performance that results in superior customer service, reliability, or other measured outcomes of utility company effort. Reducing the throughput disincentive is one important form of PBR, and if it is not addressed, the effectiveness of other aspects of PBR can be undermined.

Under federal stimulus legislation passed in 2009, state governors were required to notify the Secretary of Energy regarding their state's implementation of utility incentive policies in order to receive part of the Department of Energy's State Energy Program (SEP) $3.1 billion funding under the American Recovery and Reinvestment Act (ARRA) of 2009. States use SEP funding for a variety of programs, inclusive of energy efficiency and clean DG. Section 401 of ARRA required assurances from state governors that the state regulatory authority seeks to implement a "general policy that ensures that utility financial incentives are aligned with helping their customers use energy more efficiently and that provide timely cost recovery and a timely earnings opportunity for utilities."

Evaluation

Some states have begun to evaluate their decoupling activities to ensure program success (CA Energy Consulting 2013; Graceful Systems 2012). For example, independent evaluation of the Oregon initiative for Northwest Natural Gas included a summary of the program's intentions, recognition that deviations from forecast usage affects the amount of fixed costs recovered, and acknowledgement that partial rather than full decoupling was attained. The report stated that the program had reduced the "variability of distribution revenues" and "alter[ed] NW Natural's incentives to promote energy efficiency" (CA Energy Consulting 2005).

The following information is usually collected as part of the evaluation process to document additional energy efficiency, distributed renewable energy, and CHP; customer rate impacts; and changes to program spending that arise due to changes to regulatory structures:

- Utility energy efficiency, distributed renewable energy, and CHP program expenditure and savings information.
- Additional data on weather and economic conditions to control for factors influencing retail sales other than program actions.
- Rate changes occurring during the program, if any, such as those arising from use of a balancing mechanism.

State Examples

Numerous states previously addressed or are currently exploring electric and gas incentive policies. Experiments in incentive regulation occurred through the mid-1990s but were generally overtaken by events leading to various forms of restructuring. There is renewed interest in incentive regulation due to recognition that barriers to energy efficiency still exist, and utility efforts to secure energy efficiency, distributed renewable energy, and CHP benefits remain promising. States are looking to incentive policies to remove barriers in order to meet the cost-effective potential of clean energy resources.

Many states have had or are reviewing various forms of decoupling or incentive regulation, including performance incentive structures. The body of state experience continues to grow, and this summary section does not seek to address all of its complexities and implications. The following illustrative state examples are listed in the approximate order of the extent to which decoupling policies have been considered in the state.

California

California's rate policies are not new. Between 1983 and the mid-1990s, California's rate design included an ERAM, a decoupling policy that was the forerunner of today's policy and the model for balancing mechanisms implemented by other states during the early 1990s. The impact of the original ERAM on California ratepayers was positive, with a negligible effect on rates, and it led to reduced rate volatility. While certain issues have been contentious, California's experience helpfully illustrates one of the longest standing state policies in this area.

Beginning in 2004, California re-adopted a revenue balancing mechanism that applies between rate cases and removes the throughput incentive by allowing for rate adjustments based on actual electricity sales, rather than test-year forecast sales. The California Public Utilities Commission (CPUC) established this mechanism to conform to a 2001 law that dictated policy in this area, stating that forecasting errors should not lead to significant over- or under-collection of revenue. Currently, the revenue balancing mechanism is combined with performance incentives for energy efficiency targets.

California first implemented a shared-savings incentive mechanism in the 1990s. The CPUC authorized a 70 percent/30 percent ratepayer/shareholder split of the net benefits arising from implementation of energy efficiency measures in the 1994–1997 timeframe. This mechanism first awarded shareholder earnings bonuses based on measured program performance. Between 1998 and 2002, the performance incentive was changed to reward "market transformation" efforts by the utilities. These incentives were phased out after 2002 due to the state's overhaul of its energy efficiency policies. In 2012, the CPUC defined a new shareholder incentive mechanism known as the Energy Savings and Performance Incentive for investor-owned utilities. A subsequent ruling in September 2013 allocates incentive earnings among four categories, including energy efficiency resource savings. Incentives for energy efficiency resource savings are capped at 9 percent of program expenditures.

Websites:
http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Shareholder+Incentive+Mechanism.htm (Rulemaking 12-01-005)
http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M076/K775/76775903.PDF (Decision 13-09-023)

New York

In the 1990s, the New York PSC experimented with several different types of PBR, including revenue-cap decoupling mechanisms for Rochester Gas and Electric, Niagara Mohawk Power, and Con Edison (Biewald et al. 1997). In 2005, the PSC approved a joint proposal from all the stakeholders in a Con Edison rate case that included significant increases in spending on DSM, an LRAM, DSM program cost recovery through a PBF, and shareholder performance incentives. An April 2007 PSC order mandated that all electric and gas utilities in New York file proposals for true-up-based decoupling mechanisms, and currently, all six major electric and all 10 major gas companies have revenue decoupling mechanisms in place. In 2008, the PSC established incentives for electric utility energy efficiency programs, in which utilities earn incentives or incur negative adjustments based on the extent to which they achieve energy savings targets. Goals are set annually.

In 2014, the PSC commenced its "Reforming the Energy Vision" (REV) initiative (Case 14-M-0101), which will examine the potential for major changes to the state's energy industry and regulatory practices. The initiative is primarily intended to increase the use and coordination of distributed energy resources. On February 29, 2015, the NY PSC issued an order adopting the REV policy framework and establishing an implementation plan. The PSC also plans to release a companion to this order, under Track Two of the REV initiative, to adopt ratemaking reforms inclusive of policies that align utilities' financial interests with REV's policy objectives (NY PSC 2015).

Websites:
http://www3.dps.ny.gov/W/PSCWeb.nsf/All/26BE8A93967E604785257CC40066B91A?OpenDocument (Case 14-M-0101—Reforming the Energy Vision)
http://media.corporate-ir.net/media_files/nys/ed/Three-YearRateplan-3-24-05.pdf (CASE 04-E-0572–Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service)

Nevada

Nevada's current incentive mechanisms for electric utilities originate from a 2009 bill, SB 358, which directed the Public Utilities Commission of Nevada (PUCN) to remove financial disincentives for energy efficiency faced by utilities. In 2010, the PUCN approved an LRAM for utilities, which allows them to recover lost revenues during annual DSM filings. As of July 2014, a docket (12-12030) was open to investigate another method besides lost revenue recovery to compensate utilities for providing DSM programs. The PUCN has also adopted rules permitting gas utilities to propose decoupling profits from sales through a revenue-per-customer system.

In May 2011, NV Energy, the parent company of Nevada Power and Sierra Pacific Power Companies, received the first approval from the PUCN for the recovery of lost revenues for an electric utility.

Websites:
http://www.leg.state.nv.us/75th2009/Reports/history.cfm?billname=SB358 (Bill SB 358)
http://pucweb1.state.nv.us/PUC2/DktDetail.aspx (Docket 12-12030)

Arizona

Arizona has recently undertaken regulatory efforts to address incentive regulation, although it does not have an explicit decoupling policy in place. Arizona utilities operate a variety of DSM programs, and the Arizona Corporation Commission (ACC) has approved both performance incentives and full and partial revenue decoupling mechanisms on a case-by-case basis for utilities. Arizona Public Service and Tucson Electric Power Company (TEP), the state's two largest investor-owned utilities, both have partial revenue decoupling mechanisms and performance incentives in place, and the ACC has approved a full revenue decoupling mechanism for Southwest Gas.

Websites:
http://images.edocket.azcc.gov/docketpdf/0000137042.pdf (Partial-revenue decoupling, Arizona Public Service, Docket No. E-01345A-11-0224)
http://images.edocket.azcc.gov/docketpdf/0000152708.pdf (Performance incentive, Arizona Public Service, ACC Decision 74406)
http://images.edocket.azcc.gov/docketpdf/0000146156.pdf (Partial-revenue decoupling, TEP, Docket No. E-01933A-12-0291)
http://images.edocket.azcc.gov/docketpdf/0000146156.pdf (Performance Incentive, TEP, ACC Decision 743912)

What States Can Do

States are leveling the playing field for demand-side resources through improved utility rate design by removing disincentives through decoupling, LRAMs, or alternative rate structures. These actions make it possible for utilities to recover their energy efficiency, distributed renewable energy, and CHP program costs, and/or provide shareholder and company performance incentives.

The following are key state roles:

- *Legislatures*. While legislative mandate is often not required to allow state commissions to investigate and implement incentive regulation reforms, legislatures can help provide the resources required by state commissions to effectively conduct such processes. Legislative mandates can also provide political support or initiate incentive regulation investigations if the commission is not doing so on its own.
- *Executive agencies.* Executive agencies can support state energy policy goals by recognizing the important role of regulatory reform in providing incentives to electric and gas utilities to increase energy efficiency, distributed renewable energy, and CHP efforts. Their support can be important to encourage utilities or regulators that are concerned about change.
- *State PUCs*. State regulatory commissions usually have the legal authority to initiate investigations into incentive regulation ratemaking, including decoupling. Commissions have the regulatory framework, institutional history, and technical expertise to examine the potential for decoupling and consider incentive ratemaking elements within the context of state law and policy. State commissions are often able to directly adopt appropriate incentive regulation mechanisms after adequate review and exploration of alternative mechanisms.

Action Steps for States

States can take the following steps to promote incentive regulation for clean energy, as well as overall customer quality and lower costs:

- Survey the current utility incentive structure to determine how costs are currently recovered, whether any energy efficiency programs and shareholder incentives are in place, and how energy efficiency, distributed renewable energy, and CHP costs are recovered.
- Review available policy mechanisms.
- Review historical experience in the relevant states.
- Identify stakeholders that could be important to the process.
- Consider establishing a working group to engage stakeholders.
- Open a docket on these issues.
- Resolve priorities, which will help guide selection of tools.
- Determine which incentive regulation tools might be appropriate.
- Engage commissioners and staff and find consensus solutions.

Information Resources

General Reports, Articles, and Websites about Utility Incentives for Demand-Side Resources

Title/Description	URL Address
State and Local Energy Efficiency Action Network (SEE Action): Ratepayer-Funded Efficiency through Regulatory Policy Working Group. This SEE Action Working Group has several initiatives that provide state utility regulators and stakeholders the tools and information on how to create utility motivations that will lead to a significant increase in energy efficiency. The Working Group has hosted regional regulatory policy exercises and issued several fact sheets and reports to share policy options and best practices across states.	https://www4.eere.energy.gov/seeaction/topic-category/ratepayer-funded-efficiency-through-regulatory-policy
American Council for an Energy-Efficient Economy (ACEEE). ACEEE has published several reports in this area: • Utility Initiatives: Alternative Business Models and Incentive Mechanisms – ACEEE Policy Brief, June 2014. • Making the Business Case for Energy Efficiency: Case Studies of Supportive Utility Regulation – ACEEE Report Number U133, December 2013. • Balancing Interests: A Review of Lost Revenue Adjustment Mechanisms for Utility Energy Efficiency Programs – ACEEE Report Number U114, September, 2011. • Aligning Utility Interests with Energy Efficiency Objectives: A Review of Recent Efforts at Decoupling and Performance Initiatives – ACEEE Report Number U061, October 2006. • ACEEE's annual State Energy Efficiency Scorecards also contains information on regulatory incentives.	www.aceee.org http://www.aceee.org/files/pdf/policy-brief/decoupling-brief-0714.pdf http://aceee.org/research-report/u133 http://aceee.org/research-report/u114 http://www.aceee.org/research-report/u061 http://www.aceee.org/state-policy/scorecard
The Regulatory Assistance Project (RAP). RAP has published several reports on decoupling and financial incentives. The RAP Library allows users to search by both Decoupling/Utility Incentives and Cost Recovery within the Energy Efficiency/ Resource Planning Topic search. RAP resources include a summary of decoupling as implemented in six states.	http://www.raponline.org/search http://www.raponline.org/document/download/id/7209
Financial Analysis of Incentive Mechanisms to Promote Energy Efficiency: Case Study of a Prototypical Southwest Utility. A 2009 study published by Lawrence Berkeley National Laboratory. A primary goal of this modeling is to provide regulators and policy-makers with an analytic framework and tools that assess the financial impacts of alternative incentive approaches on utility shareholders and customers if energy efficiency is implemented under various utility operating, cost, and supply conditions.	http://emp.lbl.gov/publications/financial-analysis-incentive-mechanisms-promote-energy-efficiency-case-study-prototypic
National Action Plan for Energy Efficiency. This former public-private initiative that worked collaboratively across utilities, utility regulators, and other partner organizations published a paper titled, *Aligning Utility Incentives with Investment in Energy Efficiency*, in 2007 to provide a comprehensive overview of policy options for states.	http://www.epa.gov/eeactionplan http://www.epa.gov/cleanenergy/documents/suca/incentives.pdf
Database of State Incentives for Renewables and Efficiency (DSIRE). DSIRE is a comprehensive source of information on U.S. incentives and policies that support renewables and energy efficiency. DSIRE is currently operated by the N.C. Solar Center at N.C. State University, and funded by the U.S. Department of Energy.	http://dsireusa.org/

Title/Description	URL Address
Joint Statement of the American Gas Association and the Natural Resources Defense Council (NRDC) on Utility Incentives for Energy Efficiency. This statement identifies ways to promote both economic and environmental progress by removing barriers to natural gas distribution companies' investments in urgently needed and cost-effective resources and infrastructure.	http://www.naruc.org/Resolutions/GS%20Second%20Joint%20Statement.pdf
Edison Electric Institute/NRDC Joint Statement to State Utility Regulators. This statement includes a number of key recommendations, inclusive of utility incentives policy options.	http://docs.nrdc.org/energy/files/ene_14021101a.pdf
State Electric Efficiency Regulatory Frameworks. Published by The Edison Foundation Institute for Electric Innovation (IEI) in 2013. IEI is a not-for-profit membership organization consisting of investor-owned electric utilities that represent about 70 percent of the U.S. electric power industry.	http://www.edisonfoundation.net/iei/Documents/IEE_StateRegulatoryFrame_0713.pdf
The Effect of Energy Efficiency Programs on Electric Utility Revenue Requirements. Briefing released by the American Public Power Association as part of ARRA implementation. The briefing presents options for public power to address disincentives to increasing energy efficiency.	http://www.publicpower.org/files/PDFs/EffectofEnergyEfficiency.pdf
Link to All State Utility Commission Websites. This NARUC website provides links to all state utility commission sites.	http://www.naruc.org/commissions/

State and Regional Information on Incentive Regulation Efforts

State	Title/Description	URL Address
California	California Energy Commission (CEC). CEC website.	http://www.energy.ca.gov/
	Energy Action Plan II. California's implementation roadmap for its energy policies.	http://www.energy.ca.gov/energy_action_plan/2005-09-21_EAP2_FINAL.PDF
	California Public Utilities Commission. CPUC website.	http://www.cpuc.ca.gov/puc/
	Energy Efficiency Proceeding Activity. CPUC current rulemaking on energy efficiency policies.	http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Current+Proceeding+Activity.htm
	Energy Savings Goals for Program Year 2006 and Beyond. September 23, 2004, CPUC Decision establishing energy savings goals for energy efficiency.	http://www.cpuc.ca.gov/Published/Final_decision/40212.htm
	Energy Efficiency Portfolio Plans and Program Funding Levels for 2006–2008- Phase 1 Issues. September 22, 2005, CPUC Decision on energy efficiency spending in phase I.	http://www.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/49859.htm
Colorado	House Bill 1147. Addresses funding and cost recovery policy for natural gas energy efficiency.	http://www.leg.state.co.us/clics/clics2012a/csl.nsf/fsbillcont/50727F4BF1602BC287257981007F5282?Open&file=1147_01.pdf

State	Title/Description	URL Address
Idaho	Idaho Power—Investigation of Financial Disincentives (Case No. IPC-E-04-15). Summarizes regulatory proceedings and workshop results regarding the Idaho Power Utilities Commission's investigation of financial disincentives to energy efficiency programs for Idaho Power.	http://www.puc.idaho.gov/fileroom/cases/elec/IPC/IPCE0415/ordnotc/20060306NOTICE_OF_APPLICATION_IPC.PDF
Maryland	Gas Commodity Fact Sheet. Maryland PUC, Gas Commodity Rate Structure reference.	http://webapp.psc.state.md.us/intranet/gas/gasCommodity_new.cfm
Mid-Atlantic Distributed Resources Initiative (MADRI)	Electric Utility Revenue Stability Adjustment Factor. Model rule being developed by MADRI to reduce a utility's throughput incentive.	http://sites.energetics.com/MADRI/regulatory_models.html
Oregon	Order No. 02-388. Oregon PUC order on Northwest Natural Gas Decoupling. This order reauthorized deferred accounting for costs associated with NW Natural Gas Company's conservation and energy efficiency programs.	http://apps.puc.state.or.us/orders/2002ords/02-388.pdf
Washington	Natural Gas Decoupling Investigation. Describes the Washington Utilities and Transportation Commission's actions to investigate decoupling policies to eliminate disincentives to gas conservation and energy efficiency programs.	http://www.wutc.wa.gov/rms2.nsf/177d98baa5918c7388256a550064a61e/43eb29bd6e98d0e8882577d1007fea20!OpenDocument

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Title/Description	URL Address
ACEEE. 2014. State and Local Policy Database. American Council for an Energy-Efficient Economy. Accessed September 2014.	http://database.aceee.org/
Biewald, B., T. Woolf, P. Bradford, P. Chernick, S. Geller, and J. Oppenheim. 1997. Performance-Based Regulation in a Restructured Electric Industry. Prepared for the National Association of Regulatory Utility Commissioners.	http://www.synapse-energy.com/sites/default/files/SynapseReport.1997-11.NARUC_.PBR-in-a-Restructured-Electricity-Industry..97-U02.pdf
CA Energy Consulting. 2005. A Review of Distribution Margin Normalization as Approved by the Oregon PUC for Northwest Natural. Christensen Associates Energy Consulting, LLC.	http://www.wutc.wa.gov/rms2.nsf/177d98baa5918c7388256a550064a61e/59c3e4d9f57b530c882577230059cf34!OpenDocument
CA Energy Consulting. 2007. A Review of Natural Gas Decoupling Mechanisms and Alternative Methods for Addressing Utility Disincentives to Promote Conservation. Christensen Associates Energy Consulting, LLC.	http://www.psc.state.ut.us/utilities/gas/05docs/05057T01/6-1-0753572Exbt%206.1.doc
CA Energy Consulting. 2013. A Summary of Revenue Decoupling Evaluations. Christensen Associates Energy Consulting, LLC.	http://www.caenergy.com/summary-revenue-decoupling-evaluations/
Cadmus. 2013. DSM in the Rate Case: A Regulatory Model for Resource Parity Between Supply and Demand. Public Utilities Fortnightly. Cadmus Group, Inc.	http://www.cadmusgroup.com/wp-content/uploads/2013/01/1301-DSMRateCase-hires.pdf
Delaware PSC. 2007. PSC Regulation Docket No. 59. Delaware Public Service Commission.	http://depsc.delaware.gov/dockets/reg59/reg59.shtml

Title/Description	URL Address
Edison Foundation. 2013. State Electric Efficiency Regulatory Frameworks. Innovation Electricity Efficiency. The Edison Foundation Institute for Electric Innovation.	http://www.edisonfoundation.net/iei/Documents/IEE_StateRegulatoryFrame_0713.pdf
Graceful Systems. 2012. A Decade of Decoupling for U.S. Energy Utilities: Rate Impacts, Designs, and Observations. Graceful Systems, LLC.	http://switchboard.nrdc.org/blogs/rcavanagh/decouplingreportMorganfinal.pdf
LBNL. 1993. The Theory and Practice of Decoupling. Lawrence Berkeley National Laboratory.	http://eetd.lbl.gov/sites/all/files/publications/report-lbnl-34555.pdf
NAPEE. 2007. Aligning Utility Incentives with Investment in Energy Efficiency. National Action Plan for Energy Efficiency.	http://www.epa.gov/cleanenergy/documents/suca/incentives.pdf
NRDC. 2004. Do Electric-Resource Portfolio Managers Have an Inherent Conflict of Interest with Energy Efficiency? Natural Resources Defense Council.	http://aceee.org/files/proceedings/2004/data/papers/SS04_Panel5_Paper01.pdf
NY PSC. 2015. 14-M-0101: Reforming the Energy Vision (REV). New York Public Service Commission.	http://www3.dps.ny.gov/W/PSCWeb.nsf/All/26BE8A93967E604785257CC40066B91A?OpenDocument
NRDC. 2012. Removing Disincentives to Utility Energy Efficiency Efforts. Natural Resources Defense Council.	http://www.nrdc.org/energy/decoupling/files/decoupling-utility-energy.pdf
RAP. 2013. Recognizing the Full Value of Energy Efficiency (What's Under the Feel-Good Frosting of the World's Most Valuable Layer Cake of Benefits). Regulatory Assistance Project.	www.raponline.org/document/download/id/6739

7.3 Interconnection and Net Metering Standards

Policy Description and Objective

Summary

Standard interconnection and net metering rules for distributed generation (DG) systems, such as renewable energy and combined heat and power (CHP), are policies used by states to accelerate the development of clean energy supply. Grid-connected DG systems can meet some or all of their host's electricity needs. Renewable energy systems potentially offer reliable, but intermittent, zero emissions energy at or near the point of energy use. CHP offers an efficient, clean, and reliable approach to generating both power and thermal energy from a single fuel source by recovering the waste heat for another beneficial purpose (for more information about CHP, see Chapter 6, "Policy Considerations for Combined Heat and Power"). DG system requirements for grid connections are also important because they involve electrical system safety and reliability.

Interconnection standards are processes and technical requirements that govern how electric utilities will treat distributed generation systems that customers seek to connect to the electric grid.

Net metering is a method of compensating customers for electricity that they generate on site in excess of their own consumption—essentially giving them credit for the excess power they send back to the grid. Depending on individual state or utility rules, net excess generation may be credited to the customer's account or carried over to a future billing period.

Standard interconnection rules stem from state legislation that directs state public utility commissions (PUCs) to establish uniform processes and technical requirements for grid-connected electric generators. These rules address the type and size of systems; they also define required safeguards, grid upgrades, operating restrictions, and application procedures that system applicants must meet. In some states, municipally or cooperatively owned utilities may be exempt from state regulations. State interconnection rules typically address larger DG projects connecting to the distribution grid, whereas the Federal Energy Regulatory Commission (FERC) has jurisdiction over project interconnection at the transmission level.

State interconnection policies can sometimes create unintended barriers for DG projects. Although their impact on the utility grid is likely to be significantly lower, smaller scale DG systems in some states are often subject to the same, frequently lengthy interconnection procedures as larger systems. If interconnection procedures are excessive or expensive in proportion to the size of the project, they can overwhelm project costs to the point of making clean DG uneconomical.

State legislation is also used to require the development of standard net metering rules. Net metering policies allow DG systems to receive credit for electricity generated on site that is exported to the utility grid. In effect, customers can bank exported generation, usually on a billing cycle basis, to offset future electricity use that they would otherwise have to purchase from the utility. Net metering policies often rely on the use of a single bi-directional utility meter to measure, or "net" out, the use and flow of electricity to and from the electric grid. Net metering policies generally place several limitations on eligible onsite generators, including maximum system size restrictions and the period that customers can roll over net metering credit into the future (i.e., year-to-year).

Today, most states have existing interconnection and net metering policies in place. However, many of these policies could be improved to meet best-in-class practices. States may wish to consider evaluating their existing rules against model policies considered to represent best practices. See the information resources at the end of this section for links to some best practices.

States have found that standardized interconnection and net metering rules are important components of promoting clean DG and are often most successful when coupled with other policies and programs. Consequently, states generally promote clean DG through a suite of related policies, including standardizing interconnection and net metering rules, addressing utility rates for standby and exit fees, creating renewable portfolio standards (RPSs), and enacting other initiatives.[85]

Objective

A key objective of standard interconnection and net metering rules is to encourage the connection of clean DG systems, such as renewable energy and CHP, to the electric grid to obtain their benefits without compromising safety or system reliability.

Benefits

Standardized interconnection and net metering rules can support clean DG development by providing clear and reasonable requirements for connecting clean energy systems to the electric utility grid and for crediting onsite generation that DG systems export back to the grid. By developing standard interconnection and net metering requirements, states make progress toward leveling the playing field for clean DG relative to traditional central power generation. Standard interconnection rules can help reduce uncertainty and prevent excessive time delays and costs that small DG systems sometimes encounter when obtaining approval for grid connection.

The benefits of increasing the number of clean DG projects include reducing peak electrical demand on non-DG generators, increasing capacity, reducing the environmental impact of power generation, improving infrastructure resiliency, and avoiding energy losses along transmission and distribution lines. DG application in targeted load pockets can reduce grid congestion, potentially deferring or displacing transmission and distribution infrastructure investments. A 2013 study found that strategically sited DG yields improvements to grid system efficiency and provides additional reserve power, deferred costs, and other grid benefits (Crossborder Energy 2013). Widespread DG deployment can slow the growth-driven demand for more power lines and power stations.

States with Interconnection and Net Metering Standards

States typically regulate DG interconnections that do not involve power sales to third parties (i.e., interconnections that only send excess power back to the local utility). FERC regulates DG interconnections used to export power or for interstate commerce.[86] Because most DG is used to serve electric load at the customer's site, states approve the interconnection standards used for the majority of interconnections for smaller, clean DG systems.

Forty-five states (plus Washington D.C.) have adopted standard interconnection requirements for distributed generators as of March 2015 (see Figure 7.3.1). While these standards often cover a range of generating technologies, most include interconnection of renewable and CHP systems. In some cases, net metering provisions can be considered a subset of interconnection standards for small-scale projects. As of March 2015, 44 states (plus Washington D.C.) have rules or provisions for net metering (see Figure 7.3.2) (DSIRE 2015b). Currently, most states find that smaller DG systems are more likely to produce power primarily for their own use; exports to the grid tend to be incidental. The Solar Energy Industries Association estimates that solar DG

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[85] For additional information on these policies, please see Chapter 5, "Renewable Portfolio Standards," and Section 7.4, "Customer Rates and Data Access."

[86] FERC does not have jurisdiction in Texas, Hawaii, or Alaska; http://www.ferc.gov/industries/electric.

systems export on average 20 to 40 percent of the total energy output of the system to the utility grid (SEIA 2014). Under net metering, when a DG system's output exceeds the site's electrical needs, the utility may credit the customer for excess power supplied to the grid. Some states require that the customer's credit surplus account be reset periodically, often on a monthly or annual basis. Additionally, states often cap the output of individual net metered systems or in aggregate at the grid level.

To encourage DG, many states have adopted simplified processes under net metering rules. Some of these state provisions are limited in scope—for example, applying only to relatively small systems,[87] specified technologies, or fuel types of special interest to policy-makers. More comprehensive net metering and interconnection policies provide detailed specifications and procedures for utilities and customers to follow, provide consistent rules for all utilities within the state,[88] and cover a complete range of system and fuel types, interconnection processes, and requirements.[89]

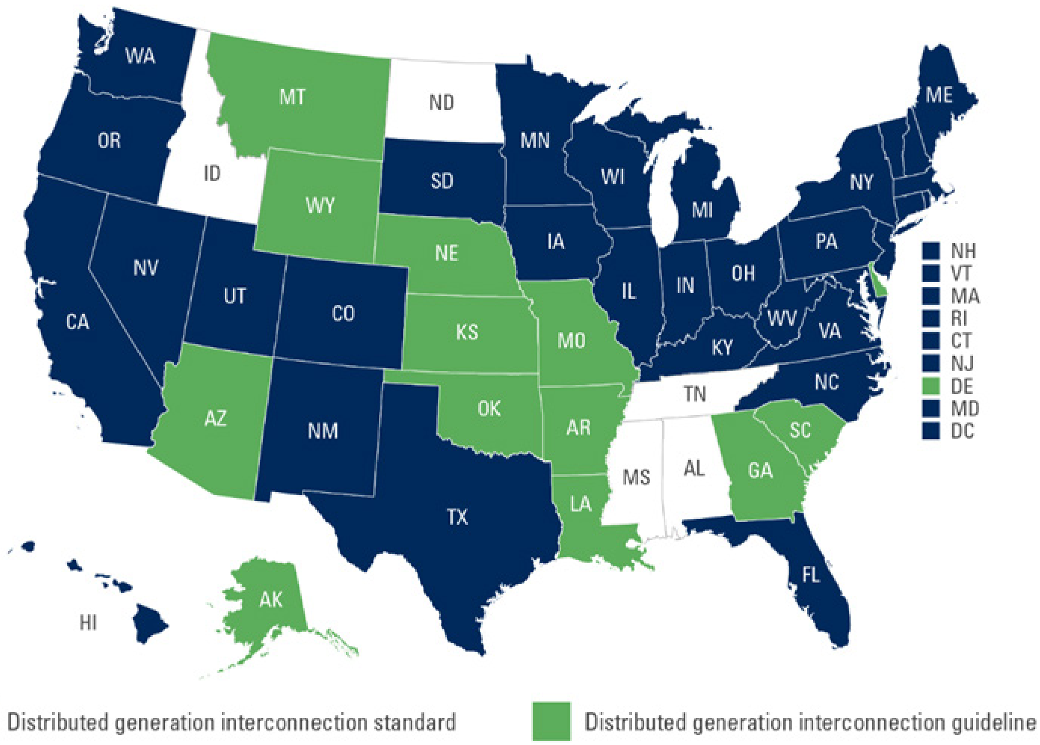
States consider a number of key factors when designing effective standard interconnection and net metering rules that balance the needs of DG owners, the utility company, and the public. This includes promoting broad participation during standards development, addressing a range of technology types and sizes, and considering current barriers to interconnection. In addition, it is important to consider state and federal policies that might influence the successful development and effective implementation of interconnection and net metering standards.

[87] Thirty-four of 39 states that have net metering rules limit system sizes to 100 kilowatts or less.

[88] States that have variable utility net metering policies that differ for investor-owned utilities, municipally owned utilities, cooperatively owned utilities, or alternative retail electric suppliers include Arizona, Florida, Idaho, and Illinois.

[89] Some states (e.g., New Hampshire and New Jersey) have developed standard interconnection processes and requirements as part of their net metering provision.

Figure 7.3.1: States with DG Interconnection Standards

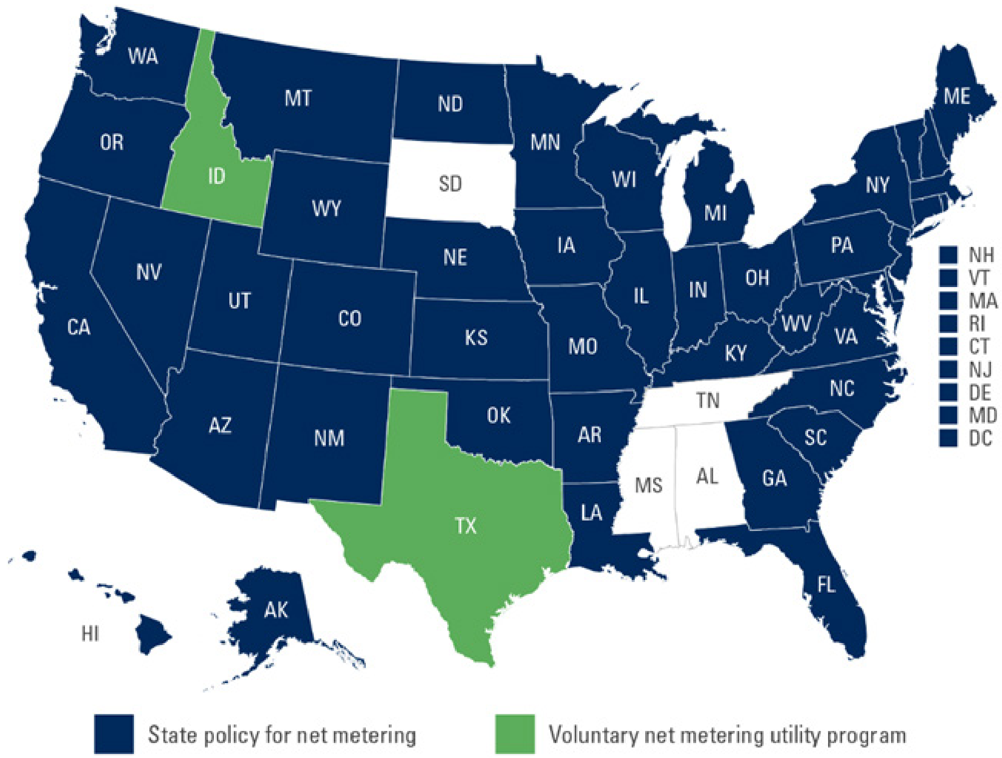


Maximum System Size for a State Interconnection Standard							
CA	None	KY*	30 kW	NJ	None	SD	10 MW
CO	10 MW	MA	None	NM	80 MW	TX	10 MW
CT	20 MW	MD	10 MW	NV	20 MW	UT	20 MW
DC	10 MW	ME	None	NY	2 MW	VA	20 MW
FL*	2 MW	MI	None	OH	20 MW	VT	None
HI	None	MN	10 MW	OR	10 MW	WA	20 MW
IA	10 MW	NC	None	PA*	5 MW	WI	15 MW
IL	None	NH*	1 MW	RI	None	WV	2 MW
IN	None						

* Denotes that policy only applies to net metered systems.
kW= kilowatts; MW= megawatts
Note: Certain states have different limits for residential and non-residential customers, while others have tiered limits.

Source: DSIRE 2015a

Figure 7.3.2: States with Net Metering Rules



Net Metering System Size Limit (kW)					
AK*	25	KY*	30	NV*	1,000
AR	25/300	LA	25/300	NY*	10/25/500/1,000/2,000
AZ	125% of demand	MA*	60/1,000/2,000/10,000	OH*	None
CA	1,000	MD	2,000	OK*	100
CO	120% of demand (for co-ops and munis: 10/25)	ME	660 (co-ops and munis, 100)	OR*	25/2,000
CT	2,000/3,000	MI*	150	PA*	50/3,000/5,000
DC	1,000/5,000/120% of demand	MN	40	RI*	5,000
DE	25/100/2,000 (co-ops and munis, 25/100/500)	MO	100	SC*	20/1,000
FL*	2,000	MT*	50	UT*	25/2,000
GA	10/100	NC*	1,000	VA*	20/500
HI	100	ND*	100	VT	20/250/2,250
IA*	500	NE	25	WA	100
IL*	40	NH	1,000	WI*	20
IN*	1,000	NJ*	None	WV	25/50/500/2,000
KS	15/100/150	NM*	80,000	WY*	25

* Denotes that policy only applies to certain types of utilities (e.g., investor-owned utilities).
Note: Certain states have different limits for residential and non-residential customers, while others have tiered limits.

Source: DSIRE 2015b

Designing Effective Interconnection and Net Metering Standards

Participants

Key stakeholders who can contribute to the process of developing effective interconnection and net metering standards include:

- *Electric utilities.* Utilities are responsible for maintaining the reliability and integrity of the grid and ensuring the safety of the public and their employees.
- *State PUCs.* PUCs have jurisdiction over investor-owned utilities (IOUs) and, in some cases, cooperatively and municipally owned utilities. They are often instrumental in setting policy to encourage onsite generation.
- *Developers and owners/operators of renewable energy and CHP systems as well as their respective trade organizations.* Developers and the customers that will rely on these systems can provide valuable technical information and real-world scenarios.
- *Technical allied organizations.* Organizations such as the Institute of Electric and Electronic Engineers (IEEE) and certifying organizations like the Underwriters Laboratories (UL) have been active in establishing interconnection protocols and equipment certification standards nationwide. In addition, organizations such as the Interstate Renewable Energy Council (IREC) help to develop national standards related to interconnection and net metering policy and to advance regulatory policy innovation.
- *Regional transmission organizations (RTOs).* These organizations may have already implemented interconnection standards using FERC requirements for large non-utility generators generally above 10 megawatts (MW).
- *Other government agencies.* Federal (e.g., FERC) and state environmental and public policy agencies—including state consumer advocates—can play an important role in establishing and developing interconnection and net metering standards.

Some states are bringing key stakeholders together to develop state-based standards via collaborative processes. For example, in Massachusetts, the DG Collaborative successfully brought together many diverse stakeholders to develop the interconnection rules now used by DG developers and customers in Massachusetts.

Emerging Approaches: Policy Variations to Net Metering

Some states have looked beyond standard net metering rules to employ innovative variations on these policies, which offer greater access to specific end consumer groups and end-use applications. For example, standard virtual net metering, meter aggregation, and community solar rules can allow customers to access self-generation and enjoy the benefits of net metering even if they are not able to directly host or invest in onsite generation. A common example of this is individually metered tenants within multi-unit housing buildings who, under newer meter aggregation rules, can share in the benefits of a centrally sited, onsite solar system across all tenant meters. In a few select cases, states and/or utilities have replaced standard net metering policies with new innovative approaches that seek to address utility concerns over cost recovery and ratepayer fairness issues. In 2013, the Minnesota State Legislature passed the first ever, statewide value-of-solar tariff, which many view as a more equitable and possibly more effective alternative to traditional net metering policies for onsite solar photovoltaic systems.[90]

[90] For more information on Solar Energy Legislation in Minnesota, see http://www.house.leg.state.mn.us/hrd/pubs/ss/sssolarleg.pdf.

Current Landscape of Interconnection for DG

Renewable energy and CHP systems used by commercial or industrial facilities are typically smaller than 10 MW in capacity. When designing and implementing standards for systems of this size, it is important to realize that the size of the system dictates how and by whom interconnection is regulated.

- *10 MW systems*. FERC has jurisdiction over developing standard interconnection rules for larger systems that are connected directly to the transmission grid. Historically, electric utilities owned most grid-connected generation systems. As a result of restructuring and other legislation (e.g., the Public Utility Regulatory Policy Act or PURPA), utilities were required to interconnect non-utility owned generators to the electric grid. States and regulatory agencies such as FERC have begun to develop or have already implemented standard interconnection rules for non-utility generators. However, these rules were historically applied to larger generating facilities (> 10 MW).
- *0.1 MW to 10 MW systems*. Systems in this size range still require regulatory attention in some states. This "intermediate" group represents systems that are interconnected to the distribution system but are larger than the systems typically covered by net metering rules and smaller than the large generating assets that interconnect directly to the transmission system and are regulated by FERC. In response to the mounting demands by customers and DG/CHP developers to interconnect generation systems to the grid, utilities have increasingly established some form of interconnection process and requirements. In addition, to increase utility confidence around DG systems, industry organizations such as the IEEE and UL have begun to develop standards that enable safe and reliable interconnection of generators to the grid. However, states need to establish standard interconnection rules for generation systems of all sizes.
- *< 100 kW (0.1 MW) systems*. Some states have developed provisions for the net metering of relatively small systems (i.e., < 100 kW). While these provisions are not typically as comprehensive as interconnection standards, they can provide a solid starting point for industry, customers, and utilities with respect to the connection of relatively small DG systems to the electric grid.

Typical Specifications

The specifications described below reflect typical elements found in existing state policies and compiled by other sources.[91] Effective interconnection standards often cover the following specifications:

Participants

- The breadth of customer classes covered under the policy. Effective state policies usually make all customer classes eligible.
- The breadth of state utilities covered under the policy. Effective state policies often cover investor, municipally, and cooperatively owned utilities.

Policy Design

- System size requirements. State policies do not typically establish individual system capacity limits and ensure that the policy applies to all state-jurisdictional interconnections.
- The type of technology that may be interconnected (e.g., inverter-based systems, induction generators, synchronous generators).
- The required components of the electric grid where the system will be interconnected (i.e., radial or network distribution, distribution or transmission level, maximum aggregate DG capacity on a circuit).

[91] Other sources include IREC's Model Net Metering Rules (2009) and Model Interconnection Rules (2013) (available at http://www.irecusa.org/publications/), ACEEE Interconnection Standards (ACEEE. 2013), and Freeing the Grid.org.

- Sensible limits on interconnection application fees. Effective policies keep application costs to a minimum, especially for smaller systems.
- Limitations on what utilities may require of systems, such as minimum metering requirements and an external disconnect switch for smaller, inverter-based systems. Effective policies would have the utility forgo requiring an external disconnect switch for smaller, inverter-based systems.
- Limitations on utility requirements of customers to purchase liability insurance (in addition to the coverage provided by a typical insurance policy) or to add the utility as an additional insured.

Process

- A standard agreement form that is easy to understand and free of burdensome terms.
- Sensible limits on procedural and administrative timelines for system interconnections. Effective policies ensure that these timelines are imposed and enforced.
- A review process. Best-in-class policies generally allow for different tiers with different levels of review to accommodate systems based on system capacity, complexity, and level of certification.
- Project technical screens to facilitate evaluation. Effective policies ensure that the technical criteria are both clear and transparent.
- A transparent and uniform dispute resolution process for affected stakeholders.

In addition, some states are developing different application processes and technical requirements for differently sized or certified systems. Since a DG system's size can range from a renewable system of only a few kilowatts (kW) to a CHP system of tens of MW, standards can be designed to accommodate this full range. Several states have developed a multi-tiered process for systems that range in size from less than 10 kW to more than 2 MW. Similar to the FERC guidelines, some states (Colorado, Florida, and North Carolina) have divided DG systems into three categories based on generator size. Other states use fewer (such as New York, Georgia, and West Virginia) or more (such as Delaware, Illinois, and Maine, where each have four) categories. States also define fees, insurance requirements, and processing times based on the category into which the DG falls. The level of technical review and interconnection requirements usually increases with generation capacity, although the requirements are ultimately driven by the applicant's impact on the grid as determined through the study process and the criteria identified in the application process.[92]

In states with a multi-tiered or screen interconnection process, smaller systems that meet IEEE and UL standards or certification generally pass through the interconnection process faster, pay less in fees, and require less protection equipment because there are fewer technical concerns. States that require faster application processing for smaller systems (< 10 to < 30 kW) include California, Connecticut, Massachusetts, Michigan, Minnesota, New York, Utah, and Wisconsin. For relatively large DG systems, processes and requirements may be similar or identical to those used for large central power generators. For mid-size systems, states may need to develop several levels of procedural and technical protocols to meet the range of needs for onsite generators, utilities, and regulators.

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[92] Thus, it is possible for a larger system to have a fairly expedited process if it is not deemed to have a notable or negative system impact. Utah's interconnection rules provide an example of this approach (see slide 5): http://www.naruc.org/international/Documents/Campbell%20Connection%20to%20Power%20Grids%20May%2023%209%20am.pdf.

States can promote DG with comprehensive net metering standards that employ strategies such as the following:

- Avoid placing an aggregate or statewide capacity limit on net metering.
- Ensure that any individual system size limitation is based only on the host customer's load or consumption (e.g., Arizona and Colorado).
- Allow the owner of a net metered system to retain ownership of RECs produced by the system, unless transferred to the utility or another party in exchange for acceptable compensation.
- Provide options for indefinite rollover, effectively or actually credited at retail rate, for net metered customers. Some states require that customers be paid for annual net excess generation at a price no lower than the average daytime wholesale price for the prior year.
- Avoid requiring retail electric customers to purchase new metering equipment. States can require utilities to make smart metering and other digital technology for energy management available to solar and other customers on a non-discriminatory and open-access basis. Integrating smart meters or other advanced metering technologies can lead to more detailed and reliable meter data, which in turn can lead to more efficient planning and energy use.
- Allow all customers to participate in net metering.
- Provide options for virtual net metering and meter aggregation.

Constraints

Designing new DG interconnection and net metering rules could resolve recurring barriers encountered by applicants for DG system interconnection. These barriers have been well-documented (NREL 2000; Schwartz 2005). Four areas in which a DG developer typically confronts problems include:

- *Costly technical system requirements.* Utilities often require additional measures related to the safety and operation of DG systems and their compatibility with the grid. For example, customers may be faced with costly electric service and grid upgrades as a condition of interconnection. Another frequently cited and particularly costly (e.g., $1,000 to $6,000) technical requirement for smaller DG systems (e.g., up to 200 kW) is the installation of an exterior manual disconnect switch that can be accessed by the utility to isolate the system from the grid, despite the fact that many grid tied systems have anti-islanding features that make such manual disconnects redundant. States may consider limiting the types of additional requirements that utilities can require of systems integrators beyond that which is covered in interconnection or net metering policies.
- *Utility business practices.* States can set policy direction for the contractual and procedural interconnection requirements that are imposed on system developers to be equitable and commensurate with the size and complexity of the system seeking interconnection. Limiting the length of the application review periods or technical study requirements can reduce what are often high costs for smaller DG systems to interconnect to the grid.
- *Regulatory constraints.* Such constraints can arise from tariff and rate conditions, including the prohibition of interconnection of generators that operate in parallel with the electric grid.[93] In some instances,

[93] When a CHP system is interconnected to the grid and operates in parallel with the grid, the utility only has to provide power above and beyond what the onsite CHP system can supply.

environmental permitting or emission limits can also create barriers. For more information on the barriers posed to DG systems by tariff and rate issues, see Chapter 6, "Policy Considerations for Combined Heat and Power," and Section 7.4, "Customer Rates and Data Access."

- *Local permitting constraints.* System permitting requirements are sometimes not well-defined and are often not uniform.

Some states are beginning to address these areas of concern through a combination of policy actions and regulatory changes to remove or alter requirements that they believe are inappropriate for the scale of small DG units.

Interaction with Federal Policies

States have found that several federal initiatives can be utilized when designing their own interconnection standards:

- In 2006, FERC set standard terms and conditions for public utilities to interconnect new DG sources with Small Generator Interconnection Procedures (SGIP) and the Small Generator Interconnection Agreement (SGIA). These requirements were developed based on requirements in FERC Orders 2006, 2006-A, and 2006-B. They apply to FERC-jurisdictional interconnections that interconnect at the transmission level. The FERC standards generally do not apply to distribution-level interconnection, which is regulated by state PUCs. The SGIP contain technical procedures as well as standard contractual provisions. They provide three ways to evaluate an interconnection request. The SGIP require interconnection equipment to be certified according to IEEE Standards 1547 and UL 1741. The SGIP address interconnection to spot networks for inverter-based DG. They do not address other interconnections to spot and area networks. The SGIP also do not cover any external disconnect switch requirements. The SGIA was developed for all interconnection requests submitted under the SGIP and governs the terms and conditions under which the Interconnection Customer's Small Generating Facility will interconnect with, and operate in parallel with, the Transmission Provider's Transmission System.
- In November 2013, FERC adopted several updates to the SGIP through Order 792. Among other changes, these updates added energy storage to the list of resources eligible to interconnect under FERC procedures. States may want to consider how state interconnection rules accommodate storage assets and how they interact with existing FERC orders.[94] While FERC's updates are not binding for states, they can provide useful models for establishing provisions that anticipate and enable higher DG penetration. Ohio is an example of a state that recently adopted substantial portions of the SGIP.[95]
- Under the Public Utility Regulatory Policy Act (PURPA), utilities are required to allow interconnection by qualifying facilities. States have significant flexibility in administering PURPA, although amendments made in 2005 and FERC decisions have limited the applicability of PURPA in some regions, particularly for facilities larger than 20 MW. In 2010, FERC ruled that California's "multi-tiered" avoided-cost-rate structure for a feed-in tariff for CHP systems of up to 20 MW is consistent with PURPA. FERC affirmed that state procurement obligations can be considered when calculating avoided cost; for example, requirements that utilities buy particular sources of energy with certain characteristics (e.g., renewable energy) to meet procurement obligations.

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94 For more information on FERC's SGIA and SGIP, see http://www.ferc.gov/whats-new/comm-meet/2013/112113/E-1.pdf.

95 http://www.irecusa.org/2013/12/ohio-joins-top-states-improving-interconnection-procedures-for-renewables/

- Section 1254 of the Energy Policy Act of 2005 (DOE 2007) required each state regulatory authority to determine whether to require interconnection service for any utility consumer who had onsite generation by August 8, 2007. The Distributed Energy Interconnection Procedures were developed as an outcome of this requirement. In the Procedures, the U.S. Department of Energy's (DOE's) Offices of Energy Efficiency and Renewable Energy and of Electricity Delivery and Energy Reliability encourage state and non-state jurisdictional utilities to consider best practices in establishing interconnection procedures.

Interaction with State Policies

Interconnection and net metering standards are critical policies that complement other clean energy policies and programs such as state RPSs (see Chapter 5, "Renewable Portfolio Standards"), clean energy fund investments (see Chapter 3, "Funding and Financial Incentive Policies"), and utility planning practices (see Section 7.1, "Electricity Resource Planning and Procurement"). Such standards can also help states achieve other related environmental, energy, and economic goals. For example, by providing incentives to site renewable energy on formerly contaminated lands, landfills, or mine sites, the state can help protect open space and transform blighted properties into community assets.[96]

Best Practices: Designing a Net Metering Standard

- Ensure the customer's right to generate electricity and connect to the grid without discrimination or undue process.
- Ensure that the value of DG electricity is quantified fairly and that DG customers are adequately compensated.
- Avoid unfair and discriminatory cost recovery practices. If the utility implements charges to recover embedded net fixed costs, ensure that these charges are applied only after accounting for all utility benefits and offset cost reductions due to DG.
- Ensure that net metering rules, regulations, and practices are applied equally statewide.
- Ensure that the policy provides transparent access to data, such as load data (including hourly profiles), so customers can understand the economic implications of adopting onsite clean energy technologies.
- Avoid restrictive total program or state (aggregate) capacity limits.
- Avoid restrictive individual system capacity limits beyond that of the host customer's load or electricity consumption.
- Ensure that the net metering system owner retains renewable energy certificate (REC) ownership unless the REC is transferred to another party in exchange for fair compensation.
- Ensure that monthly or annual "rollover" provisions provide the net metering customer compensation at a retail rate for excess generation sent to the grid.
- Provide virtual net metering and meter aggregation options to ensure that all customers are able to participate in net metering.

[96] For example, Vermont's Act 99 of 2014 included specific considerations that can facilitate solar installations on landfill sites, while New Jersey's Solar Act of 2012 (S.B. 1925) authorized a new incentive to cover the additional costs for deploying solar electric power generation facilities on brownfield sites. For more examples and resources regarding renewable energy development on contaminated lands, see EPA's RE-Powering America's Land initiative at www.epa.gov/renewableenergyland/.

Best Practices: Designing an Interconnection Standard

The following are a compilation of best practices derived from current literature or from existing state policy examples.[97]

Participants

- Ensure that all customer classes are eligible under the policy.
- Ensure that interconnection policies apply equally to all utilities (including municipally and cooperatively owned utilities) statewide.

Policy Design

- Work collaboratively with interested parties to develop interconnection rules that are clear, concise, and applicable to all potential DG technologies. This will streamline the process and avoid untimely and costly rework.
- Develop standards that cover the scope of the desired DG technologies, generator types, sizes, and distribution system types.
- Minimize related application costs, particularly for smaller systems.
- Avoid restrictive individual system capacity limits.
- Avoid restrictive requirements for external disconnect switches for smaller, inverter-based systems.
- Avoid restrictive requirements that place unnecessary mandates on customers to buy liability insurance or require customers to make the utility an additional insured party.
- Consider adopting portions of national models (such as those developed by the National Association of Regulatory Utility Commissioners, IREC, and FERC) and successful programs in other states, or consider using these models as a template in developing a state-based standard. Also, consistency within a region increases the effectiveness of these standards.
- Try to maximize consistency between the RTO and the state standards for large generators.
- Develop consistency among states based on common practices to reduce compliance costs for the industry.

Process

- Ensure that a standard form interconnection agreement be available and easy to understand.
- Establish that reasonable, punctual procedural timelines should be adopted and enforced.
- Address all components of the interconnection process, including issues related to both the application process and technical requirements.
- Develop an application process that is streamlined with reasonable requirements and fees. Consider making the process and related fees commensurate with generator size. For example, develop a straightforward process for smaller or inverter-based systems and more detailed procedures for larger systems or those utilizing rotating devices (such as synchronous or induction motors) to fully assess their potential impact on the electrical system.
- Create a streamlined process for generators that are certified compliant with certain IEEE and UL standards. UL Standard 1741, “Inverters, Converters and Charge Controllers for Use in Independent Power Systems,” provides design standards for inverter-based systems under 10 kW. IEEE Standard 1547, “IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems,” establishes design specifications and provides technical and test specifications for systems rated up to 10 MW. These standards can be used to certify electrical protection capability.
- Provide for a multi-tier (three to four separate levels) review process to accommodate systems based on system capacity, complexity, and level of certification.
- Identify and establish clear, transparent technical screens across all system tiers.
- Ensure that the interconnection rule includes a dispute resolution process for involved stakeholders.

[97] Best practice examples taken from the following sources: IREC, FreeingTheGrid.org, and ACEEE Interconnection Standards (ACEEE. 2013).

Implementation and Evaluation

This section describes the implementation and evaluation of new interconnection standards and net metering practices, including best practices that states have found successful.

Administering Body

While individual states may develop interconnection standards that are then approved by the PUC, utilities are ultimately responsible for their implementation.

Evaluation/Oversight

By establishing clearly defined categories of technologies and generation systems, utilities are able to streamline the process for customers and lessen the administrative time related to reviewing interconnection applications. For example, some states create multiple categories and tiers for reviewing applications with established maximum review periods. Across these technology categories, the maximum processing time allowed can vary by more than a factor of five depending on the technical complexity and size of the interconnection. Several states (including California, Connecticut, Massachusetts, Michigan, Minnesota, New York, and Wisconsin) have created tiered application processes based on system size and other factors. This tiered approach streamlines the process for smaller systems while maintaining a standard process for larger systems.

- A streamlined process that applies to smaller[98] or simpler systems (e.g., inverter-based) could have lower fees, shorter timelines, and fewer requirements for system impact studies. In some cases, states (i.e., California and New York) have pre-certified certain devices. Other states (i.e., Connecticut, Massachusetts, Minnesota, New Jersey, and Texas) require compliance with UL 1741 or IEEE 1547 and other applicable standards to expedite approval.
- Systems in a standard process are subject to a comprehensive evaluation. Applicants for these systems are typically required to pay additional fees for impact studies to determine how the DG may affect the performance and reliability of the electrical grid. Because of the higher degree of technical complexity, fees are higher and processing times are longer.

Best Practices: Implementing an Interconnection or Net Metering Standard

The best practices identified below will help guide states in implementing interconnection or net metering standards. These best practices are based on the experiences of states that have implemented such standards.

- Consider working as a collaborative to establish monitoring activities that evaluate the effectiveness of interconnection or net metering standards and application processes.
- Periodically review and update standards based on monitoring activities, including feedback from utilities and applicants.
- Keep abreast of changes in DG/CHP and electric utility technology and design enhancements, since these may affect existing standards, such as streamlining the application process and interconnection requirements.
- Consider working with groups such as IEEE to monitor industry activities and to stay up-to-date on standards developed and enacted by these organizations.

[98] California, Connecticut, Massachusetts, Michigan, Minnesota, New York, and Wisconsin require faster processing of smaller system (< 10 kW to < 30 kW) applications.

State Examples

There is tremendous diversity among the key elements of interconnection standards recently established at the state level. In the examples presented below, application processes such as fees, timelines, and eligibility criteria differ in each state.

Greater similarities are emerging among states' technical requirements, and this consistency is making it easier to increase the amount of clean DG in the states.

Massachusetts

Massachusetts' initial net metering rules were created in 1982 by the state's Department of Public Utilities (DPU). These rules have been modified several times and in August 2009, the DPU issued its model net metering tariff so that customers in Massachusetts are subject to the same net metering tariffs regardless of utility. The state's IOUs must offer net metering. Massachusetts' interconnection standards apply to all forms of DG, including renewables, and to all customers of the state's three IOUs (Unitil, Eversource, and National Grid). Both fossil-fueled and renewably fueled CHP systems are eligible for standardized interconnection. However, renewably fueled CHP systems alone are eligible for net metering.

Massachusetts' interconnection and net metering policies stand out on the following merits:

- The state's Model Interconnection Tariff provides for three system interconnection options: a simplified process, an expedited process, and a standard process. The size and technical complexity of each system determines the interconnection pathway.
- Massachusetts' rules allow for a manual external disconnect switch to be required at the discretion of the utility.
- Utilities are required to collect and track information related to the interconnection process in order to improve and update the standards.
- Massachusetts' interconnection policy was designed to pay special attention to network systems found in dense urban areas, which required a transparent review and screening process for projects.
- The state's net metering policy is open to a wide variety of renewable and other DG technologies.
- The net metering policies are applicable to all IOUs within the state.
- There are three different classifications of net metered systems based on the size of the applicant system.
- System owners are afforded the ownership of all related environmental benefits such as RECs.
- Massachusetts' Solar Renewable Energy Credit program includes specific incentives for renewable energy on landfills and brownfields.
- Massachusetts also allows "neighborhood net metering" for neighborhood-based Class I, II, or III facilities that are owned by (or serve the energy needs of) a group of 10 or more residential customers in a single neighborhood and served by a single utility.
- The net metering laws establish various system capacity limits, such as 10 MW for municipal or government entities, 2 MW for all other Class III systems, 1 MW for all other Class II systems, and 60 kW for all other Class I systems.

Websites:
http://programs.dsireusa.org/system/program/detail/986
http://programs.dsireusa.org/system/program/detail/986
http://www.epa.gov/chp/policies/policies/mamassachusettsnetmeteringrules.html

Oregon

Oregon has three separate interconnection standards: one for its net metered systems made up of primary investor-owned (PGE and PacifiCorp), municipally owned, and cooperatively owned utilities; one for small generator facilities (non-net metered systems); and one for large generator facilities (non-net metered systems). The Oregon rules do not apply to customers of Idaho Power, which provides net metering to Oregon customers pursuant to rules adopted by the Idaho PUC (DSIRE 2014a). Both fossil-fueled and renewably fueled net metered systems, including CHP systems, are eligible for standardized interconnection. Oregon is one of few states to receive an "A" grade for both its interconnection and net metering policies in FreeingTheGrid.org's survey of state policies.

Oregon's interconnection and net metering policies stand out for the following reasons:

- The rules differentiate between system size classes, allowing for small, non-net metered generator facilities up to 10 MW.
- Oregon also requires that utilities provide for the use of a standard interconnection application, a standard agreement, and reasonable procedural timelines.
- All utilities must establish a single point of contact through which applicants can obtain basic information regarding the interconnection process.
- Oregon does not require a manual, external disconnect switch for systems smaller than 25 kW.
- Utilities may not require customers to purchase additional insurance or to name the utility as an additional insured party on the applicant's liability policy.
- Net metered systems have three levels of interconnection review with reasonable application fees.
- Oregon maintains an individual system capacity limit of 25 kW to 2 MW for non-residential applications.
- The state allows for net excess generation to be carried over monthly as a kilowatt-hour (kWh) credit for a 12-month period.
- Municipally owned utilities, cooperatively owned utilities, and public utility districts are required to offer net metering up to 25 kW for non-residential systems and 10 kW for residential systems.
- In 2008, Oregon authorized third-party ownership for renewable energy installations of net metered systems.
- Customers own all associated RECs from net metered systems.

Websites:
http://programs.dsireusa.org/system/program/detail/802
http://programs.dsireusa.org/system/program/detail/39
http://epa.gov/chp/policies/policies/ororegoninterconnectionstandards.html

Utah

Utah requires the state's IOU, Rocky Mountain Power, and cooperatively owned utilities serving greater than 10,000 customers to offer net metering to customers who generate electricity. In 2010, FreeingTheGrid.org gave Utah's interconnection and net metering policies an "A" ranking based on a scoring system that compares state rules against a standard best practice model policy. In Utah, renewable fuels such as waste gas and waste heat capture and recovery are eligible under the state's interconnection standards. Only renewably fueled CHP systems are eligible under the state net metering and interconnection standards.

Utah's interconnection and net metering policies stand out for the following reasons:

- Utah's interconnection rules are based on FERC's interconnection standards for small generators, adopted in May 2005 by FERC Order 2006.
- The state's interconnection requirements, standards, and review procedures are divided into three levels for systems up to 20 MW in capacity, based on system complexity. Level 1 applies to inverter-based systems under 25 kW. Level 2 applies to systems between 25 kW and 2 MW that fail to qualify under Level 1. Level 3 applies to systems under 20 MW that do not qualify for Level 1 or 2 interconnections.
- Utah's net metering policies apply equally to the state's IOUs and rural cooperatively owned utilities.
- Utah has set system capacity limits at 2 MW for non-residential and 25 kW for residential net metered systems.
- For Rocky Mountain Power, both residential and small commercial customers may accrue excess kWh credits against their next bill at retail rate on a kWh-for-kWh basis. Any credits remaining at the end of a 12-month billing cycle are granted to the utility.
- For Rocky Mountain Power, large commercial and industrial customers with demand charges may choose between valuing net excess generation at an avoided-cost-based rate or at an alternative rate based on utility revenue and sales contained in FERC Form No. 1.
- System owners own the RECs associated with the system.
- Utah authorizes meter aggregation for customers who have multiple meters on or adjacent to the same site.

Websites:
http://programs.dsireusa.org/system/program/detail/806
http://programs.dsireusa.org/system/program/detail/743
http://www.epa.gov/chp/policies/policies/ututahnetmeteringrules.html
http://epa.gov/chp/policies/policies/ututahinterconnectionstandards.html

What States Can Do

States have adopted successful interconnection and net metering standards that expedite the implementation of clean energy technologies while accounting for the reliability and safety needs of the utility companies. Action steps for both initiating a program to establish interconnection and net metering rules and for ensuring the ongoing success of the rules after adoption are described below. Importantly, the success of effective interconnection standards is enhanced by effective net metering standards in place. States have recognized the need for concurrent net metering standards by either incorporating net metering requirements or by establishing separate net metering standards.

Action Steps for States

States That Have Existing Interconnection and Net Metering Standards

A priority after establishing standard interconnection and net metering rules is to identify and mitigate issues that might adversely affect the success of the rules. Being able to demonstrate the desired benefits is critical to their acceptance and use by stakeholders. The following strategies demonstrate these benefits:

- Many states can improve upon existing interconnection and net metering rules by comparing them to established model rules and best practices. IREC and FreeingTheGrid.org are sources for model rules.
- Monitor interconnection applications to determine if the standards ease the process for applicants and cover all types of interconnected systems. States can also monitor utility compliance with the new standards or create a complaint/dispute resolution point of contact.
- If resources permit, identify an appropriate organization to maintain a database on interconnection applications and new DG systems, evaluate the data, and convene key interconnection stakeholders when necessary.
- Modify and change interconnection or net metering rules as necessary to respond to the results of monitoring and evaluation activities.

States That Do Not Have Existing Interconnection and Net Metering Standards

Public support can help establish standard interconnection rules. The following strategies foster support from public officials and other stakeholders:

- Ascertain the level of demand and support for standard interconnection and net metering rules in the state from both public office holders and key industry members (e.g., utilities, equipment manufacturers, project developers, and potential system owners). If awareness is low, consider implementing an educational effort targeted at key stakeholders to raise awareness of the environmental and, especially, economic benefits resulting from uniform interconnection rules. For example, demonstrate that DG can result in enhanced reliability and reduced grid congestion. A 2013 study found that strategically sited DG yields improvements to grid system efficiency and provides additional reserve power, deferred costs, and other grid benefits (Crossborder Energy 2013). If resources are available, perform an analysis of these benefits and implement a pilot project (e.g., similar to Bonneville Power Authority's "non-wires" pilot program [BPA 2005] or the Massachusetts Technology Collaborative's Utility Congestion Relief Pilot Projects [RET 2005]) that promotes DG along with energy efficiency and voluntary transmission reduction. While this type of analysis is not essential, states have found it to be helpful.
- Establish a collaborative working group of key stakeholders to develop recommendations for a standard interconnection process and technical requirements. Open a docket at the PUC with the goal of receiving stakeholder comments and developing a draft regulation for consideration by the state PUC.
- If necessary, work with members of the legislature and the PUC to develop support for passage of the interconnection and net metering rules.
- Remember that implementing interconnection standards may take some years. States have found that success is driven by the inherent value of DG, which eventually becomes evident to stakeholders.
- Consider existing federal and state standards while developing new interconnection procedures and rely on accepted IEEE and UL standards to develop interconnection technical requirements.

Related Actions

- Interconnection standards are most effective in combination with tariffs and regulations that encourage DG. If current tariffs and regulations discourage DG—for example, through high standby charges or backup rates—then interconnection standards may not result in DG growth. Tariffs that encourage DG growth may allow customers to sell excess electricity back to the utility at or near retail rates.
- More generally, utilities can offer certain financial incentives to discourage customers from making their own electricity and discourage DG deployment. This is especially true when utilities' revenues are tied to the volume of electricity they sell, which is known as the throughput incentive. Some states have implemented policies that help decouple revenue from sales volumes, thus reducing disincentives for DG. For more information about these policies and about utility financial incentives in general, see Section 7.2, "Policies That Sustain Utility Financial Health."
- Communicate the results to state officials, public office holders, and the public.
- Include key stakeholders (e.g., utilities, equipment manufacturers, project developers, potential customers, advocacy groups, and regulators) in the development of the standard interconnection rules. Stakeholders can also contribute to rule modification based on the results of ongoing monitoring and evaluation.

Information Resources

State-by-State Assessment

Title/Description	URL Address
Database of State Incentives for Renewables and Efficiency (DSIRE). This database provides information on state interconnection policies. It also provides comparative information on policies for each state.	http://www.dsireusa.org
dCHPP (CHP Policies and Incentives Database). This online database allows users to search for CHP policies and incentives on interconnection by state or at the federal level.	http://www.epa.gov/chp/policies/database.html
Eastern Interconnection States Planning Council EZ Mapping Tool. This resource allows users to query state policies on a wide variety of topics.	https://eispctools.anl.gov/policy_query

Federal Resources

Title/Description	URL Address
Distributed Generation Interconnection Collaborative. DOE's National Renewable Energy Laboratory (NREL) actively participates in many of the programs that create national standards for interconnection.	http://www.nrel.gov/tech_deployment/dgic.html
The Combined Heat and Power Partnership (CHPP). EPA's CHPP is a voluntary program that seeks to reduce the environmental impact of energy generation by promoting the use of CHP. The CHPP helps states identify opportunities for policy development (energy, environmental, economic) to encourage energy efficiency through CHP and can provide additional assistance to help states implement standard interconnection.	http://www.epa.gov/chp/
RE-Powering America's Land: Mapping and Screening Tools. This EPA website provides tools for evaluating the renewable energy potential for current and formerly contaminated lands, landfills, and mine sites. This initiative identifies the renewable energy potential of these sites and provides other useful resources for communities, developers, industry, state and local governments, or anyone interested in reusing these sites for renewable energy development. In particular, see the Solar and Wind Site Screening Decision Trees.	http://www.epa.gov/renewableenergyland/rd_mapping_tool.htm
The Effect of State Policy Suites on the Development of Solar Markets. This NREL paper uses statistical analysis and case studies to examine the effectiveness of state policies in fostering successful solar photovoltaic markets.	www.nrel.gov/docs/fy15osti/62506.pdf

National Standards Organizations

Title/Description	URL Address
IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems. The IEEE Standards Association has developed standards relevant to many of the technical aspects of interconnection. In particular, Standard 1547 provides requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection.	http://grouper.ieee.org/groups/scc21/1547/1547_index.html
UL 1741: Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources. UL also develops standards for interconnecting DG. In particular, UL 1741 will combine product safety requirements with the utility interconnection requirements developed in the IEEE 1547 standard to provide a testing standard to evaluate and certify DG products.	http://ulstandards.ul.com/standard/?id=1741

Examples of Standard Interconnection Rules

Title/Description	URL Address
IREC Regulatory Reform. IREC has prepared a model interconnection rule and a guide to connecting DG to the grid.	http://www.irecusa.org/regulatory-reform/
Model Interconnection Procedures and Model Net Metering Program Rules. These documents provide state policy-makers with a clear baseline to measure the minimum adequacy of their interconnection procedures, along with guidance to improve those procedures.	http://www.irecusa.org/regulatory-reform/interconnection/ (interconnection) http://www.irecusa.org/regulatory-reform/net-metering/ (net metering)
Connecting to the Grid: A Guide to Distributed Generation Interconnection Issues. This guide provides a model for stakeholders to develop state-level interconnection standards.	http://www.solarelectricpower.org/media/8165/irecconnecting-to-the-grid09.pdf
Freeing the Grid. This website and annual report, co-produced by IREC and Vote Solar, provides information on the status of state interconnection and net metering policies. Also available on this site are best and worst practice approaches to policy development as well as model rules.	http://freeingthegrid.org/
Model Interconnection Tariff. Massachusetts adopted this model interconnection tariff to establish a clear, transparent, and standard process for DG interconnection applications.	https://sites.google.com/site/massdgic/home
Mid-Atlantic Distributed Resources Initiative (MADRI) Working Group. In a collaborative process, MADRI has developed a sample interconnection standard.	http://www.energetics.com/MADRI/
Model Distributed Generation Interconnection Procedures and Agreement. NARUC developed these documents for small DG resources.	http://www.naruc.org/grants/Documents/dgiaip.pdf
Chapter 3. Interconnection Standards for CHP with No Electricity Export. This *Guide to the Successful Implementation of State Combined Heat and Power Policies* informs state utility regulators and other state policymakers with actionable information to assist them in implementing key state policies that impact CHP. It discusses five policy categories, including interconnection, and highlights successful state CHP implementation approaches within each category.	https://www4.eere.energy.gov/seeaction/system/files/documents/publications/chapters/see_action_chp_policies_guide_chap_3.pdf

Other Resources

Title/Description	URL Address
Removing Regulatory Barriers to Distributed Generation. This report by the Oregon PUC addresses barriers for DG.	http://www.puc.state.or.us/meetings/pmemos/2005/030805/reg3.pdf
Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects. This NREL report studies the barriers projects have faced interconnecting to the grid.	http://www.nrel.gov/docs/fy00osti/28053.pdf
Optimal Portfolio Methodology for Assessing Distributed Energy Resources Benefits for the Energynet: CEC, PIER Energy-Related Environmental Research (CEC-500-2005-061-D). This project addresses whether DG, demand response, and localized reactive power sources, or distributed energy resources, can be shown to enhance the performance of an electric power transmission and distribution system.	http://www.energy.ca.gov/2005publications/CEC-500-2005-096/CEC-500-2005-096.PDF
Model Regulations for the Output of Specified Air Emissions from Smaller-Scale Electric Generation Resources. The Regulatory Assistance Project (RAP) prepared a Distributed Resource Policy Series to support state policy efforts, and facilitated the creation of a Model Distributed Generation Emissions Rule for use in air permitting of DG.	http://www.raponline.org/document/download/id/174
Designing Distributed Generation Tariffs Well: Fair Compensation in a Time of Transition. This RAP paper outlines current tariffs and considerations for regulators as they weigh the benefits, costs, and net value to DG adopters, non-adopters, the utility system, and society as a whole.	http://www.raponline.org/document/download/id/6898
Rate Design Pathways to Fair Utility Rates for Solar PV in a Distributed Energy Age. This article from ElectricityPolicy.com provides insights on how states can accommodate growth in the solar photovoltaic market.	http://www.electricitypolicy.com/articles/7530-rate-design-pathways-to-fair-utility-rates-for-solar-pv-in-a-distributed-energy-age
The CHP Association (CHPA). CHPA brings together diverse market interests to promote the growth of clean, efficient CHP in the United States. As a result, they have been stakeholders in states that have developed standard interconnection rules.	http://chpassociation.org/

State Resources

State	Title/Description	URL Address
California	California Interconnection Guidebook: A Guide to Interconnecting Customer-owned Electric Generation Equipment to the Electric Utility Distribution System Using California's Electric Rule 21. This guidebook, written for the California Energy Commission's Public Interest Research Program in 2003, is intended to help customers interconnect electric generators to their investor-owned electric utility Distribution System under the California Public Utilities Commission's approved utility interconnection Rule 21.	http://www.energy.ca.gov/reports/2003-11-13_500-03-083F.PDF
	Decision Adopting Settlement Agreement Revising Distribution Level Interconnection Rules and Regulations (Decision 12-09-018). This 2012 order by the California Public Utilities Commission reformed Electric Tariff Rule 21, which governs the interconnection by electric generating facilities to the distribution systems of California IOUs.	http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M028/K168/28168335.pdf
Connecticut	DPUC Investigation into the Need for Interconnection Standards for Distributed Generation—Area Network Interconnection Standards. This decision provides revised guidelines for the Connecticut Department of Public Utility Control's joint interconnection guidelines to bring them into alignment with FERC Order 2006.	http://www.dpuc.state.ct.us/dockhist.nsf/8e6fc37a54110e3e852576190052b64d/0802f9f14f6a0ab18525775100510969?OpenDocument
	DPUC Investigation into the Need for Interconnection Standards for Distributed Generation–2007 Revisions. This docket provides status updates on the research and development of standards for interconnection from Connecticut's investor owned utilities.	http://www.dpuc.state.ct.us/dockhist.nsf/8e6fc37a54110e3e852576190052b64d/55810423d6501987852573e800837054?OpenDocument
Delaware	Interconnection Standards for Delmarva Power & Light Company's Delaware Operating Territory. This 2011 filing contains Delmarva Power & Light Company's interconnection standard for its Delaware operating territory in compliance with the Delaware PUC's Regulation Docket No. 49 and Order Numbers 7832 and 7984.	http://www.dsireusa.org/documents/Incentives/DE05R.pdf
	In the Matter of the Adoption of Rules and Regulations to Implement the Provisions of 26 DEL. C. CH. 10 Relating to the Creation of a Competitive Market for Retail Electric Supply Service (Order No. 7984).This 2011 proceeding revises Delaware net metering rules to include single customers with multiple accounts and multiple customers and multiple accounts served by community energy generation facilities.	http://depsc.delaware.gov/orders/7984.pdf

State	Title/Description	URL Address
Hawaii	Instituting a Proceeding to Investigate the Implementation of Reliability Standards for Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Limited (Docket No. 2011-0206). This proceeding initiated an investigation to examine the implementation of reliability standards for utilities in the state of Hawaii, including interconnection of DG facilities.	http://dms.puc.hawaii.gov/dms/DocketSearch.jsp (Enter 2011-0206 in search box Docket No.)
	Decision and Order for Approval to Modify Rule 14H, Interconnection of Distributed Generating Facilities Operating in Parallel with the Companies Electrical Systems as Shown in Appendices I, II, and III (Docket No. 2010-0015). This 2011 decision updates Hawaii Electric Companies' Tariff Rule 14H, which governs the interconnection of distributed generating facilities, to facilitate the higher penetration of renewable distributed generating facilities.	http://www.dsireusa.org/documents/Incentives/HI01Rd.pdf
Massachusetts	Distributed Generation and Interconnection in Massachusetts. Massachusetts Department of Energy Resources Web page. This website provides resources and information on interconnection, net metering, and grid modernization in the state of Massachusetts.	https://sites.google.com/site/massdgic/
	Department Investigation on Distributed Generation Interconnection (Docket 11-75). This docket features an order approving an interconnection timeline enforcement mechanism, which requires the state's IOUs to file interconnection tariffs. The docket is also an ongoing investigation on DG interconnection.	http://web1.env.state.ma.us/DPU/FileRoom (Click Dockets/Filings and enter Docket #11-75 in search box to access materials)
	Inquiry into Net Metering and Interconnection of Distributed Generation (Docket 11-11). This 2011 docket establishes an inquiry into net metering and interconnection of DG.	http://web1.env.state.ma.us/DPU/FileRoom (Click Dockets/Filings and enter Docket #11-11 in search box to access materials)
Michigan	Customer Generation. Michigan Public Service Commission (PSC) Department of Licensing and Regulatory Affairs Web page. This page provides applications for interconnection and net metering, as well as generator interconnection procedures and parallel operating agreements.	http://www.michigan.gov/mpsc/0,1607,7-159-16393_48212---,00.html
	In the Matter, on the Commission's Own Motion, to Approve Procedure, Agreements, and Forms, for Use with the Category 1 and Category 2 Interconnection and Net Metering Programs (Docket No. U-15919). This 2012 case approves general interconnection procedures in the state of Michigan for projects up to 150 kW. Procedures are divided into two categories based on the aggregate generator size.	http://www.dleg.state.mi.us/mpsc/orders/electric/2012/u-15919_09-25-2012.pdf

State	Title/Description	URL Address
Minnesota	Distributed Generation. Minnesota Department of Commerce's Web page. This website contains general information on DG in Minnesota, including resources from stakeholder workshops held in 2011–2014 on issues related to DG resources.	http://mn.gov/commerce/energy/businesses/clean-energy/distributed-generation/index.jsp
	In the Matter of Establishing Generic Standards for Utility Tariffs for Interconnection and Operation of Distributed Generation Facilities under Minnesota Laws 2001, Chapter 212. This 2004 order establishes guidelines for DG tariffs in Minnesota, and mandates that retail electric public utilities submit distribution tariffs consistent with the guidelines.	http://mn.gov/puc/portal/groups/public/documents/puc_pdf_orders/008982.pdf
New Hampshire	Net Metering for Customer-Owned Renewable Energy Generation Resources of 1,000 Kilowatts or Less. This code, enacted in 2001 and subsequently amended, establishes interconnection requirements for net energy metering.	http://www.puc.state.nh.us/Regulatory/Rules/PUC900.pdf
New Jersey	Net Metering and Interconnection. New Jersey Board of Public Utilities' Web page. This page explains net metering and interconnection requirements in the state of New Jersey.	http://www.njcleanenergy.com/renewable-energy/programs/net-metering-and-interconnection
	Interconnection of Class I Renewable Energy Systems N.J.A.C 14:8-5.1 et seq.). This administrative code, enacted in 2004, and subsequently amended, provides general interconnection provisions and lays out requirements for interconnection in the state of New Jersey.	http://www.lexisnexis.com/hottopics/njcode/ (Enter 14:8-5.1 into search box)
New York	Distributed Generation Information. New York PSC Web page. This page provides updated New York State standardized interconnection requirements.	http://www3.dps.ny.gov/W/PSCWeb.nsf/All/DCF68EFCA391AD6085257687006F396B?OpenDocument
	New York State Standardized Interconnection Requirements and Application Process for New Distributed Generators 2 MW or Less Connected in Parallel with Utility Distribution Systems. This document, updated in 2014, contains standardized interconnection requirements for DG in New York state.	http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/dcf68efca391ad6085257687006f396b/$FILE/ATTP59JI.pdf/Final%20SIR%202-1-14.pdf
Ohio	Interconnection Forms and Interconnection Applicant Checklist. The Public Utilities Commission of Ohio Web page. This page provides sample interconnection forms, including applications and interconnection agreements, for the state of Ohio.	http://www.puco.ohio.gov/puco/index.cfm/puco-forms/interconnection-forms/#sthash.Tfd4dojZ.dpbs
	In the Matter of the Commissions Review of Chapter 4901:1-22 Ohio Administrative Code Regarding Interconnection Services (12-0251-EL-ORD).This case, opened in 2012, is an ongoing review of the administrative code regarding interconnection services in the state of Ohio.	http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=12-2051

State	Title/Description	URL Address
Oregon	Net Metering Rules (R. 860-039).This 2007 document presents rules for net metering in the state of Oregon.	http://arcweb.sos.state.or.us/pages/rules/oars_800/oar_860/860_039.html
	Small Generator Interconnection Rules (R. 860-082). This 2009 document presents rules for interconnection in the state of Oregon.	http://arcweb.sos.state.or.us/pages/rules/oars_800/oar_860/860_082.html
Texas	Certification and Licensing. PUC of Texas Web page. This page contains forms, documents, and legislation for DG in the state of Texas, including technical requirements for interconnection.	http://www.puc.texas.gov/industry/electric/business/dg/Dg.aspx
	Distributed Generation Interconnection Manual. This manual, developed by the PUC of Texas in 2002, provides a guide for the inclusion of DG into the Texas electric system.	http://www.puc.texas.gov/industry/electric/business/dg/dgmanual.pdf
	Substantive Rule § 25.211—Interconnection of On-Site Distributed Generation (DG).This rule by the PUC of Texas in 1999 states the terms and conditions governing the interconnection and parallel of onsite DG in Texas.	http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.211/25.211ei.aspx
	Substantive Rule § 25.212—Technical Requirements for Interconnection and Parallel Operation of On-Site Distributed Generation. This rule by the PUC of Texas in 1999 states the technical requirements for interconnection and parallel operation of onsite DG in Texas.	http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.212/25.212ei.aspx
Utah	Net Metering of Electricity (Utah Code § 54-15-101 et seq.). This code, enacted in 2002, outlines rules for the net metering of electricity in the state of Utah.	http://le.utah.gov/UtahCode/section.jsp?code=54-15
	Electrical Interconnection (Utah Admin Code R746-312). This code, enacted in 2010, outlines rules for the interconnection of DG facilities in the state of Utah.	http://www.rules.utah.gov/publicat/code/r746/r746-312.htm
Wisconsin	Distributed Generation Interconnection Procedure. PSC of Wisconsin Web page. This page provides materials for DG interconnection procedures in the state of Wisconsin, including guidelines, points of contact for electric providers, and forms.	http://psc.wi.gov/utilityinfo/electric/distributedGeneration/interconnectionProcedure.htm
	Chapter PSC 119: Rules for Interconnecting Distributed Generation Facilities. This 2004 text provides rules for interconnecting DG facilities in the state of Wisconsin.	http://www.legis.state.wi.us/rsb/code/psc/psc119.pdf

References

Title/Description	URL Address
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Crossborder Energy. 2013. Evaluating the Benefits and Costs of Net Energy Metering in California. Prepared for the Vote Solar Initiative. Crossborder Energy Comprehensive Consulting for the North American Energy Industry.	http://votesolar.org/wp-content/uploads/2013/01/Crossborder-Energy-CA-Net-Metering-Cost-Benefit-Jan-2013-final.pdf
DOE. 2007. Distributed Energy Interconnection Procedures Best Practices for Consideration. Office of Energy Efficiency and Renewable Energy and Office of Electricity Delivery and Energy Reliability. U.S. Department of Energy.	http://www1.eere.energy.gov/solar/pdfs/doe_interconnection_best_practices.pdf
DSIRE. 2013. Utah: Interconnection Standards. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/806
DSIRE. 2014a. Massachusetts: Interconnection Standards. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/986
DSIRE. 2014b. Massachusetts: Net Metering. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/281
DSIRE. 2014c. Oregon: Interconnection Standards. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/802
DSIRE. 2014d. Oregon: Net Metering. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/39
DSIRE. 2014e. Utah: Net Metering. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/743
DSIRE. 2015a. Summary Tables: Interconnection Policies. Database of State Incentives for Renewables and Efficiency. Accessed March 2015.	http://programs.dsireusa.org/system/program?type=14&category=2&
DSIRE. 2015b. Summary Tables: Net Metering. Database of State Incentives for Renewables and Efficiency. Accessed March 2015.	http://programs.dsireusa.org/system/program?type=37&category=2&
SEIA. 2014. Issues and Policies: Net Metering. Solar Energy Industries Association.	http://www.seia.org/policy/distributed-solar/net-metering

7.4 Customer Rates and Data Access

Policy Description and Objectives

Summary

Customers benefit economically from utility bill savings or direct payments for their electricity output when they improve their energy efficiency or install distributed renewable energy and combined heat and power (CHP). Consequently, the specifics of a customer's rates and other utility charges can drive the economic attractiveness of energy efficiency, distributed renewable energy, CHP, and other technologies, such as storage and electric vehicles. States have found that access to utility data on energy usage is key to helping customers understand and manage their utility bills and consider potential energy efficiency and clean energy investments.

Objective

The policies described in this section involve setting rates and giving customers access to information that will encourage them to use energy more efficiently or invest in distributed renewable energy and CHP. States have found that rate design and data access policies can help encourage additional customer investment in these technologies and practices while complementing the energy efficiency, renewable energy, and CHP policies discussed elsewhere in the *Guide to Action*, such as energy efficiency resource standard and renewable portfolio standard (RPS) policies.

In most cases, utility rates are not designed with energy efficiency and clean energy technology in mind. Utility rates are the outcome of a complex process that must take into account multiple objectives. There are usually three main priorities: 1) meeting utility revenue requirements, 2) fair apportionment of costs among customers, and 3) economic efficiency (Bonbright 1961; Phillips 1993). Other regulatory and legislative goals may include providing stable revenues for the utility and stable rates for customers, simplifying understanding and ease of implementation, encouraging effective load management, promoting social equity in the form of lifeline rates for people with low incomes, and promoting environmental sustainability in the form of rates that encourage reduced energy use and lower emissions.

Because states consider multiple priorities when designing rates, rate design may be more or less compatible with the adoption of energy efficiency, distributed renewable energy, and CHP. This section describes common rate forms and how they can affect the benefits and risks of these technologies and practices. This section also discusses the role of electronic energy use data (and related privacy protections). Electronic access to energy use data can help customers manage their utility bills and make informed decisions about participating in energy efficiency programs and investing in distributed renewables.

Types of Utility Rates

Table 7.4.1 summarizes nine types of rate designs and highlights whether each design focuses on a customer's net usage or focuses on generator output. Each type of rate design is described in more detail below, followed by a discussion about providing customers with access to detailed energy use data.

Table 7.4.1: Summary of Rate Designs

Rate Form	Effect or Goal of Design	Applies to Customer Usage or Generator Output
Energy Consumption Rates		
Flat Rates	Simplest rate form, often consisting of monthly demand/access charges and energy charges per kilowatt-hour consumed. Historically used to meet state policy objectives for rate design.	Customer usage
Inclining Block Rates	Promotes reduced monthly energy usage. Also provides bill reductions for consumers with smaller overall usage.	Customer usage
Time-Varying Rates (Time-of-Use and Real Time Pricing)	Promotes economically efficient consumer decisions by providing prices to customers that reflect the time-varying cost of energy.	Customer usage
Demand Charges	Incentivizes customers to reduce their demand during peak periods when electricity is more expensive for the utility to provide.	Customer usage
Technology Targeted Rates		
Standby Rates	Compensates the utility for having equipment ready and available to serve a customer when needed to provide backup for the customer's generator.	Generator output
Exit Fees	Allows the utility to charge customers for costs previously incurred by the utility even if the customer no longer requires grid service. Adds a disincentive for customers to depart from the grid.	Generator output
Net Energy Metering	Compensates customers for their generation output at rates that are equivalent to their retail rates.	Customer usage
Buyback Rates (Feed-in Tariffs)	Separates the value of customer-installed generation from the customer's rates. Compensates the customer for generation output.	Generator output
Electric Vehicle Rates	Provides time-of-use rates that incentivize off-peak charging.	Customer usage

Energy Consumption Rates

The first four types of rates relate to the way utilities charge customers for the amount of energy they use. While typically designed to meet the general ratemaking objectives described above, these rates can also incentivize energy efficiency and clean energy in a variety of ways.

Flat rates. The flat rate charges customers based on the total kilowatt-hours (kWh) of electricity or therms of natural gas they consume. In addition to these charges per unit of energy consumed, bills may also include a daily or monthly customer access charge to help cover the utility's fixed costs.[99] Flat rates are typically limited to residential and small commercial customers. Customers could realize cost savings if they adopt energy efficiency, distributed renewable energy, or CHP, but flat rates do not necessarily incentivize the customer to

[99] Access charges include items such as monthly customer charges or daily facility access fees. These charges and fees provide a stable revenue source for utilities that reduces the remaining costs that utilities must recover from customers via energy charges. For example, an all-energy rate might be 20 cents per kWh; whereas the addition of a $10 per month customer charge might allow a lower 18 cent per kWh rate.

adopt these technologies and practices in a manner that maximizes cost savings and environmental benefits across the electricity system as a whole.

Inclining block rates. Under this rate form, the price per unit of electricity or natural gas increases with higher usage. Inclining block rates offer the advantages of being simple to understand and simple to meter and bill. Inclining block rates can also meet the policy goal of protecting small energy users. It was this desire to protect small users that prompted the adoption of inclining block rates in California. For larger users, inclining block rates offer a stronger price signal for energy efficiency and clean energy than a simple flat rate. In contrast, some utilities offer a declining block rate structure for their largest customers, in which the first block of usage is billed at a higher rate than subsequent usage.

Time-varying rates. Time-of-use (TOU) and real time pricing (RTP) rates refine the utility's pricing so that the cost of energy differs by season, month, time of day, or hour. Generally, natural gas rates will only vary by season or month, while electricity TOU prices will typically vary by season and consist of up to four pricing periods within each season that vary by time of day. RTP prices typically vary hourly. Other variations involve energy prices that are fixed for most of the year, but the utility can raise prices for a limited number of hours, or offer large credits for energy reductions in response to system needs or high market prices. Such hourly responses have existed for decades, but have historically been limited to large commercial and industrial customers. More recently, the implementation of advanced metering infrastructure (AMI) projects by utilities has enabled small commercial and residential customers to participate in RTP.[100]

TOU and RTP rates allow utilities to offer prices to customers that can better match the utility's supply costs. By reducing demand at peak times, these rates can decrease the need for utilities to build additional generation capacity or operate less efficient backup units. TOU and RTP prices can also provide larger economic incentives than flat rates for energy efficiency, distributed renewables, and CHP that provide relatively higher output during times of higher utility costs and prices—for example, solar power during hot, sunny summer days. Access to energy usage data and pricing information is important for customers who are on time-varying rates.

Demand charges. With demand charges, customers pay for their energy usage and then pay an additional charge based on their peak demand during a particular period (a month, the year as a whole, or at a specific time of day). Demand charges reflect the fact that portions of the electricity system are sized to accommodate customers' peak loads. Demand charges have historically been limited to industrial and larger commercial customers because of the cost of advanced metering, but the spread of AMI to smaller customers presents additional opportunities—although the complexity of understanding and managing demand by smaller, less sophisticated customers remains an issue. (For more discussion about AMI and other modern grid technologies, see Section 7.5, "Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration.")

Like TOU and RTP structures, demand charges can lead to environmental benefits and overall cost savings by decreasing the need for utilities to build additional generation capacity or operate less efficient backup units during periods of peak usage. To the extent that energy efficiency, distributed renewable energy, and CHP can

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[100] For example, PG&E, Portland General Electric, and Georgia Power are offering real-time pricing to customers. For more information, see http://www.pge.com/en/mybusiness/rates/tvp/peakdaypricing.page, https://www.portlandgeneral.com/our_company/corporate_info/regulatory_documents/pdfs/schedules/Sched_012.pdf, and http://www.georgiapower.com/pricing/files/rates-and-schedules/CPP-R-1.pdf.

reduce peak demand, they can greatly reduce customer demand charges. Some customers have also installed electricity storage to reduce their demand charges.[101]

Technology-Targeted Rates

In some cases, customers who install technologies could be subject to rates that are specific to their installation of distributed renewable energy, CHP (see Chapter 6, "Policy Considerations for Combined Heat and Power"), storage equipment (see Section 7.5), or a unique energy-intensive end-use (e.g., electric vehicles). This section discusses several common types of technology-targeted rates.

Standby rates. Facilities that use distributed renewable energy or CHP may still need backup power from the grid when the onsite system is unavailable due to equipment failure, maintenance periods, or other planned outages. Electric utilities often assess standby charges to cover the additional costs they incur as they continue to provide adequate generation, transmission, or distribution capacity (depending on the structure of the utility) to meet these customers' needs. The utility's concern is that the customer could require power at a time when electricity is scarce or at a premium cost, and the utility must be prepared to serve load during such extreme conditions, sometimes on short notice (see the introduction to Chapter 7, "Electric Utility Policies," for additional discussion on how the electric power grid must match supply with demand).

The probability that any one generator will require standby service at the exact peak demand period is low, and the probability that all interconnected small-scale distributed renewable energy or CHP will need it at the same time is even lower. Consequently, states are exploring standby rate alternatives that may more accurately reflect these conditions (DOE 2012a; NRRI 2012). States are also looking for ways to account for the diversity of customer types[102] when determining the probability that the demand for standby service will coincide with peak (high-cost) hours.

Exit fees. When facilities reduce or end their use of electricity from the grid, this affects the utility's ability to recover fixed operating costs for the investments it has made to serve all ratepayers. These fixed costs are usually recovered over time and are often tied to kWh consumption. The remaining customers may eventually bear these costs. This can be particularly problematic if a large customer leaves a small electric system. To minimize potential rate increases due to the load loss,[103] utilities sometimes assess exit fees on departing loads.

As many states began to restructure (i.e., deregulate) their electricity markets during the 1990s, utilities that previously generated power began to focus on delivery only, which meant that more of their costs tended to be fixed (e.g., investments in transmission and distribution infrastructure). Thus, exit fees gained favor as a means to allow these utilities to recover historical or "stranded" costs. Some states, however, exempted certain generation projects from exit fees because of the other benefits they provided, such as grid congestion relief and reliability enhancement. For example, Massachusetts and Illinois exempted some or all CHP projects from their stranded cost recovery fees.

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[101] See Section 7.5, "Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration," for more information on electricity storage.

[102] For example, some industrial facilities run three shifts per day while others only run one shift per day. This would lead to a three-fold disparity between peak and minimum power demand in two otherwise identical facilities.

[103] Many factors affect utility rates and net revenues (e.g., customer growth, climate, fuel prices, and overall economic conditions). Therefore, a load reduction will not necessarily result in a net loss that would need to be recovered from the departing customer or other customers.

Net energy metering. Net metering is designed for customers who own small distributed generation (DG) systems. The basic principle behind net metering is that the amount of electricity produced by the DG system is measured against the amount of electricity used by the customer (i.e., the customer's load). If the DG system produces more electricity in any given month than the customer needs to meet its own load, the surplus electricity is exported to the grid for other customers to use. The customer then receives a bill credit for the surplus kWh, which can be used to offset electricity use in future months when the customer's load exceeds the DG system's production. This crediting system means that the utility is effectively purchasing the surplus electricity generated by the DG system at the full retail rate. Net metering programs typically address interconnection in a simple way, which is appropriate for small renewable projects. (For more information on net metering, see Section 7.3, "Interconnection and Net Metering Standards.")

Several aspects of net metering vary by state, including roll-over of bill credits and the maximum size of a net metered system. Net metering is designed for customers who install a small DG system that will produce roughly the same amount as the customer's load, not for utility-scale power producers whose systems export large amounts of electricity to the grid and support many customers' loads. Most states also set a limit on the aggregate capacity of net metered systems in each utility's territory. See Section 7.3 for a map of state net metering policies.

Buyback rates. The payment received for surplus power generated by distributed renewable energy and CHP projects can be a critical component of project economics. The price at which the utility is willing to purchase this power can vary widely and is also affected by federal and state requirements.

The feed-in tariff (FIT) is a common type of buyback rate. A FIT consists of a contract between the utility and the renewable generator to purchase the output of the renewable generation capacity at a fixed rate for a fixed period of time (often 10 to 20 years). The FIT price is often higher than the utility's retail rate, and it remains fixed for the length of the contract period even if the retail rate fluctuates. This fixed price provides a degree of certainty that net metering cannot match with regard to the payback period of the customer's energy system.

FITs are a powerful tool for incentivizing renewable development, and they can jump-start a renewable industry faster and more effectively than many other policy instruments. However, it is precisely for this reason that they must be designed carefully and flexibly, allowing them to adjust to fluctuations in the industry and the markets they affect. This is a lesson learned from examples such as in Spain, where the government offered a highly attractive FIT rate in 2007 that incentivized installations far beyond the capacity targets (Voosen 2009). The government quickly reduced the tariff incentives a year after the start of the program, and they suspended the FIT altogether in 2012 to contain costs to the government and other utility customers (EIA 2013). To avoid such boom and bust cycles and to provide stability for both utilities and the clean energy technology industry, FITs can be designed with features such as capacity caps, incentives that decline with installed capacity levels, or incentives that are linked to market conditions.

Electric vehicle rates. As battery-powered electric vehicles (e.g., Tesla Model S, Nissan Leaf) and plug-in hybrid electric vehicles (e.g., Chevrolet Volt) become more common, some utilities have begun offering rate plans (tariffs) designed specifically for households that charge electric vehicles. These tariffs usually employ a TOU structure to encourage electric vehicle owners to charge their cars during off-peak hours and thus prevent peak load from increasing.

As of July 2014, 25 utilities scattered across 14 states have made electric vehicle-targeted rates available (Northeast Group 2014). These tariffs sometimes include "super off-peak" hours to encourage charging late at night (e.g., Georgia Power, 11:00 p.m. to 7:00 a.m.) (Georgia Power 2014). Others, such as the electric vehicle tariffs offered by Pacific Gas and Electric (PG&E), include an option to meter the electric vehicle charger separately from the rest of the home (PG&E 2014d). This enables electric vehicle owners to put the charger on a different rate plan from the rest of the house, taking advantage of low off-peak prices without incurring higher costs for electricity used elsewhere in the house during peak hours.

In Texas, where night-peaking wind power is abundant, the utility TXU Energy's "Free Nights" plan offers free electricity from 9:00 p.m. to 6:00 a.m. every day, albeit with rates higher than those of many other plans during the rest of the day (TXU Energy 2014). This arrangement enables electric vehicle owners to save money and charge their vehicles with renewably generated electricity, and it helps the utility by minimizing surplus generation from renewables during off-peak hours.

Data Access

Providing customers, utilities, third parties and others access to energy use information can be an important part of incentivizing energy efficiency, distributed renewable energy, and CHP. Each group has different data access considerations.

Commercial customers. Access to energy use data is critical for benchmarking energy use in commercial, administrative, and multifamily residential buildings. Benchmarking allows building owners and managers to understand their buildings' energy use, identify the best opportunities for improvement, and measure the impact of efficiency efforts. Metering can present a challenge, as a single meter might register the combined energy use for multiple buildings, or a large building might have multiple meters that need to be summed to obtain total building energy use. This may require technical upgrades on the utility's part. Regulators can play a role by mandating that utilities provide such data access to commercial building owners, especially if the benchmarking process is itself being undertaken due to a regulatory mandate (SEE Action 2013). Seven states (California, Colorado, Illinois, Oklahoma, Pennsylvania, Texas, and Washington) have passed laws mandating that utilities provide consumers with access to their own data (SEE Action 2012).

Customers on time-varying rates. Rate schedules that seek to reduce peak demand by shifting some usage to off-peak hours are much more likely to be effective if ratepayers can see how specific choices and actions affect their energy use—and consequently, their bills—at different times. The standard total monthly energy use found on most ratepayers' bills will not provide sufficient detail for them to evaluate how much impact a particular action had. Many utilities are providing customers new online energy management tools, in-home energy use displays, and programmable thermostats to provide customers with better access to their energy usage information and to help them manage their energy bills. More detailed information on energy use also makes it easier for customers to track the savings afforded by distributed renewable energy such as solar panels.

Utilities. Though the utility itself has access to data—provided that its metering infrastructure is sufficiently advanced—the utility may employ an outside company to help implement its energy efficiency or clean energy programs. That company will likely need at least partial access to energy use data in order to fulfill its role. Utilities typically include provisions for data security and limitations on data usage in their contractual arrangements with outside companies. Customer consent is typically not required; however, the state public utility commissions (PUCs) in Oregon and Vermont have established rules for data sharing when all customer billing and energy use data is shared (SEE Action 2012).

Third parties. From the perspective of third parties such as energy service companies, customer energy use data can be a valuable tool for identifying market opportunities and developing successful customer acquisition strategies. As discussed above, state regulators can exercise some control over the data that utilities can share with outside vendors. A key question is how much aggregate information the utility can share without obtaining consent from all the individual customers whose energy use is included in the total. This question is important to utilities due to the logistical expense of contacting customers to obtain consent, so several states have now passed standards governing when the need for consent is triggered. Vermont, for example, has established regulations that set minimum standards for size of the geographic area covered by the data, while Colorado has regulated the number of customers included in an aggregated data pool and their relative percent of the total energy use.

In situations where customers voluntarily provide their energy use data to third parties, there is again the potential for improper data usage and breach of privacy. In these situations, there are fewer direct actions regulators can take, but they can encourage third parties to provide privacy assurances and encourage customers to ask to see an official privacy policy (SEE Action 2012). For example, states could encourage third parties to voluntarily adopt the U.S. Department of Energy's (DOE's) Voluntary Code of Conduct, which includes concepts and principles regarding customer data privacy. [104]

Others. For researchers and policy-makers, energy use data aggregated by time period, geographic area, or demographic group can provide a valuable window into opportunities for energy efficiency or clean energy incentive programs on a larger scale (SEE Action 2012). However, requests for such data can raise customer privacy and utility cost concerns.

Designing Utility Rates and Providing Data Access to Support Energy Efficiency, CHP, and Clean Energy Goals

While there are a range of strategies available for encouraging customer investment in energy efficiency, distributed renewable energy, and CHP, states have found that having a supportive rate structure and complementary access to energy usage data can be critical to a customer making the business case and moving forward with investment. Similarly, ensuring that all customers benefit regardless of whether they directly participate in energy efficiency programming or invest in clean energy is important to maintaining long-term support for investments and policy goals. For this reason, it is important to understand the system-wide benefits of these investments and to address the unique perspectives and implications for each customer class. This section summarizes some key design issues, introduces the participants, and highlights how federal and state policies can interact with clean technology rates.

Key Design Issues

Utilities and regulators balance competing goals in designing rates. Achieving this balance is essential for obtaining regulatory and customer acceptance. Key design issues are described below.

Fairly Apportion Costs Among Customers

Utilities undergo formal processes to determine what share of their revenue will be received from each customer class. In regulatory proceedings, this process is often contentious, as each customer class seeks to

[104] DOE's Office of Electricity Delivery and Energy Reliability and the Federal Smart Grid Task Force facilitated a multi-stakeholder process to develop the Voluntary Code of Conduct. The Final Concepts and Principles, released on January 12, 2015, are available at http://www.energy.gov/sites/prod/files/2015/01/f19/VCC%20Concepts%20and%20Principles%202015_01_08%20FINAL.pdf.

pay less. This makes it difficult for utilities to propose rate designs that shift revenues between different customer classes. In redesigning rates to encourage energy efficiency, distributed renewable energy, and CHP, it is important to avoid unnecessary or inadvertent cost shifts between customer classes.

Maintain Rate Simplicity

The challenge for promoting energy efficiency is balancing the desire for rates that provide the right signals to customers with the need to have rates that customers can understand, and to which they can respond. Rate designs that are too complicated for customers to understand will not be effective at promoting efficient consumption decisions. Particularly in the residential sector, customers might pay more attention to the total bill than to the underlying rate design.

Mandatory vs. Voluntary Rates

A key design issue for utilities and policy-makers is whether the energy efficiency, distributed renewable energy, or CHP customer remains on a standard utility rate, can elect to move to a voluntary optional utility rate, or is required to take service under a special mandatory rate.

The use of voluntary rates provides more flexibility to incentivize clean energy, but it also introduces a potential free rider effect. For example, hot summer days are typically a peak usage period, so a utility might incentivize people to reduce their peak energy usage by offering a voluntary TOU rate with high summer midday prices and lower prices at other times of the year. These rates could encourage the installation of onsite solar, which would lower customers' net energy usage the most during sunny summer days. However, the same rate would also benefit a residential customer who commutes to work and is not home during the day, even if they do not install onsite solar. This is an example of the free rider effect. One partial solution would be to make the optional rate only available to customers who own onsite solar; however, in that case, a commuter customer with onsite solar could still see a large portion of their savings come from switching to the optional rate rather than from their onsite solar.

Mandatory special rates can be customized and targeted to energy efficiency, distributed renewable energy, and CHP customers. This design freedom can also lead to controversy, though, as targeting could be viewed as discriminatory *against* the technologies (i.e., high standby rates) or *for* clean technology (i.e., high FIT). Whereas standard utility rates are anchored by existing rate levels and utility rate increase percentages, special rates may be so unique that they have no clear benchmarks for deciding reasonableness.

Compensating Customers Who Generate Electricity

Another key design issue is how to compensate customers who generate their own electricity, such as through distributed renewables or CHP. These customers may be compensated through bill reductions due to their lower net energy usage, or they may be paid directly for their electricity output. As discussed above, the bill reduction method adds uncertainty into the customer's purchase decision because of unknown future changes in utility rates. Conversely, the use of set payment methods, such as FIT contracts with 20-year fixed prices, can burden utilities and other utility customers if the value of the distributed renewable generation drops.

Cost of Implementation

All of these designs will have implementation implications. For example, rates like RTP will have extensive data requirements, which raise the issue of how utilities will recover the costs incurred by information technology updates associated with making detailed energy data available to consumers. The range of recovery options includes spreading the costs to all customers via general operating expenses; adding a surcharge to customer bills; folding the costs into other project budgets, such as advance meter deployments and/or customer programs; or charging customers for data access.

Participants

Given the issues described above, changing rate design is often a contentious process involving lengthy workshops, settlement discussions, or litigated proceedings. This section introduces the major participants in the rate-setting process.

- *State PUCs.* Rates typically are approved by the state PUC during a utility rate filing or other related filing. The PUC staff are the focal point for evaluating costs and benefits to generators, utilities, consumers, and society as a whole. Many PUCs conduct active rate reviews in order to maintain consistency with changing policy priorities.
- *Utilities.* Utilities play a critical role in rate-setting. Their cost recovery and overall economic focus have historically revolved around volumetric rates that reward the sale of increased amounts of electricity. Anything that reduces electricity sales (including energy efficiency, distributed renewables, and CHP) also reduces utility income and may make it more difficult to cover fixed costs if the fixed components of existing tariffs are not calculated to match utility fixed costs. This creates a disincentive for utilities to support such projects. New ways of setting rates (e.g., decoupling or performance-based rates) can make utility incentives consistent with those of energy efficiency developers and policy-makers. (For more information on policies that can serve as utility incentives for clean energy, including decoupling utility profits from electric sales, see Section 7.2, "Policies That Sustain Utility Financial Health.")
- *Renewable energy and CHP project developers.* Project developers establish clean technology benefits and the policy reasons for developing rates that encourage their application. They participate in rulemakings and other proceedings, where appropriate.
- *Regional transmission organizations or independent system operators.* While not directly involved in utility rate-setting, these entities manage electricity infrastructure in some regions of the country. They interact with CHP and renewable generators and may also be involved in ratemaking discussions.
- *State energy offices, energy research and development agencies, and economic development authorities.* These state offices often have an interest in encouraging energy efficiency, distributed renewables, and CHP as a strategy to deliver a diverse, stable supply of reasonably priced electricity. They may be able to provide objective data on actual costs and help balance many of the issues that must be addressed.
- *Ratepayer advocates.* Many state governments have staff dedicated to representing ratepayer interests in rate case proceedings. These staff may be located within state PUCs (as in California), in the Office of the Attorney General (as in Kentucky, Arkansas, Alabama), or elsewhere within the state government (NASUCA 2014).

Interaction with Federal Policies

PURPA section 210 regulates interactions between electric utilities and renewable/CHP generators that are considered "qualifying facilities." PURPA played a role in structuring these relationships, most notably in conceptualizing rates based on avoided cost. In noncompetitive markets, qualifying facility status may be the only option for non-utility generators to participate in closed electricity markets. In those jurisdictions with open electricity wholesale markets, generators no longer need to attain qualifying facility status to participate in wholesale markets. Historically, PURPA has not spurred large growth in renewable generation because the definition of "avoided cost" was taken to mean the cost of the cheapest marginal power source available. This was usually combined cycle natural gas, whose low cost was not enough to support renewable growth.

In October 2010, the Federal Energy Regulatory Commission (FERC) issued a ruling that changed the definition of avoided cost. Due to the fact that the original definition failed to stimulate much renewable energy growth, many states subsequently enacted RPSs. In its 2010 ruling, FERC recognized that an RPS changed the value of renewable generation because that value became dependent on more than just the cost of the cheapest marginal generation. FERC's ruling therefore authorized states to require higher payments to qualifying facilities, allowing for payments large enough to make renewables more economically feasible (NREL 2011).

More indirectly, the federal government plays a role in the evolution of electricity rate structures through the provision of analysis, funding, and research. The National Renewable Energy Laboratory (NREL) has produced numerous reports exploring the economics of various renewable energy technologies (NREL 2014). Some of these reports focus explicitly on the relationship between electricity rate structures, electricity prices, and economic feasibility of the technology in question—often solar PV.[105] NREL reports are freely available to the public, and may therefore be used by state officials and utilities during the ratemaking process.

The federal government also provides funding for projects that catalyze grid modernization, and this modernization process can profoundly affect data access and future rate structures. For example, the Smart Grid Investment Grants (SGIG) program, funded by the American Recovery and Reinvestment Act of 2009, distributed $3.4 billion in funds for grid modernization projects. Two of the eligible project categories were AMI and computer systems (DOE 2012b). Both of these technology classes enable a broader choice of rate structures by providing utilities and their customers with a more detailed, real-time picture of energy use. Lawrence Berkeley National Laboratory is also leading customer behavior research projects leveraging SGIG deployments. Similarly, the DOE's most recent loan guarantee solicitation for Renewable Energy and Efficient Energy Projects, released July 3, 2014, specifically names advanced grid integration and storage as a preferred project category (DOE 2014).

Interaction with State Policies

Designing utility rates to support energy efficiency, distributed renewable energy, and CHP can be coordinated with other state policies:

- Ratemaking issues are often closely tied to the structure of the state's electric regulatory authority. States regulate supply and delivery of vertically integrated IOUs. In restructured "retail choice" states, where the utility supply has been deregulated and is now separate from the delivery company, consumers can choose from whom they buy their energy. Utilities in restructured states often have exit fees, and they may also be sensitive to the need to facilitate clean technologies to prevent customers from looking to alternate electricity providers. Furthermore, customers in states with retail choice suppliers may have an opportunity to choose rate structures that are not subject to state regulatory approval. For example, Direct Energy in Texas offers a program called the "Meridian Plus" plan, which requires customers to lock in a fixed-rate electricity price for 24 months at a price that is currently above the variable and short-term pricing options. In exchange for the slightly higher price, customers gain price certainty in addition to devices and services that help them reduce their energy usage. Under the rate plan, Direct Energy offers smart thermostat installation and smartphone integration to improve customer heating and cooling

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[105] E.g., "Impacts of Commercial Electric Utility Rate Structure Elements on the Economics of Photovoltaic Systems," http://energy.gov/sites/prod/files/2014/11/f19/46782.pdf; "Impacts of Regional Electricity Prices and Building Type on the Economics of Commercial Photovoltaic Systems," http://www.nrel.gov/docs/fy13osti/56461.pdf.

decisions, as well as a seasonal heating, ventilating, and air conditioning maintenance checks to improve equipment performance (Direct Energy 2014).

- States have explored decoupling utility revenues from the volume of electricity sold. This issue addresses the inherent conflict when a utility has an incentive to maximize sales (the throughput incentive) instead of promoting demand-side options such as energy efficiency and onsite generation. Decoupling can be important when examining clean technology rates. States have also considered allowing utilities to recover more of their costs through monthly bill charges rather than through rate structures applied to the volume of electricity consumption. However, such approaches could lessen the incentive for energy efficiency and customer-sited clean energy. (For more information on decoupling and other mechanisms for adjusting utilities' incentives, see Section 7.2, "Policies That Sustain Financial Health.")
- If an RPS is in place, high standby rates, exit fees, and non-bypassable charges may unintentionally render clean energy projects uneconomical. (See Chapter 5, "Renewable Portfolio Standards.")
- As part of disaster preparedness planning, some states include grants or other incentives for DG installations that can support critical pieces of infrastructure during blackouts. CHP plants are typically included among the eligible technologies.[106]

Program Implementation and Evaluation

Administering Body

State PUCs are responsible for rate oversight and approval for IOUs and some cooperatively and municipally owned utilities. If not under PUC oversight, local boards oversee cooperatively and municipally owned utilities. In restructured (retail choice) states, competitive energy suppliers can set their own generation rates. However, PUCs in restructured states still have authority over the rates a regulated utility will charge for providing electricity to customers who do not receive their service from competitive suppliers. PUCs in restructured states also retain authority over other components of electricity rates, such as electricity delivery charges and collection of public benefits funds.

Evaluation and Oversight

States are attempting to ensure that rates are based on accurate cost and benefit measurements of energy efficiency, distributed renewable energy, and CHP; they are also attempting to ensure that such costs and benefits are distinct from those that are already captured in the otherwise applicable rate classification. Additionally, states are starting to explore ways to ensure that rates reflect the extent to which energy efficiency, distributed renewable energy, and CHP can benefit the rest of the electricity grid and under what conditions. These benefits include increased system capacity, potential deferral of transmission and distribution investment, reduced system losses, improved stability from reactive power, and voltage support. In restructured states, these benefits may be external to the regulated utility, but it is important that rates capture these elements to ensure optimal capital allocation by both regulated and unregulated parties.

Conducting evaluations of a state rate offering may require funding and other resources be made available at the utilities and state PUCs. Such resources will also allow for the monitoring of rate impacts on energy efficiency, distributed renewable energy, and CHP and across customers. Significant, unanticipated, or adverse impacts may be identified, which could then be addressed through modifications such as adjusting the rate

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106 For example, see Connecticut's Microgrid Grant and Loan Pilot Program at http://www.ct.gov/deep/cwp/view.asp?a=4120&Q=508780.

design or altering the rate qualification criteria. For example, several states have now initiated proceedings to move beyond net metering and develop new rate structures for energy efficiency, distributed renewable energy, and CHP that are more closely tied to DG's estimated value (CPUC 2014).

State Examples

Inclining Block Rates

California

Each of the California IOUs uses inclining block rates for their default residential customers. For example, PG&E has an inclining block rate with four tiers based on cumulative energy use in a given month. As customers use less energy due to installation of clean energy technologies, they see bill savings at their marginal tier energy rate. For example, in 2014, the Tier 4 residential rate is about 17 cents per kWh higher than the Tier 1 energy rate. This structure gives larger energy users larger incentives to adopt clean energy technologies than smaller users because the large users will have higher marginal tier energy rates.

Residential customers under net energy metering rates are also indirectly subject to the inclining block rates because the inclining block rates are the foundational "otherwise applicable schedule" upon which the residential net energy metering rates are based. An inclining block rate provides strong incentives for DG systems because these systems cancel out the most expensive kWh first.

New York

Consolidated Edison's (Con Edison's) default residential rate is a blend of flat and inclining block rates. The energy rate is flat for October through May. In the summer months, the rate switches to an inclining block rate with Tier 2 being about 1.3 cents per kWh higher than Tier 1. Tier 2 applies to all kWh in the summer months in excess of 250 kWh. As with PG&E, Con Edison's inclining block rate also provides the foundation for its net energy metering rate.

Time-Varying Rates

California

PG&E uses TOU energy rates for its business customers. The general TOU rate uses five TOU periods (two in the winter and three in the summer). While TOU rates have long been common for large commercial and industrial customers, the California Public Utilities Commission (CPUC) mandated the transition for all business customers to TOU rates. Small and medium business customers began transitioning in November 2012 (PG&E 2014e).

Inclining block is the default rate for residential customers, with inclining block TOU rates as a voluntary option. The inclining block TOU rate is the mandatory rate for all net energy metering customers starting service on or after January 1, 2007. The inclining block TOU rate has peak and off-peak rates and four tiers. The higher the tier usage, the higher the energy rate, and usage in the peak period receives a higher energy rate. Peak and off-peak usage is assigned to tiers on a pro-rata basis. For example, if 20 percent of a customer's usage is in the peak period, then 20 percent of the total usage in each tier will be treated as peak usage and 80 percent of the total usage will be treated as off-peak usage (PG&E 2014b).

New York

Con Edison offers TOU rates as voluntary rate options. The voluntary TOU option is promoted for electric vehicle customers (see description under *Electric Vehicle Rates* below) but is also available to non-electric vehicle customers, albeit without the bill guarantee that is available to registered electric vehicle users. Con Edison customers can also choose to obtain supply from alternate providers that can offer different pricing options.

Standby Rates

California

California Senate Bill 1-28 (passed in April 2001) required utilities to provide DG customers with an exemption from standby reservation charges. The exemptions applied for the following time periods:

- Through June 2011 for customers installing CHP-related generation between May 2001 and June 2004.
- Through June 2006 for customers installing non-CHP applications between May 2001 and September 2002.
- Through June 2011 for "ultra-clean" and low-emission DG customers, 5 MW and less, installed between January 2003 and December 2005.

After Bill 1-28 expired, standby rates were left to be incorporated into utilities' general rate cases. However, CPUC still requires that utilities exempt DG systems from fixed standby charges as long as the DG systems provide physical assurance (EPA 2014).

New York

Under General Rule 20.3.1, Con Edison exempts customers from standby rates if 1) their onsite generation nameplate capacity is less than 15 percent of their maximum demand, 2) they take service on energy-only residential or small commercial rates, or 3) they have a contract demand less than 50 kW. In addition, General Rule 20.3.2 allows customers to opt out of the standby rate if they install a designated technology between July 29, 2003, and May 31, 2015. A customer with a designated technology must meet the following criteria (Con Edison 2012):

- Has an on-site generation facility that: 1) exclusively uses one or more of the following technologies and/or fuels: fuel cells, wind, solar thermal, PVs, sustainably managed biomass, tidal, geothermal, or methane waste, or 2) uses small, efficient types of CHP generation that do not exceed 1 MW of capacity in aggregate and meets eligibility criteria that were approved in the order of the New York State Public Service Commission, dated January 23, 2004, in Case 02-E-0781; and
- Has a contract demand of 50 kW or greater and has onsite generation equipment having a total nameplate rating equal to more than 15 percent of the maximum potential demand from all sources.

Exit Fees

California

There are several types of exit and transition fees in the California market, and they are handled differently depending on the specific utility. Fee exemptions exist for the following classes of renewable and CHP systems:

- Systems smaller than 1 MW that are net metered or are eligible for CPUC or California Energy Commission incentives for being clean and super-clean (PG&E 2014a).

- Ultra-clean and low-emission systems that are 1 MW or greater and comply with the California Air Resources Board's 2007 air emission standards (PG&E 2014a).
- Zero emitting, highly efficient (> 42.5 percent) systems built after May 1, 2001.

Illinois

Illinois ended exit fees for stranded costs on December 31, 2006. Prior to that end date the rule was fairly stringent and specific about the instances that triggered such a fee. The rule did, however, provide an exemption for DG and CHP. A departing customer's DG source had to be sized to meet its thermal and electrical needs with all production used on site (Illinois 2014).

Net Energy Metering

Georgia

In 2001, the state government of Georgia passed the Georgia Cogeneration and Distributed Generation Act, which requires all utilities to offer net metering to their customers. The Act contains the following provisions:

- Only solar PV, wind, and fuel cell systems are eligible.
- System size must not exceed 10 kW for residential systems or 100 kW for non-residential systems.
- The aggregate capacity of all the net metered systems in a utility's service territory must not exceed 0.2 percent of the utility's peak load from the previous year.
- If a customer's net metered system produces surplus electricity in any given month, the surplus is credited to the customer's bill for the following month. Surplus generation is credited at a value set by the Georgia Public Service Commission, as opposed to the full retail rate used by many states (DSIRE 2014a).

Connecticut

Connecticut provides net metering for a wide variety of technologies, including solar PV, solar thermal, wind, fuel cells, municipal solid waste, landfill gas, hydroelectric, wave and tidal energy, ocean thermal, and CHP. Connecticut's program has the following provisions:

- Systems must not exceed 2 MW in size, but there is no cap on the aggregate capacity of net metered systems.
- Excess generation is rolled over each month as kWh credits at full retail value.
- At the end of each year, customers are paid the wholesale value of any accumulated kWh credits.
- Net metered facilities are eligible to earn renewable energy certificates, which the system owner can sell to utilities to help the utilities meet their RPS commitments.

Connecticut also offers virtual net metering for certain types of facilities. Virtual net metering allows additional customers besides the owner to receive credits for the electricity generated by a net metered system. This can be extremely helpful for large institutions that have multiple meters (e.g., a large farm or state government complex), because the output from a net metered system can be shared among all the institution's electricity accounts while being wired to only one meter. This also allows multiple farms or government institutions to share both the costs and the benefits of a DG system. DG systems that will be using virtual net metering may be up to 3 MW in size (DSIRE 2013).

New York

The state of New York offers net metering for distributed solar PV, wind, biomass, small hydroelectric, fuel cells, CHP, anaerobic digestion, and microturbine systems. New York's program has the following provisions:

- Maximum eligible system size varies by technology and sector, ranging from 10 kW for residential CHP systems to 2 MW for non-residential solar, wind, and small hydroelectric systems.
- Net excess generation is rolled over to the next month's bill at retail rate, with the exception of CHP and fuel-cell systems. For these two types of systems, excess generation is rolled over only at the avoided-cost rate.
- Long-term treatment of accumulated credits again varies, but depending on technology and customer sector, the credits are either rolled over from month to month indefinitely or paid to the customer at the avoided-cost rate at the end of each year.
- Aggregate capacity of net metered systems cannot exceed 3 percent of the demand for electricity generated from solar, fuel cells, micro-hydro, and agricultural biomass in a designated benchmark year (2005) (DSIRE 2014b).

California

California's net metering program dates back to 1996, and in the original form it was only available to wind and solar systems. The program has since been updated extensively, now covering landfill methane, biomass, geothermal, fuel cells, small hydroelectric, wave and tidal power, ocean thermal power, anaerobic digestion, and biogas. California's program has the following provisions:

- Systems may be up to 1 MW in size, with exceptions for up to 5 MW systems granted to municipal governments.
- Net excess generation rolls over monthly at the retail rate, and customers can choose whether to roll it over indefinitely or sell the accumulated credits at the 12-month average spot market price (hours of 7:00 a.m. to 5:00 p.m. only) at the end of each year.
- The aggregate capacity of net metered systems was originally set at 5 percent of peak demand, but differences in utility methodology for calculating peak demand led the state legislature to set absolute caps on the number of MW of net metered capacity for each of California's three largest electric IOUs. The caps are 607 MW for San Diego Gas and Electric, 2,240 MW for Southern California Edison, and 2,409 MW for PG&E. The net metering program expires when each utility reaches its cap or on July 1, 2017, whichever comes first.
- California is one of a few states that are actively developing alternatives to net metering in an attempt to avoid the cost shifts that net metering produces as the aggregate capacity of net metered systems increases. The CPUC is currently conducting a formal proceeding to gather stakeholder input on potential programs and rate structures that can replace net metering when the program expires.

Feed-in Tariff

Hawaii

In 2010, Hawaii instituted a FIT for a variety of renewable energy technologies. Owners of eligible DG installations can sign 20-year contracts with one of the three IOUs in Hawaii, wherein the utility agrees to purchase the output of the DG system at a fixed per kWh price. Eligible technologies include solar PV, concentrating solar thermal, in-line hydroelectric, on-shore wind, and all other renewable technologies that qualify for Hawaii's RPS. The FIT price varies with the technology type and the system size. Concentrating solar plants command the highest FIT rates, followed by small (≤20 kW) solar PV and in-line hydroelectric systems (DSIRE 2014c).

Electric Vehicle Rates

Georgia

Rate schedules specifically for electric vehicles vary by utility rather than state. The plug-in electric vehicle tariff offered by Georgia Power is a good example of a residential electric vehicle rate. Each day is divided into three periods: on-peak, off-peak, and super off-peak. On-peak hours are from 2:00 p.m. to 7:00 p.m. on summer weekdays, June through September. These hours have the highest rates because this is when utilities have to deal with peak demand and thus wish to discourage the charging of electric vehicles. By contrast, the super off-peak hours of 11:00 p.m. to 7:00 a.m. have the lowest rates, because this is when aggregate demand is minimized and charging electric vehicles puts a minimal amount of stress on the grid. Regular off-peak hours fill the gap between on-peak and super off-peak hours, and their price correspondingly falls between the two (Georgia Power 2014). For customers who choose the plug-in electric vehicle rate, the charging load from their electric vehicle is aggregated with the rest of their household load in their total hourly meter reading. Though choosing this rate will save them money on the electric vehicle portion of their electricity load (assuming they charge during super off-peak hours), these customers may see their total bill increase from what it was under a flat rate if their household has high electricity demand for other uses during peak hours.

California

PG&E offers electric vehicle rates that incentivize charging between 11:00 p.m. and 7:00 a.m. (off-peak). Prices are lowest during these hours, and highest from 2:00 p.m. to 9:00 p.m. (peak). All other hours, designated "partial-peak" hours, have a price that falls between peak and off-peak prices. The partial-peak category applies only on weekdays; on weekends the partial-peak hours are absorbed into the off-peak category and use the off-peak rate (PG&E 2014c).

The most unique feature of PG&E's electric vehicle rate program is that it gives electric vehicle owners the option to meter their charging station separately from the rest of their home. This means that the vehicle charger and the rest of the home can be on different rate schedules, which is advantageous for electric vehicle owners who use large quantities of electricity elsewhere in their homes during peak hours. If they meter their charger separately and put only the charger on the electric vehicle rate, such vehicle owners can still subscribe to a flat rate schedule for the rest of their homes and avoid the high peak-hour charges they would receive if the whole house were on the electric vehicle schedule.

New York

Con Edison offers an off-peak rate of only 1.34 cents per kWh for usage between midnight and 8:00 a.m. under the voluntary TOU rate (Con Edison 2014). Unlike the PG&E rate, Con Edison's customer places their entire home on the TOU rate. Because the peak rate under TOU is higher than the standard rate, this introduces some risk that customers could pay more under the TOU rate than under the standard rate. To address this uncertainty, the voluntary TOU rate offers a price guarantee for customers who register a plug-in electric vehicle with Con Edison. Under the price guarantee, during the first year after registering their vehicle, plug-in electric vehicle customers are assured that they will not pay more over the course of the year than they would have paid under the standard rate.

What States Can Do

Action Steps for States

States have chosen a wide variety of approaches and goals in developing their rates. Suggested action steps are described below for two groups of states: those that have already begun to address utility rates to incentivize energy efficiency, distributed renewable energy, and CHP, and those that have not.

States That Have Addressed Rates and Data Access

States that have established rate design and data access policies have found that it is important to identify and mitigate issues that might adversely affect the success of the rates. States can:

- Monitor utility implementation of rates. By doing so, a state may want to confirm that the rates are being properly communicated to customers and that the rates are not serving as unintentional barriers to energy efficiency, distributed renewable energy, and CHP adoption.
- Explore policies to give customers the data format and tools they may need to manage their energy bills.
- Monitor the impact of the rates on energy efficiency, distributed renewable energy, and CHP, as well as across customers. States have addressed significant, unanticipated, or adverse impacts through modifications such as adjusting the rate design or altering the rate qualification criteria. In considering the impact of clean energy technologies, a state may find it useful to consider the wide breadth of benefits of such technologies, and not focus solely on near-term economic impacts.
- Periodically review the evolving technologies to gauge whether rate or data access modification might be warranted. For example, in California, inclining block residential rates have long been lauded for promoting the adoption of energy efficiency. However, the recent surge in PV installations that produce more electricity than the homeowner can use at certain times of the year is raising questions about whether the inclining block rates are providing the correct incentives for PV installations under the net energy metering program.

States That Have Not Addressed Rates and Data Access

Experience from those states that have implemented rates to promote energy efficiency, distributed renewable energy, and CHP indicates that political support from PUC officials and staff is a key first step for establishing effective rates. Once support for these rates has been established, states have found that the next step is to facilitate discussion and negotiation among key stakeholders toward appropriate rate design. More specifically, states can:

- Ascertain the level of general interest and support for energy efficiency, CHP, and/or distributed renewable energy among public office holders and the public. If awareness is low, consider implementing an educational program about the environmental and economic benefits of accelerating development in order to gain policy and public support.
- Identify existing or pending policies that might be significant drivers for new energy efficiency, distributed renewable energy, and CHP. Rate revisions or new rate designs can then be presented and negotiated in the context of being consistent with and enabling these existing policy goals.
- Establish a working group of interested stakeholders to consider design issues and develop recommendations for favorable rates.
- Open a generic PUC docket to explore actual costs and system benefits of energy efficiency, distributed renewable energy, and CHP in order to inform rate reasonableness.

Information Resources

Federal Resources

Title/Description	URL Address
The U.S. Environmental Protection Agency's (EPA's) CHP Partnership. A voluntary program that seeks to reduce the environmental impact of energy generation by promoting the use of CHP. The Partnership helps states with resources for policy development (energy, environmental, economic) to encourage energy efficiency through CHP and can provide additional assistance to states in assessing and implementing reasonable rates.	http://www.epa.gov/chp/
State and Local Energy Efficiency Action Network (SEE Action) Customer Information and Behavior Working Group. This Working Group has issued a report which discusses key state and local issues relating to customer access to energy usage data.	https://www4.eere.energy.gov/seeaction/working-group/customer-information-and-behavior
Guide to the Successful Implementation of State Combined Heat and Power Policies. The SEE Action Industrial Energy Efficiency and CHP Working Group has issued a report that informs state utility regulators and other state policy-makers with actionable information to assist them in implementing key state policies that impact CHP.	https://www4.eere.energy.gov/seeaction/publication/guide-successful-implementation-state-combined-heat-and-power-policies
DOE's CHP Technical Assistance Partnerships (CHP TAPs). CHP TAPs promote and assist in transforming the market for CHP, waste heat to power, and district energy technologies/concepts throughout the United States.	http://www.energy.gov/eere/amo/chp-technical-assistance-partnerships-chp-taps
Consumer Behavior Studies. DOE is working with several SGIG award recipients who are conducting special studies to examine acceptance, retention, and response of consumers involved in time-based rate programs that include AMI and customer systems such as in-home displays and programmable communicating thermostats.	https://www.smartgrid.gov/recovery_act/consumer_behavior_studies
The National Action Plan for Energy Efficiency. A federally facilitated, private-public initiative that produced a number of resources on energy efficiency. In particular, the Customer Incentives for Energy Efficiency Through Electric and Natural Gas Rate Design briefing provides a foundation on the relationship between rates and energy efficiency.	www.epa.gov/eeactionplan http://www.epa.gov/cleanenergy/documents/suca/rate_design.pdf

Resources on Ratemaking

Title/Description	URL Address
The Regulatory Assistance Project (RAP). RAP has published several reports and presentations on utility rate design issues—for example, "Designing Distributed Generation Tariffs Well: Ensuring Fair Compensation in a Time of Transition." The RAP Library allows users to search by Rate Design within the Energy Efficiency/ Resource Planning Topic search.	http://www.raponline.org http://www.raponline.org/press-release/designing-distributed-generation-tariffs-well-ensuring-fair-compensation-in-a-time-of
Rate Design for the Distribution Edge. This report from the Rocky Mountain Institute's Electricity Innovation Lab discusses retail electricity pricing issues as use of distributed energy resources increases.	http://www.rmi.org/PDF_rate_design
Standby Rates for Customer-Sited Resources: Issues, Considerations, and the Elements of Model Tariffs. This EPA report provides background	http://www.epa.gov/chp/documents/standby_rates.pdf

Title/Description	URL Address
information on rate design and the economics of DG, then delves specifically into the topic of standby rates.	
California Net Energy Metering Ratepayer Impacts Evaluation. This study commissioned by the CPUC evaluates the net monetary impact that net metering has on DG owners, non-owner ratepayers, and society as a whole.	http://www.cpuc.ca.gov/NR/rdonlyres/C311FE8F-C262-45EE-9CD1-020556C41457/0/NEMReportWithAppendices.pdf

Other Resources

Title/Description	URL Address
Database of State Incentives for Renewables and Efficiency (DSIRE). Online database of information on incentives and policies that support renewables and energy efficiency in the United States. DSIRE is operated by the N.C. Solar Center at N.C. State University, with support from the Interstate Renewable Energy Council, Inc. DSIRE is funded by DOE.	http://www.dsireusa.org
Regulatory Requirements Database for Small Generators. Online database of regulatory information for small generators. Includes information on standby rates and exit fees, as well as environmental permitting and other regulatory information.	http://www.eea-inc.com/rrdb/DGRegProject/index.html
The Combined Heat and Power Association (CHPA). CHPA brings together diverse market interests to promote the growth of clean, efficient CHP in the United States.	http://chpassociation.org
Electricity Transmission: A Primer. This RAP publication was prepared for the National Council on Electric Policy in connection with the Transmission Siting Project. The primer is intended to help policy-makers understand the physics, economics, and policies that influence and govern the electric transmission system.	http://energy.gov/oe/downloads/electricity-transmission-primer

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7.5 Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration

Policy Description and Objective

Summary

State have found that the U.S. electric grid has significant potential to deliver energy efficiency and support renewable energy integration if technology and infrastructure investments are made and managed with these goals in mind. As electricity is transmitted across long distances and then distributed by underground or overhead wires to our homes and businesses, it undergoes a number of conversions and during each conversion some energy is lost as heat.[107] The U.S. Energy Information Administration estimates that on average 7.5 percent[108] of the electricity produced to serve customers is lost in transmission and distribution, with losses ranging from 5 to 13 percent depending on location (Wagner et al. 1991, as cited in DOE 2012).[109] Modern grid investments can provide grid operators with tools to better visualize and control conditions across the electric system, enabling them to reduce system losses, better accommodate intermittent renewable resources, and help customers use less energy.

State-regulated transmission and distribution investments have traditionally been made with a goal of providing economic, reliable service that alleviates congestion, allows recovery from outages, and expands to meet new or growing loads. While these remain primary goals, states also are working to encourage investments that are planned and managed to increase system energy efficiency, anticipate growth in renewable resources, and deal with related issues of balancing utility revenue requirements with customer rates. This section focuses on what states and public utility commissions (PUCs) are doing—primarily at the distribution level (i.e., actions that do not involve interstate transmission planning)—to realize clean energy benefits from the electric grid.

Objective

Enabled by new and emerging technologies coupled with aging transmission and distribution systems, states are finding that if intentionally designed and managed, modern grid investments will not only provide necessary grid services but also deliver energy efficiency benefits and better accommodate renewable resources. Since many of these investments will last for 15 to 50 years, ensuring that modern grid investments are planned and managed with these objectives in mind is an important policy and planning goal.[110] While not captured neatly by any single mechanism, these objectives are nonetheless being advanced through interrelated policies and state and PUC decisions throughout the nation. This section provides state policymakers and interested stakeholders with background on emerging opportunities and steps that can be taken to lay groundwork for future grid investments to support greater energy efficiency and renewable energy penetration.

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[107] Weather and other physical factors also contribute to line losses.

[108] Line losses estimate is based on the historical difference between total net generation (minus direct use) and retail sales of electricity, as cited in the Clean Power Plan (EPA 2013) and derived from EIA (2012).

[109] Nearly all of these losses are physical in nature (as opposed to theft, for example).

[110] See, for example, BPA (2010).

Benefits

Maximizing modern grid investments to increase transmission and distribution system efficiency and support renewable generation integration has the potential to deliver significant environmental benefits:

- Pacific Northwest National Laboratory estimates that a comprehensive nationwide effort to better manage distribution system voltage could reduce annual energy consumption by 3.2 percent and reduce related carbon dioxide emissions by more than 63 million tons (PNNL 2012).[111]
- Grid investments could also enable greater integration of renewable energy resources and deploy complementary resources such as storage or demand response during periods when renewable resources wane (e.g., when solar production is interrupted due to cloud cover).
- Strategically located renewable resources, energy efficiency investments, and demand response capabilities can be targeted to alleviate grid congestion and defer capital investments. The flexibility of these resources can reduce the need to dispatch economically inefficient generation resources. Conventional generation resources also often need advanced notice to come online and need to run longer once started, even if periods of peak electricity demand are short. Storage and demand response do not usually need the same advance notice.

In addition, the ability to deliver energy efficiency and improve the integration of distributed renewables provides additional benefits for making the business case for modernizing electricity distribution systems.

Technical Background on Key Opportunities

Modern grid investments can enable better visibility into grid conditions throughout the distribution system, can allow two-way communication between the utility and customers (or their devices), and can enable automation to respond to grid conditions in real time. However, no single technology or combination of technologies delivers modern grid benefits. The way technologies and grid assets are managed is critical to achieving the promise of a modern grid. This section provides a technical overview of some of the energy efficiency and renewable energy benefits that states can realize if modern grid investments are planned for and managed with these resources in mind.[112]

Energy Efficiency Opportunities

Voltages in the transmission and distribution system can be adjusted to reduce system losses and/or to reduce customer load level to manage peak demand or to achieve broader energy efficiency benefits. Customer meter data also can be used strategically by grid operators, energy efficiency program managers, and customers to reduce consumption. These interrelated opportunities are discussed below:

- *Improved voltage management.* Throughout the United States, electricity is required to be delivered to most customers within a narrow range of voltages. For example, residential customer voltage is typically between 114 and 126 volts (for normal 120-volt service).[113] Delivering electricity closer to the lower end of

[111] Technical potential based on feeder modeling of representative high-value circuits; does not address time horizon for achievability.

[112] A fully integrated modern grid is likely to enable greater potential for cost-effective energy efficiency and renewable energy opportunities from smart grid and advanced microgrid technologies. The *Guide to Action* focuses on some of the better-established, nearer=term opportunities that states can realize if grid investments are planned for and managed with energy efficiency and renewable energy goals in mind.

[113] ANSI C84.1, "Electric Power Systems and Equipment—Voltage Ratings (60 Hertz)," specifies the nominal voltage ratings and operating tolerances for 60-hertz electric power systems above 100 volts.

this voltage range can save customers energy, because some equipment operates more efficiently at lower voltage (e.g., closer to 120 volts). For example, voltage reduction of incandescent lighting will generally reduce waste heat and therefore save energy. Not all customer devices will save energy by reducing voltage. For many water heaters, operating at the lower end the voltage range reduces immediate demand, but ends up using the same amount of energy to reach a target water temperature setting. Other loads, like today's fluorescent lamp ballasts, are likely to draw about the same amount of power regardless of voltage.[114]

Since the equipment used within homes, buildings, and industry varies, the potential for energy efficiency benefits also varies. In addition, some distribution circuits already operate in the lower band of voltage (i.e., 114–117 volts), further adding to the geographic variability of energy efficiency potential. Operating the transmission and distribution system at lower voltages to achieve energy efficiency benefits has historically been referred to as conservation voltage reduction (CVR). While CVR is a fairly mature approach and can be deployed without advanced technology, modern grid technologies enable a better understanding of the exact voltage at different points in the transmission and distribution system. Rapid communication with controls, as well as the ability to automatically respond to grid conditions, offers the potential for greater energy savings. The improved information also increases operational confidence among grid managers and regulators. While performance can vary by circuit, many utilities find 1 to 4 percent savings on initial deployment (PNNL 2010).

- *Improved reactive power management.* In alternating current (AC) systems—almost universally used in the United States to deliver electricity—current and voltage can get out of phase from equipment like motors and other devices that require magnetic fields to operate.[115] (This is referred to as reactive power and is measured in vars).[116] Since motors are ubiquitous in equipment found in factories, businesses, and homes, transmission and distribution system operators need to provide reactive power to maintain electric power flow. Some of the same technologies and strategies used to adjust system voltage can be used to better manage reactive power. Like voltage management, reactive power can be managed without modern grid technologies; however, modern grid technologies allow utilities to better monitor voltage and reactive power in real time along the entire delivery path from generator through transmission and distribution to the ultimate customers. Better communications and control equipment allows operators to adjust settings to control both factors all along the delivery path. This is a big improvement over adjusting settings manually and at infrequent intervals. Better reactive power management can reduce the fuel needed to operate the grid and can improve power quality.
- *Volt/var optimization.* When utilities manage and optimize both voltage and reactive power simultaneously, it is referred to as volt/var optimization. Since the flow of reactive power affects power system voltages, management of costs and operational performance of a power system may improve if voltage control and reactive power are well integrated (NEMA n.d.).
- *More efficient distribution transformers.* Distribution transformers are devices that are used to transfer current from one circuit to another and change the value of the original voltage or current as needed. A significant amount of all electricity network losses are due to distribution transformers. The use of more efficient medium voltage, liquid-immersed distribution transformers has the potential to yield large energy and monetary savings when projected over the products' lifetime. Despite substantial improvements made

[114] More information on power consumption responses to voltage is available in PNNL (2010) or Bokhari et al. (2014).

[115] Most devices that need magnetic fields will cause current and voltage to be out of phase. Besides motors, this will include some of the equipment used in transmission and distribution systems, such as transformers.

[116] Vars or var is the measure or reactive power in electric transmission and distribution systems. The term is derived from "volt-ampere reactive."

to distribution transformer efficiencies over recent years and new Federal efficiency standards set to take effect in 2016, EPA estimates that additional savings of up to 4 to 5 terawatt-hours per year can be achieved through identification and further deployment of the most efficient transformers available on the market today (EPA 2014).[117]

- *Strategic use of customer data/big data.* To customers, changes in utility meters may be the most noticeable new technology investment. These new meters, which are also referred to as smart meters or advanced metering infrastructure (AMI) meters, have sometimes caused controversy related to privacy concerns and billing accuracy among customers. Nonetheless, they have several operational advantages over conventional meters: they enable utilities to read meters without having to go to customer addresses, can facilitate same-day stop/start service when tenants move, and can help in detecting outages during storms to speed service restoration. AMI meters, along with sensors along distribution circuits, are giving utilities access to an unprecedented amount of data about their system and the customers they serve. For example, AMI meters can deliver consumption data at various intervals (e.g., hourly, 15-minute or 5-minute interval consumption data). Utilities are beginning to explore how to capture, store, analyze, and take advantage of "big data" to inform the following applications:
  - *Customer-level voltage and reactive power monitoring.* Modern AMI meters can be programmed to record voltages and reactive power flow periodically or on demand. This information can provide assurance that voltage and reactive power optimization efforts are performing as planned. For example, voltage readings can confirm that customers are receiving power at the intended voltage.
  - *Customer data services.* Utilities offer their customers energy usage information in varying levels of detail and through a variety of channels, such as customer bills, the Web, and automated data transfer services. The large-scale information technology projects that are often part of AMI and other grid modernization investments present an opportunity for utilities to incorporate the development of improved data access for customers (SEE Action 2013).
  - *Behavior-based energy efficiency programs.* Utilities are combining insights from behavioral science with energy use information to inform new energy efficiency program offerings. These behavior-based programs use economic and non-economic incentives, education, and feedback to change how people use energy. Utilities may combine multiple behavioral insights within an energy efficiency program offering such as peer comparisons, competitions, goal setting, and rewards (CEE 2014).
  - *Facilitating change in energy use in response to price signals.* Though not yet common in all deployments, some AMI meters can facilitate a two-way flow of information between the utility and the customer. When coupled with time-varying rates (see Section 7.4) that better reflect the price of electricity (which varies throughout the day), this information can encourage customers to shift consumption to lower-cost periods and support efforts to reduce peak demand (SEE Action 2014).
  - *Energy efficiency program planning, implementation, and evaluation.* AMI data can be analyzed for usage patterns to inform energy efficiency opportunities (for example, fluctuating usage may indicate that equipment is cycling on and off often, indicating that an appliance is improperly sized or ready for replacement). These data can inform program planning and targeting efforts. Some programs have begun pilot efforts to analyze data to provide virtual energy audits for interested customers.[118] Research is also underway to better understand how the more detailed energy usage data from AMI

[117] Given the aggregate energy losses of millions of medium voltage distribution transformers, EPA recently launched a stakeholder process to develop criteria for ENERGY STAR designation.

[118] Pacific Gas and Electric in California and Con Edison in New York are two such examples.

can be used to inform evaluation, measurement, and verification of energy efficiency programs (PEEC n.d.).

Renewable Energy Integration Opportunities

Generally, transmission and distribution system losses increase as the distance between generation and customer load increases. When renewable energy is located in the distribution system close to customers, it can reduce losses.[119] To take full advantage of increasing renewable resources in the distribution system, state PUCs are working with utilities to better understand how distributed renewables can be managed and integrated into the system. Improved voltage and reactive power management, together with the aid of modern inverters and complementary deployment of demand response and storage assets, show promise for helping maximize the clean energy contribution of renewable resources.

- *Improved voltage and reactive power management with modern inverters.* Utilities and state PUCs are increasingly looking to strategies like improved voltage monitoring and management in anticipation of more distributed renewables coming online. The greatest effects will likely be felt in distribution feeders—the final stage in the delivery of electric power to individual consumers. Traditionally, these feeders were designed for one-way power flow—from substation to customer. Similar to the branches of a tree, feeders have their heaviest loading near the substation with decreased loading as the various branches reach their ends. Generally, the voltage on distribution feeders also falls at points farther from the substation. Utilities have traditionally managed these voltage drops using conventional technology. Adding distributed generation on longer circuits can boost voltage to help reach end-of-line customers, but the distribution system must still stay within acceptable voltage levels.

  Combined with other modern grid technologies, advanced inverter systems used with solar and wind generation have the potential to further benefit the system by improving control of feeder voltages. In general, it is advantageous to locate solar generation near substations because electricity generally flows from generation to load. However, voltage also tends to be higher closer to substations, and under some grid conditions, conventional inverters disconnect solar resources to avoid overvoltage to the system. Advanced inverter systems have the potential to tailor the output of solar and wind resources to meet system needs and provide grid services such as voltage or reactive power support and can respond very quickly when needed. Many of the inverters being installed in the United States today have smart capabilities that are not yet in use. Government and industry are working to develop standards for how advanced inverters will work in the U.S. market (Solar Oregon 2014).

- *Complementary deployment of demand response and storage.* Since demand is variable and not completely predictable or controllable, grid system operators typically rely on conventional fossil-fuel-fired peaking power plants to balance generation and demand. This balancing happens on time scales from seconds to hours. Since some renewable generation is intermittent, as the amount of renewable generation is increased, balancing becomes more challenging. Adding flexible loads through demand response and storage has the potential to help system operators balance supply and demand without the need to start up economically inefficient power plants for short periods solely to provide additional balancing capability.

[119] This advantage applies to all distributed generation, not just renewable energy generation.

Traditional demand response programs, which are offered by many utilities nationwide, provide financial incentives in return for customers reducing consumption during certain conditions, e.g., periods of peak load. Historically, most utilities call on these customers to respond to peak events for a limited number of hours per year. Automation of demand response offers great promise for customer participation, not only in peak load reduction events but also in serving as a flexible resource to provide other grid services for shorter periods of time. Utilities have begun conducting pilot programs to automate demand response by communicating with the building energy management systems of participating commercial customers. The emergence of ENERGY STAR products with connected functionality (see text box), combined with automation, may increase the willingness and ability of residential customers to participate in demand response initiatives.

ENERGY STAR® Products with Connected Functionality

To help advance the market for products with connected functionality that can offer immediate consumer convenience and control as well as energy and demand savings, EPA has developed connected criteria for several appliance categories as well as pool pumps. ENERGY STAR products with connected functionality offer:

- Convenience: communicate with other devices and services, provide alerts and maintenance information.
- Personalized insights: provide energy usage feedback.
- Energy and cost savings: provide a means of optimizing energy use to enable savings.
- Control: remotely control energy settings either through a consumer or utility device.

By recognizing ENERGY STAR-certified products with connected functionality, EPA hopes to encourage manufacturers to design products that offer consumer convenience and control and ultimately help customers manage their energy usage directly or enable their participation in utility demand response programs.

In addition, storage is being used to support renewable energy integration. For example, storage can be used to store excess renewable energy for later use; it can be installed close to where energy will be consumed, potentially alleviating congestion on transmission and distribution systems during peak periods; and certain storage technologies with rapid response capabilities can be used to help manage fluctuations on the electricity grid caused by the intermittency of some renewable energy resources. Due to their flexibility and ability for rapid response, automated demand response and storage are being explored by system operators for better integrating distributed renewable energy resources.

States with Policies to Encourage Energy Efficiency and Renewables Integration in Grid Investments

As noted in previous sections, efforts to ensure that modern grid investments include energy efficiency and support the growth in renewable resources are not captured neatly by any single policy mechanism. Therefore comprehensive data on the extent of these efforts are not widely available. Nonetheless, there have been a few notable efforts in California, Massachusetts, and Hawaii to convene multiple stakeholders to address diverse perspectives including environmental considerations in planning grid modernization efforts (see *State/Regional Examples* for additional information).

A growing number of states have gained experience with modern grid deployments in part due to the American Recovery and Reinvestment Act of 2009, Smart Grid Investment Grants. Overseen by the U.S. Department of Energy (DOE), Smart Grid Investment Grant matching funds totaling $3.4 billion were awarded to nearly 100 recipients to accelerate the modernization of the nation's electricity infrastructure. As a result, a growing number of states, PUCs, and utilities have gained operational experience with enabling technologies and related enhanced operations. In addition, since award recipients were required to co-fund projects, many states and utilities have gained experience with funding grid modernization efforts (See Table 7.5.1). States are also gaining knowledge and operational experience by supporting microgrid projects at state universities or critical facilities. (See text box, "Campus Microgrids Serve as Laboratories of Learning.")

Table 7.5.1: States with Policies to Advance Energy Efficiency and Renewable Integration in Grid Investments

Policy	Description	States
Stakeholder process for grid modernization	Has convened or initiated a stakeholder process to determine how to plan for and implement modern grid investments.	CA, HI, IL, MA, NY, VT
Pilot for voltage management to improve energy efficiency	At least one utility in the state has implemented pilot effort testing the ability of modern grid investments to better manage voltage with the explicit goal of achieving energy efficiency benefits.	AZ, CA, CO, IL, NV, OH, RI, WA
Credit for voltage management for energy efficiency as a resource	Has policies or plans to enable utilities to count energy efficiency from improved voltage management toward energy efficiency goals or resource standards	Pacific NW (ID, parts of MT, OR, UT, WA, WY), AZ, IN, MD, NC, PA
Decision about cost recovery for grid investments that deliver end-use energy efficiency benefits	Has made an initial decision on cost-recovery for grid-side investments that deliver end-use energy efficiency benefits. This does not include compensating for lost revenue associated with reduced sales. Maryland however does have revenue decoupling (see Section 7.2 for more on this topic).	Recovery through rates: MD Recovery through other mechanism: IN, Pacific NW (WA, OR, ID, parts of MT, WY, UT)
Policy on customer access to energy usage data	Has policies supporting customer access to their own energy usage data.	CA, CO, IL, OK, PA, TX, WA

A few states are planning for and crediting grid-side efficiency in their energy efficiency goals. The Northwest Power and Conservation Council—which coordinates supply planning for the Columbia River basin and serves Washington, Oregon, Idaho, and parts of Montana, Wyoming, and Utah—targets distribution energy efficiency in its most recent power plan. Arizona, Maryland, North Carolina, and Pennsylvania have also approved voltage management for energy efficiency and will allow it to count toward their energy efficiency goals.

Big data is also presenting opportunities for utilities to enable greater energy efficiency. As utilities explore how to capture, store, analyze and take advantage of big data, state regulators are grappling with issues of data access and privacy. Several states including California, Colorado, Illinois, Oklahoma, Pennsylvania, Texas, and Washington have policies giving customers access to their own data, though application of this principle to support greater energy efficiency varies (SEE Action 2012). In addition, utilities and third parties can voluntarily adopt DOE's Voluntary Code of Conduct, which includes concepts and principles regarding customer data privacy.[120]

States also are encouraging utilities to increase customer access to energy usage data through mechanisms such as Green Button and Web services to exchange data with Portfolio Manager, EPA's ENERGY STAR building benchmarking tool. Regardless of the mechanism used, states must also balance customer privacy with ease of data access (SEE Action 2013). States are beginning to explore use of demand response to assist with grid operation and the integration of renewables. Currently, at least one utility in every state offers some form of

[120] DOE's Office of Electricity Delivery and Energy Reliability and the Federal Smart Grid Task Force facilitated a multi-stakeholder process to develop the Code. The Final Concepts and Principles, as released on January 12, 2015, are available at http://www.energy.gov/sites/prod/files/2015/01/f19/VCC%20Concepts%20and%20Principles%202015_01_08%20FINAL.pdf.

demand response through load management programs and/or pricing programs. Even though demand response is being offered across the country, automation of demand response to provide additional grid services and support the integration of renewable energy is not yet widespread. For example, the California Energy Commission is exploring policies to expand the amount of automated demand response resources for renewable energy integration (CEC 2013).

Similarly, states are enacting policies and regulations to encourage the demonstration and deployment of storage to complement the integration of greater renewable energy in a modern grid. For example, California has mandated 1.3 gigawatts of storage statewide by 2024 and requires future renewable portfolio standards plans in the state to comply with the storage decision (CPUC 2014a). Washington State enacted two laws related to energy storage: the first enables qualifying utilities to credit energy storage output of renewable sourced energy at 2.5 times the normal value in meeting the state's renewable energy targets, and the second requires electric utilities to include energy storage in all integrated resource plans (Washington House of Representatives 2013a, 2013b). Lastly, the New York Battery and Energy Storage Technology Consortium is an example of leveraging a public-private partnership to research storage technology and manufacturing and aid energy storage organizations and other stakeholders on policies and programs that could improve energy storage.

Campus Microgrids Serve as Laboratories of Learning

"Microgrid" refers to a group of interconnected distributed generators (such as solar panels and diesel generators), storage, combined heat and power (CHP) systems, distribution lines, controllable loads, and associated communication and control systems. A microgrid can be designed to meet some or all of the power needs of a facility or campus and may or may not be connected to the larger electric grid. When connected to the grid, a microgrid can be designed to island itself during a power outage to serve all or part of the load of the facility or campus. A grid-connected microgrid can also be designed and managed to serve as a multi-function grid resource, providing reliable and resilient electricity supply, load shedding, and other important grid services. To date, most microgrids have been developed for critical applications, such as military installations, and for university campuses, where they also serve as laboratories of learning. For example,

- The University of California, San Diego (UCSD) operates a microgrid that generates roughly 95 percent of its own energy and saves more than $8 million annually compared to importing the same amount of energy. UCSD leveraged various state energy efficiency and clean energy programs, federal grants, the university's capital investment budget and other sources to fund their microgrid build out. UCSD's microgrid consists of a CHP system; solar power; a fuel cell; battery energy storage systems; and flexible loads including a thermal energy storage tank, electric and steam driven chillers, and building level demand response. The performance of all of the systems is recorded using a centralized monitoring system, giving UCSD access to key data points that can help to continually improve the operation of the microgrid. The UCSD microgrid serves as a testbed for campus research including research on how to utilize its microgrid to provide renewable integration services. (See http://calsolarresearch.ca.gov/funded-projects/73-innovative-business-models-rates-and-incentives-that-promote-integration-of-high-penetration-pv-with-real-time-management-of-customer-sited-distribut and http://sustainability.ucsd.edu/highlights/microgrids.html).
- In addition to providing economic benefits and the potential to supporting clean energy integration, microgrids are getting increased attention for their ability to island from the grid during severe weather events or other electricity service disruptions. Princeton University gained national recognition for the successful performance of its microgrid in the wake of Hurricane Sandy. The campus has a gas turbine generator and nearby solar field capable of producing 15 megawatts. After the hurricane, Public Service Enterprise Group restored energy to the campus long enough for Princeton to restart its generator before the utility grid went out again. The campus was able to serve as a staging ground for firefighters, paramedics, and emergency service workers for a day and half until the larger electric grid was restored to service (Princeton University 2014).

Designing Effective Policies

A number of key issues have emerged from state and PUC efforts to advance grid modernization, including 1) who participates and in what aspects of the grid modernization dialogue; 2) key considerations such as what needs to be considered in design, how to gain operational experience operating a modern grid, and how to fund and make the business case for investments; and 3) how to balance ratepayer costs and benefits.

Participants

- *State executive and legislative bodies.* At the state level, the governor's office, state legislature, and state energy offices are often involved in policy- and goal-setting that includes or is facilitated by modern grid investments. Depending on how utilities are regulated in a given state and the issue at hand, state legislatures may become involved in modifying existing legislation to accommodate modern grid investments. For example, state energy efficiency resource standard legislation may be created or revised to include grid-side efficiency investments.
- *PUCs/utility boards.* PUCs and utility boards of municipal or cooperative utilities oversee goals, investments, and ratemaking for electric utilities. Most of this oversight is found in specific regulatory proceedings, including those for modern grid investments. These proceedings range from those that approve pilot efforts to those that define what resources count toward energy efficiency resource standards, determine AMI investment, or modify rate structures. For investor-owned utilities, PUCs also deliberate on a range of topics—such as transmission and distribution capital plans and planning standards—through periodic general rate case proceedings. PUCs and utility boards are faced with new challenges as the volume and complexity of proceedings increase.
- *Electric utilities.* Electric utilities are the primary purchaser of modern grid technologies and need to make the internal and external business case for modern grid investments while also responding to commission mandates or board directives. In the changing landscape of modern grid technologies and operations, utilities are often concerned about investing in technologies that may become obsolete before their costs can be fully recovered and about being compensated between rate cases for lost revenues associated with reduced electricity use due to grid-side energy efficiency or increased customer reliance on distributed generation (including renewables). (See Section 7.2.) While utilities have the expertise to execute grid modernization initiatives, absent permission or guidance from their regulators, their tendency may be to avoid risk or delay deployment.
- *Regional transmission organizations (RTOs)/independent system operators (ISOs).* About 60 percent of U.S. electric power supply is managed by RTOs or ISOs: independent, membership-based organizations that ensure reliability and usually manage the regional electric supply market for wholesale electric power. In the rest of the country, electricity systems are operated by individual utilities or utility holding companies (EIA 2011). RTOs/ISOs engage in long-term planning that involves identifying effective, cost-efficient ways to ensure grid reliability and system-wide benefits. Coordination and cooperation between utilities, state PUCs, and RTOs/ISOs is often required to advance energy efficiency and renewable energy integration goals in grid modernization efforts.
- *Public interest organizations.* Groups representing consumers, environmental interests, and other public interests are often involved in offering technical expertise as well as public perspectives. Consumer advocates are often concerned with maintaining low rates and ensuring equitable treatment of all customer classes. Environmental advocates are often concerned with ensuring that all cost-effective energy efficiency is considered and that robust funding for traditional energy efficiency programming is maintained; in some areas they may also advocate for transmission and distribution investments to

support renewables' integration. Increasingly, public interest organizations are interested in privacy and data access issues associated with AMI as well as in ensuring that utility business models are increasingly aligned with public interest goals.

- *Vendors and service providers*. Vendors of smart grid technologies and software may be called on to provide expertise during public proceedings, to respond to formal requests for information or proposals from utilities or states, or to participate directly in public dialogue to advance the interests of their organization. Service providers including those that work to acquire and aggregate demand response and distributed solar resources may be interested in regulatory proceedings that will affect how distributed resources will be valued and compensated by regulators, utilities, and capacity markets. Other service providers, such as those wishing to offer integrated home energy management services, may be interested in data access and privacy issues.
- *Customer/general public.* Customer engagement will vary by customer size and class and/or interest in key issues such as rate impacts and pricing structures, power quality, ability to participate in providing demand response and other grid services, interest in renewable energy, and data access and privacy. In general, it is advisable to provide customers with proactive education and outreach on the installation of AMI meters and any changes to billing or rate structures.

Key Design Considerations

Many existing policies affecting electricity generation, transmission and distribution, renewable energy, and demand-side management (e.g., energy efficiency and demand response) have been designed independently from one another and as a result are often planned and managed by different departments within a utility—each with unique expertise and regulatory drivers. Successful planning and management of modern grid investments to achieve broader energy efficiency and renewable energy benefits requires consideration of how to better integrate utility functions and policy goals to achieve the multiple objectives of grid modernization. Key considerations during the design of state or PUC policies for modern grid investments include:

- The prudent level of investment given the state of the market, considering local conditions and system needs, existing investments, the availability of external funding (e.g., federal grants), and experience with key technologies.
- How the need to engage multiple functional departments within a utility will affect timing and success.
- The best way to gain operational experience using modern grid technology to maximize energy efficiency benefits and distributed resource integration.
- When, where, and how to take proven pilot initiatives to scale.
- How to apportion costs, given the multiple benefits of these technologies and practices.
- How to balance customer rates and utility revenue requirements.

The following section provides more information on these key policy design considerations.

Evaluating current systems and future needs

Before making investment decisions, representatives from multiple departments within a utility meet to discuss existing system assets and operations, anticipated future system needs, the purpose of planned pilots, and key design considerations moving forward (see *Program Implementation and Evaluation* later in this section). During this phase, participants review technical data about the system such as the configuration of the distribution system and substations; equipment ratings; historical data on usage, voltage, costs, reliability, and risk; and current operating criteria and practices such as how temperature is monitored and controlled at the transformer to avoid overheating and extend equipment life. State and Federal regulatory requirements also are discussed to ensure a clear understanding of what various parties are legally required to do and identify any regulatory issues, such as how property rights for new assets will be assigned, that will require further legal review or action. PUCs are not normally involved at this stage but can have influence whether such evaluation occurs by calling for an assessment of grid side energy efficiency potential or requesting utilities in their jurisdiction consider pilot efforts to deliver grid side efficiency or improve the integration of distributed renewables.

Gaining operational experience

Most utilities conduct pilot initiatives to gain experience with new technologies and new operational practices before larger-scale investment. A significant number of utilities have already gained some operational experience with one or more modern grid investments through participation in Federal Smart Grid Investment Grants and Demonstration Programs, as well as through demonstration projects in partnership with the Electric Power Research Institute (see *Interaction with Federal Programs* and *Information Resources*, respectively). Pilots and demonstration projects may be subject to PUC or board approval. During pilots it is helpful to establish clear milestones and a process for reviewing progress against them, and to track actual costs and benefits and compare them to expectations. With proven costs and benefits from a real world pilot, the business case for full deployment gains credibility for approvals within utilities and with regulatory bodies.

Making the business case

When evaluating the benefits of investing in modern grid technologies and related changes to operations and management, states, PUCs, and utilities have found it helpful to apply a comprehensive benefit-cost analysis that accounts for the risk associated with some of these investments. The Bonneville Power Administration (BPA) recently conducted an interim analysis of the smart grid regional business case for the Pacific Northwest (BPA n.d.) that accounted for the range of uncertainty and evaluated investments based on energy efficiency benefits, reliability benefits, and improved operational efficiency. Importantly, their assessment took into account only the net benefits and costs from adding modern or smart grid capabilities compared to the benefits and costs of traditional technologies/approaches. Their interim assessment found that benefits significantly outweighed costs for modern grid investment and management strategies targeted to improving grid reliability, optimizing voltage and reactive power to achieve energy efficiency, and automating demand response to enable customers to respond to signals provided through the electricity supply chain (BPA n.d.).

Note that costs and benefits will vary by location and specific operating situations. The same technology can have a very different implementation cost in a rural area with low customer density than in an urban area with high customer density and significant commercial loads. Service territories need to be broken down into similar groupings of circuits, which can then be separately analyzed in terms of costs and benefits. In addition, modern grid investments often interact with one another, and that needs to be taken into account. Often investment in one technology helps avoid costs in the implementation of another technology. On the benefits side, care needs to be taken to avoid double-counting benefits, particularly when multiple technologies are being considered. In addition, it is often challenging to value the services technologies will enable when they do not yet exist across the population.

Funding and cost recovery

Modernizing the electric grid requires an investment of time, money, and human capital. Some believe that, in the long run, a rethinking of the utility business model is needed so that utilities no longer recover fixed operating costs based on the volume of electricity they deliver to customers or receive compensation based on capital investments they make to provide service but for the broader services they provide to customers and society. In most parts of the country, utilities are years away from experiencing significant revenue impacts from the high penetration of distributed renewables or grid-controlled energy efficiency, but a few states with higher renewables penetration and/or a strong interest in improving grid resiliency to respond to increasing severe weather events have begun to discuss an evolving utility business model as part of a larger conversation about grid modernization (see *State/Regional Examples*).

In the near term, utilities and their regulators are evaluating how to fund modern grid investments, absent a full rate case, since transmission and distribution planning investments are typically recovered through rates (see Section 7.1) and access to capital has been cited as a key barrier by some utilities (NEEA 2014). Additional or unforeseen investments in grid technology require utilities to risk that these investments will not be recovered through future rate cases. Other issues include ensuring that benefits are widely distributed among customers and whether regulators will compensate utilities for lost revenues when the modern grid investment delivers energy efficiency benefits to customers. A growing number of utilities receive compensation for revenue lost from reduced sales attributable to their energy efficiency programs (see Section 7.2).

Interaction with Federal Programs

Several federal-level programs and efforts are targeted toward fostering grid modernization. Combined, the Smart Grid Investment Grant and the Smart Grid Demonstration Program (authorized by the Energy Independence and Security Act [EISA] of 2007 and amended through the Recovery Act) authorized $5 billion to accelerate grid modernization activities across the country. Smart Grid Investment Grant projects spanned AMI, customer systems, distribution system upgrades, transmission upgrades, equipment manufacturing, and cross-cutting systems. Smart Grid Demonstration Program projects focused on verifying the viability, costs, and benefits of regional smart grid demonstrations and on projects demonstrating the use of energy storage systems to provide grid services and renewable resource integration.[121] These funding sources were in addition to the direct project funding from the U.S. Department of Agriculture's Rural Utility Service for rural electricity delivery infrastructure. The EISA also called on the National Institute of Standards and Technology to coordinate the development of a framework that includes protocols and model standards for information management so that smart grid devices and systems work together. The resulting Smart Grid Interoperability Panel work is now administered through a public-private partnership (see http://www.sgip.org).

Because of the diversity of technologies and applications that fall under the umbrella of grid modernization, there are several other agency efforts and programs that support different aspects of grid modernization as co-benefits of their primary work, such as energy efficiency, economic development, security, and consumer protection. The Federal Smart Grid Task Force,[122] established under Title XIII of the EISA and led by DOE's Office of Electricity Delivery and Energy Reliability, is designed to ensure awareness, coordination, and integration of the diverse activities of the federal government related to smart grid technologies, practices, and services across federal agencies. Given the nexus between smart grid and the need for rapid data

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[121] For information on Smart Grid Demonstration Program projects, see http://www.smartgrid.gov/recovery_act/overview/smart_grid_demonstration_program.

[122] For more information on the Federal Smart Grid Task Force, see https://www.smartgrid.gov/task_force.

communications, the U.S. Department of Commerce, National Telecommunications and Infrastructure Administration's Broadband Technology Opportunities Program (funded through the Recovery Act), has also resulted in partnerships between broadband providers, electric cooperatives, and communities that would otherwise be underserved by broadband deployments.

Interaction with State Policies

Modern grid investments can enable or facilitate a range of state policies focused on reducing costs, improving the environment, promoting innovation, and enhancing reliability. However, some of the policies do not provide the appropriate mechanisms or incentives to capture all of the available capabilities and benefits. As modern grid applications continue to emerge, states are reviewing policies to determine how to take better advantage of the additional capability of the modern grid.

For example, investments that can reduce customer energy use (such as CVR) do not typically count toward a utility's energy efficiency resource standard or similar goals. Other policies that encourage more renewable generation, such as renewable portfolio standards (see Chapter 5), may be facilitated by increased flexible loads and advanced demand response if implemented in a coordinated way. Similarly, customer information programs that use AMI data may improve energy efficiency deployment and encourage energy-saving behaviors. However, many utilities that provide such information programs to customers are not evaluating, measuring, and verifying energy savings.

Program Implementation and Evaluation

Implementation

Within a utility, senior leadership as well as multiple operating units within the company are often involved in deploying, managing, monitoring, and measuring programs or initiatives that leverage grid modernization investments for load reduction or energy efficiency. Utilities have cited establishing coordination across departments as a key step for success. It is helpful for states and their PUCs to understand these operational complexities in setting realistic timeframes for pilot efforts or larger-scale deployment. The following are examples of how different operating departments within a utility may be engaged in modern grid deployments or pilot initiatives:

- Electric distribution operations staff are directly engaged in planning and operations. They know critical system data; understand the mix of residential, commercial, and industrial customers along various feeders; and are responsible for ensuring that grid operations deliver expected services within allowable voltage levels.
- Electric forecasting departments are instrumental in understanding and planning future load requirements, including specific seasonal, peak, time-of-day, or customer class impacts.
- Energy efficiency and demand-side management program staff are interested in the implications of grid-side efficiency programs and the potential to count customer impacts toward program goals. As such, they provide valuable insights on how to track and monitor costs and benefits.
- Key account managers are usually incorporated into any demonstration that could affect service to large customers or customer groups.
- Customer call centers and billing departments manage customer contact, usage history, and other information necessary for pilot design and measurement, depending on the project being implemented.

They are also often a first point of contact for any service or billing accuracy complaints, such as those associated with new AMI meter deployments.

- Regulatory and public affairs staff become involved in developing the strategy for raising awareness of new technologies among customers, making the business case for implementing modern grid investments for energy efficiency and peak load reduction, and engaging in related regulatory proceedings.

Oversight

The primary oversight of utility distribution modernization efforts is the state PUC or utility board, depending on utility type. These entities generally approve capital investments, establish the policies that govern investment and operation of the electric grid, and ensure fair treatment and equity between the ratepayer and the utility and among ratepayers.

Decision-makers generally have both formal and informal options available for oversight. For example, formal PUC processes are often handled through dockets with evidence-based hearings and opportunities for public comment.[123] These formal processes are generally used to approve or disapprove a specific grid investment proposal. For a deeper exploration of the pros and cons of a range of grid modernization options, oversight organizations—on their own or at the request of interested parties—may opt to initiate an informal process, such as workshop or stakeholder collaboration. Informal processes may lead to formal processes, but in the meantime they allow decision-makers to engage and learn without the limitations associated with rules of evidence, enabling a deeper exploration of the pros and cons of the full range of opportunities.

Evaluation

Some states are requiring utilities to evaluate the benefits of modern grid deployments similarly to other energy efficiency, renewable energy, and CHP initiatives, as illustrated below using CVR as an example.

- *Understanding potential.* As discussed previously, the potential of voltage management to deliver energy efficiency to customers will vary by circuit; it is best informed by breaking service territories down into groups of circuits similar in length, current voltage levels, customer class, and other technical characteristics. Utilities often conduct modeling to inform which circuits are best suited to voltage management. Once operational experience is gained on a mixture of circuits, utilities can understand and target high-value circuits for future deployments.
- *Developing tracking metrics and systems*. All evaluations benefit from developing tracking metrics and systems in advance of deployment. These need to be informed by a clear understanding of the multiple objectives of a deployment.
- *Establishing baselines.* As with other energy efficiency investments, establishing credible baselines is critical to claiming program impacts. In the case of CVR, since customer energy use naturally depends on weather and season, it is common to cycle voltage control on and off for a sufficient duration at different times throughout the year. Depending on system type, utilities usually follow either a day on/day off or week on/week off protocol. Because data gained from these operations are often used as proxy data for other system-wide planning efforts, it is important that they be regularly refreshed. For example, if a particular circuit experiences rapid load growth, the usefulness of its data for broader estimation purposes will quickly be reduced.

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[123] See Section 7.1, "Electricity Resource Planning and Procurement," for more information on formal processes PUCs use to approve utility investments.

- *Assessing benefits and costs.* As discussed previously, it can be beneficial to understand the additional costs and the additional benefits that can be realized from implementation using modern grid technology versus traditional approaches. For example, CVR can be implemented with conventional grid technology, however additional energy savings could be realized from modern grid technologies. It is also important to take into account difficult-to-quantify benefits such as increased operational confidence that come from modern grid investments.
- *Understanding how benefits are allocated.* In a modernizing grid, customers are increasingly able to both consume and generate electricity, can both benefit from and provide grid services, and can participate knowingly or passively in energy efficiency or demand response programming. As a result, utilities and regulators are increasingly interested in tracking costs and understanding benefits at a more granular level. Depending on the policy and regulatory environment, the distribution of impacts can vary—either between ratepayers and the utility or among different ratepayer groups. The use of multiple methods can help establish these distributional impacts. For example, comparing CVR impacts at the substation to CVR impacts at the customer meter combined with engineering simulations are useful for estimating the proportion of energy savings the customer will realize (compared to the energy savings the utility will realize from operational improvements).

For utilities interested in gaining energy efficiency credit for grid-side efficiency programming, use of a third-party evaluator will be beneficial—and in many cases required for making the case to their oversight authority. Many states require use of third-party evaluators for energy efficiency program impact evaluations.

State and Regional Examples

Massachusetts

In October 2012, the Massachusetts Department of Public Utilities began an investigation into what a grid modernization initiative should look like (Massachusetts Department of Public Utilities 2014a). A working group was established to gather input from various grid-facing and customer-facing stakeholders and make recommendations. After further deliberation and review, the Department issued an Order in June 2014 requiring all of the state's utilities to develop and submit 10-year grid modernization plans designed to 1) minimize outages and 2) reduce system and customer costs through optimizing demand, facilitating integration and higher penetration of distributed resources, and improving management of assets and personnel (Massachusetts Department of Public Utilities 2014b). Utilities were also required to submit 5-year capital investment plans in support of these goals. In a separate but related order, the commission requested that utilities establish time-varying rates as their default rates (Massachusetts Department of Public Utilities 2014c).

California

California was an early innovator in grid modernization, with the California Public Utilities Commission (CPUC) producing its first grid modernization plan in 2010 (CPUC 2014b). Utilities are now required to submit annual Smart Grid Deployment Plan updates to CPUC, and CPUC in turn produces an annual Smart Grid Report for the Governor and legislature detailing annual progress. California has become one of the first states to achieve near complete coverage of AMI across all its utility service areas, and CPUC has put forth several measures to address the questions of data access and consumer privacy that AMI brings to the forefront (CPUC 2014c). The California Energy Commission is also exploring policies to expand the amount of automated demand response resources for renewable energy integration (CEC 2013). California, along with other states in the Western Electricity Coordinating Council, has initiated a program to deploy technologies that help operators better integrate renewables through monitoring grid conditions and receiving real-time automated alerts (California ISO 2011).

Maryland

As part of its order transitioning into the next 3-year phase of the Empower MD Energy Efficiency Act of 2008, the Maryland Public Service Commission, "intrigued by the opportunities for highly cost-effective savings that CVR programs could create," approved one proposed utility CVR program and directed all other regulated companies to develop or accelerate CVR programs. In the same order, the Commission requested that utilities recover the costs of their CVR programs in rates rather than through the Empower Maryland Surcharge, allowed the companies to count their projected energy savings generated by their respective CVR programs toward their EmPOWER energy efficiency goals, and requested companies to track and separately report the costs of their CVR programs to determine cost-effectiveness (MD PSC 2011).

Indiana

In Indiana, the legislature created a new tracker, which is overseen by the Indiana Utility Regulatory Commission, to encourage utility investment in transmission, distribution and storage system improvements. Traditionally, these costs would have been included in rates for recovery in a base rate case. The tracker enables utilities to recover these costs on a more regular basis. Before costs can be passed through to consumers, the utility is required to submit a 7-year plan that is subject to public comment and approval by the Indiana Utility Regulatory Commission. The utility is also required to undergo a rate case in that 7-year period (Indiana General Assembly 2013).

Pacific Northwest

The Northwest Power and Conservation Council, in its Sixth Conservation and Electric Supply Plan, targets 400 average megawatts of savings from utility distribution systems by 2029. As a wholesale electric power marketer and transmission operator in the Northwest, BPA contributes to achieving the goals set forth in the plan. Through its Energy Smart Utility Efficiency Program, BPA offers incentives of $0.25 per kilowatt-hour to acquire utility distribution sector energy savings including voltage optimization and high-efficiency transformers (BPA 2012, 2014; NPCC 2010).

What States Can Do

States and their PUCs interested in advancing grid modernization efforts to achieve energy efficiency benefits and anticipate the need to better accommodate growing renewable resources may wish to consider the following actions:

- *Conduct pilot-scale efforts*. Pilot studies can help utilities gain operational knowledge and an understanding of costs and benefits prior to broader implementation and can inform energy efficiency, CHP, and distributed renewables potential.
- *Assess energy efficiency potential.* Grid-side energy efficiency has not historically been included in energy efficiency potential studies. States can consider including grid-side efficiency deployments such as CVR in existing potential studies or as a separate effort.
- *Integrate in resource/procurement planning.* Modern grid investments can increase operational confidence in grid-side energy efficiency, demand-responsive resources, and the ability of the distribution system to integrate and benefit from distributed generation resources such as CHP and renewable energy. As such,

these resources deserve increased attention in long-term integrated resource and procurement planning efforts.

- *Review policies to encourage investment:* Particularly for states that have already gained operational knowledge with modern grid deployments, review of the role of existing utility policies in inhibiting or encouraging investment in modern grid technologies can be beneficial to encouraging larger scale deployment. For example, utilities have expressed that crediting customer energy efficiency benefits from CVR as part of their energy efficiency resource standards as an important incentive to moving forward with deployments. Similarly, utilities that have decoupling policies in effect are neutral to the revenue losses from reduced sales associated with both CVR and customer-sided renewables. (See Section 7.2.)
- *Convene a stakeholder process.* Understanding the perspectives of multiple stakeholders will become increasingly important as grid modernization efforts mature and distributed resources become more prevalent. States may benefit from tracking the proceedings of leading states to understand emerging issues.

Information Resources

Federal Resources

Title/Description	URL Address
A Policy Framework for the 21st Century Grid: A Progress Report. This 2013 report summarizes recent federal government actions to encourage the development of a 21st century grid.	http://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_nstc_grid.pdf
SmartGrid.gov. SmartGrid.gov is the gateway to information on federal initiatives that support the development of technologies, policies, and projects to transform the electric power industry.	http://www.smartgrid.gov
Smart Grid Investment Grants and Smart Grid Regional and Energy Storage Demonstration Projects. These two Web pages provide information on American Reinvestment and Recovery Act grant-funded grid modernization and energy storage demonstration projects across the United States. The projects were awarded from DOE's Office of Electricity Delivery and Energy Reliability.	http://energy.gov/oe/technology-development/smart-grid/recovery-act-smart-grid-investment-grants (investment grants) http://energy.gov/oe/services/technology-development/smart-grid/recovery-act-sgdp (demonstration projects)
Federal Energy Regulatory Commission (FERC). FERC's website provides information on smart grid advancements, including annual assessments of demand response and advanced metering potential.	http://www.ferc.gov/industries/electric/indus-act/smart-grid.asp http://www.ferc.gov/legal/staff-reports/2014/demand-response.pdf
National Forum on Demand Response. The U.S. Department of Energy and the Federal Energy Regulatory Commission sponsored a forum as part of the Implementation Proposal for the National Action Plan for Demand Response. In February 2013, National Forum working groups published a series of reports on cost-effectiveness, measurement and verification, program design and implementation, and tools and methods.	http://energy.gov/oe/services/electricity-policy-coordination-and-implementation/state-and-regional-policy-assistanc-7
USDA Rural Utility Service Loans. USDA loans funds to rural electric utilities for a variety of infrastructure expansions and improvements, including modern grid technologies.	http://www.rurdev.usda.gov/Home.html
Broadband USA. This Web page provides information on American Reinvestment and Recovery Act grant-funded community broadband projects, many of which include smart grid capabilities. The projects were awarded from the U.S. Department of Commerce, National Telecommunications and Infrastructure Administration.	http://www2.ntia.doc.gov/about
State and Local Energy Efficiency Action Network (SEE Action). The federally facilitated SEE Action summarizes information on the importance of customer access to energy use data as a tool for supporting energy efficiency in the residential and commercial sectors, and provides related resources for state and local policy makers and their partners.	https://www4.eere.energy.gov/seeaction/topic-category/energy-use-data-access
National Institute of Standards and Technology (NIST). NIST's website provides an overview of smart grid technology and the development of interoperability standards to make it possible.	http://www.nist.gov/smartgrid/

Title/Description	URL Address
Smart Grid Legislative and Regulatory Policies and Case Studies. This 2011 report highlights the development of the smart grid in the United States and abroad, summarizes U.S. smart grid legislation and regulation, and provides case studies of smart grid pilots and programs in the United States.	http://www.eia.gov/analysis/studies/electricity/
Data Privacy and the Smart Grid: A Voluntary Code of Conduct. Utilities and third parties can voluntary adopt these concepts and principles in order to address privacy related to customer data.	http://www.energy.gov/sites/prod/files/2015/01/f19/VCC%20Concepts%20and%20Principles%202015_01_08%20FINAL.pdf
Grid Energy Storage. This 2013 report describes potential options to improve energy storage, as well as specific actions that could help maintain scientific advancements and a pipeline of project deployments.	http://energy.gov/oe/downloads/grid-energy-storage-december-2013
Integrated Building Energy Systems Design Considering Storage Technologies. This 2009 report analyzes how energy storage technologies can help with the optimization of micro-generation systems. It features examples from New York and California.	http://emp.lbl.gov/sites/all/files/REPORT%20lbnl-1752e_0.pdf

Potential and Business Case

Title/Description	URL Address
Evaluation of Conservation Voltage Reduction (CVR) on a National Level. This 2010 report presents an estimate of the benefits of CVR for individual feeder types, as well as an extrapolation of the benefits on a national level.	http://www.pnl.gov/main/publications/external/technical_reports/PNNL-19596.pdf
BPA Study of Smart Grid Economics Identifies Attractive Opportunities and Key Uncertainties. This primer summarizes a white paper documenting the interim results of an economic assessment for smart grid technologies in the Pacific Northwest.	http://www.bpa.gov/Projects/Initiatives/SmartGrid/DocumentsSmartGrid/BPA-Smart-Grid-Regional-Business-Case-Summary-White-Paper.pdf
Estimating the Costs and Benefits of the Smart Grid. This 2011 technical report, a partial update of an earlier report, documents the methodology, key assumptions, and results of a preliminary quantitative estimate of the investment needed to create a viable smart grid.	http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001022519
Costs and Benefits of Conservation Voltage Reduction: CVR Warrants Careful Examination. This 2013 report investigates the CVR deployment experience at four rural electrical cooperative utilities and uses their data to develop and calibrate a hybrid power flow-economic model, which is used to derive a cost-benefit analysis methodology for CVR.	https://smartgrid.gov/sites/default/files/doc/files/NRECA_TPR2_Costs_Benefits_of_CVR_0.pdf
Market Analysis of Emerging Electric Energy Storage Systems. This research paper evaluates the economics of two emerging electric energy storage systems: sodium sulfur batteries and flywheels.	http://netl.doe.gov/File%20Library/Research/Energy%20Analysis/Publications/DOE-NETL-2008-1330-MarkAnalyElectEnergyStorageSys-FinalRpt.pdf

Stakeholder Processes

Title/Description	URL Address
Illinois Energy Infrastructure Modernization Act of 2011. Provides Illinois Investor Owned Utility plans to make significant upgrades and investments to the electric grid while meeting performance metrics. Stakeholder groups engaged to ensure that related consumer and environmental benefits, including greenhouse gas benefits, are to be tracked and reported for these investments.	http://www.icc.illinois.gov/electricity/infrastructureinvestmentplans.aspx
Smart Grid Roadmaps. This series lays out a path and technical vision for the discovery and deployment of smart grid technologies. It includes links to current and past stakeholder processes.	http://www.caiso.com/informed/Pages/CleanGrid/SmartGridRoadmap.aspx
Report to the Governor and the Legislature: California Smart Grid—2012. This report, published in May 2013, is the third annual report providing the Governor and legislature with information on CPUC's and California investor-owned utilities' progress toward modernizing the state's electric grid.	http://www.cpuc.ca.gov/NR/rdonlyres/7AB03474-E27C-4EB6-AB8D-D610A649C029/0/SmartGridAnnualReport2012Final.pdf
The Future of the Grid: Evolving to Meet America's Needs. These materials were compiled in 2014 in advance of the "Future of the Grid—Evolving to Meet America's Needs National Summit." They consolidate key findings from four regional workshops that were held to obtain stakeholder views on the ways in which the grid must evolve to meet America's energy needs and customer expectations by the year 2030.	http://www.pdf.investintech.com/preview/92816eb2-f883-11e3-9de8-002590d31986/index.html
The Smart Grid Stakeholder Roundtable Group: Perspectives for Utilities and Others Implementing Smart Grids. This 2009 document provides general guiding principles for utilities and other smart grid project developers as they begin to plan and implement upgrades to their metering infrastructure and transmission and distribution networks, with the goal of helping developers better communicate how and why smart grid technologies will provide benefits.	http://www.epa.gov/cleanenergy/documents/suca/stakeholder_roundtable_sept09.pdf

Environmental Benefits and Other Policy Considerations

Title/Description	URL Address
Is It Smart If It's Not Clean? Strategies for Utility Distribution Systems. Part one of a two-part series on smart grid's potential benefits for energy efficiency and distributed generation. This issue letter discusses questions that PUCs and stakeholders can ask if they want smart grid investments to improve system distribution efficiency, focusing on CVR and optimizing voltage and var control.	http://www.raponline.org/document/download/id/656
Is It Smart If It's Not Clean? Smart Grid, Consumer Energy Efficiency, and Distributed Generation. Part two of a two-part series on smart grid's potential benefits for energy efficiency and distributed generation. This issue letter explains smart grid opportunities to advance end-use energy efficiency and clean distributed generation.	http://www.raponline.org/docs/RAP_Schwartz_SmartGrid_IsItSmart_PartTwo_2011_03.pdf

Title/Description	URL Address
Nation Association of Utility Regulatory Commissioners (NARUC) Smart Grid Resources. NARUC's website contains resources about smart grid deployment, including congressional testimony, reports, policies, and links to federal agencies.	http://www.naruc.org/smartgrid/
The Future of the Utility Industry and the Role of Energy Efficiency. This study estimates future electricity sales, identifies options for the future role of utilities, and evaluates the role of energy efficiency in the utility of the future.	http://www.aceee.org/research-report/u1404
Advancing Grid Modernization and Smart Grid Policy: A Discussion Paper. This white paper, developed from the Advanced Energy Economy Grid Modernization forum held in 2013, identifies the most relevant barriers to broader smart grid adoption, as well as corresponding policy options put forward for consideration.	http://info.aee.net/advancing-grid-modernization-and-smart-grid-policy
The Smart Grid: An Estimation of the Energy and CO_2 Benefits. This report highlights nine mechanisms by which the smart grid can reduce energy use and carbon impacts associated with electricity generation and delivery.	http://energyenvironment.pnnl.gov/news/pdf/PNNL-19112_Revision_1_Final.pdf
The Green Grid: Energy Savings and Carbon Emissions Reductions Enabled by a Smart Grid. This paper quantifies the energy savings and carbon dioxide emissions reduction impacts of smart grid infrastructure. Integrating Smart Distributed Energy Resources with Distribution Management Systems. This paper describes ongoing research by the Electric Power Research Institute to ensure that distribution management systems can more effectively use distributed energy resources.	http://www.smartgridnews.com/artman/uploads/1/SGNR_2009_EPRI_Green_Grid_June_2008.pdf http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001024360
Evaluation Framework for Smart Grid Deployment Plans: A Systematic Approach for Assessing Plans to Benefit Customers and the Environment. This document provides a template to evaluate the Smart Grid Deployment Plans that California's investor-owned utilities are required to file under CPUC's Decision 10-06-047.	http://www.edf.org/sites/default/files/smart-grid-evaluation-framework.pdf
Redefining Smart: Evaluating Clean Energy Opportunities from Products with Grid Connected Functionalities. This paper maps out clean energy opportunities for certain types of appliances and uses the framework as a tool to estimate the greenhouse gas emissions reduction potential of opportunities along the spectrum.	http://aceee.org/files/proceedings/2014/data/papers/11-969.pdf

Industry Resources

Title/Description	URL Address
Smart Grid Interoperability Panel (SGIP). SGIP is a public-private partnership with a mission to accelerate the implementation of interoperable smart grid devices and systems. Members develop standards to help educate key stakeholders on best practices, lessons learned, and vectors of influence affecting successful integration of next-generation smart grid technologies.	http://www.sgip.org
Smart Grid Demonstration—Integration of Distributed Energy Resources. This initiative conducts regional demonstrations and supports research focusing on smart grid activities related to integration of distributed energy resources. These resources include distributed generation, storage, renewable, and demand response technology.	http://smartgrid.epri.com/Demo.aspx
The Gridwise Alliance. Gridwise is a coalition of stakeholders that works to transform the electric grid by creating a venue for collaboration across the electricity industry. Gridwise provides a broad range of online resources about smart grid technologies and policies.	http://www.gridwise.org
National Electrical Manufacturers Association (NEMA). NEMA maintains a variety of smart grid fact sheets, as well as policy position papers that apply at the state and federal level.	http://www.nema.org/Policy/Energy/Smartgrid/Pages/default.aspx
Association for Demand Response & Smart Grid (ADS). This site provides links to ADS-generated reports and case studies, as well as major reports issued by government and others.	http://www.demandresponsesmartgrid.org/reports-research
Advanced Energy Management Alliance (AEMA) Demand Response Resources. AEMA is a demand response advocacy group that maintains a directory of industry demand response resources.	http://aem-alliance.org/demand-response/resources/
State Proceedings. The Energy Storage Association maintains a listing of state regulatory proceedings that relate to energy storage.	http://energystorage.org/policy/state-policy/state-proceedings?page=1

Understanding the Modern Grid

Title/Description	URL Address
What Is the Smart Grid? This website is a resource for information about the smart grid concepts and government-sponsored smart grid projects.	https://www.smartgrid.gov/the_smart_grid
Governors' Guide to Modernizing the Electric Power Grid. This paper looks at ways in which governors can help better understand and communicate the costs and benefits of grid modernization.	http://www.nga.org/cms/home/nga-center-for-best-practices/center-publications/page-eet-publications/col2-content/main-content-list/governors-guide-to-modernizing-t.html
The Smart Grid: An Introduction. This publication provides a "plain-English" exploration of the nature, challenges, opportunities, and necessity of smart grid implementation.	http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages.pdf

Title/Description	URL Address
Smart Grid. The Center for Climate and Energy Solutions is a nonprofit organization that advocates for policies and actions to address the twin challenges of energy and climate change. This fact sheet describes key smart grid technologies and applications, and explains how these components can provide economic and environmental benefits.	http://www.c2es.org/technology/factsheet/SmartGrid

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BPA. n.d. BPA Study of Smart Grid Economics Identifies Attractive Opportunities and Key Uncertainties. Bonneville Power Administration.	http://www.bpa.gov/Projects/Initiatives/SmartGrid/DocumentsSmartGrid/BPA-Smart-Grid-Regional-Business-Case-Summary-White-Paper.pdf
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Glossary

Distribution systems deliver electricity to end customers. In the United States, the electric distribution system is alternating current at 60 Hz. At distribution substations, high-voltage electricity is received from the transmission system and converted into the lower-voltage electricity needed for distribution to customers. From distribution substations, distribution circuits (also called lines or feeders) are used to distribute electricity at a lower voltage. The secondary transformers on the distribution circuits are used to convert voltage to an even lower voltage for delivery to end customers. For residential customers, that voltage is 120 volts (+/- 5 percent).

Current is movement of electric charge, measured by the number of electrons passing a single point in one second.

- Alternating current is electricity that periodically reverses direction. In the United States, the alternating current is a 60 Hz sinusoidal wave form.
- Direct current is electricity flowing in a constant direction.

Voltage for an electrical system is the difference in electrical potential between any two points on the system.

Power is the rate at which energy is used (measured in watts or kilowatts); electric energy is usually sold by the kilowatt hour.

Reactive power occurs in alternating current systems when there is a shift between voltage and current (when voltage and current are not in phase). Reactive power must be supplied to most types of magnetic equipment (such as products with motors) and to compensate for the power losses in distribution and transmission systems. It typically is expressed in volt-ampere reactive (var).

Tools for a Modern Grid

No single technology or combination of technologies delivers modern grid benefits. How technologies and grid assets are managed is critical to achieving the promise of a modern grid. The following are some of the tools grid operators use to monitor, evaluate, and respond to grid conditions in real time.

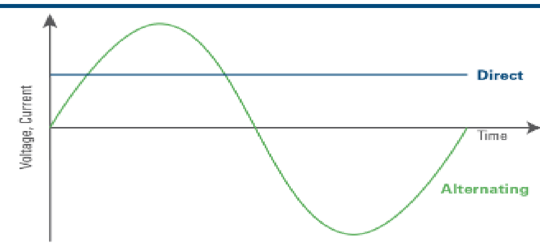
System controls include *load tap changers,* which are installed on transformers and raise or lower voltage at the beginning of the feeder; *voltage regulators,* which are installed on substations or feeders, and raise or lower downstream voltage; and *capacitor banks,* which are installed at the substation or feeder, and manage reactive power and voltage. *Control packages* are installed on capacitor banks and voltage regulators and programmed to turn on and off based on system conditions or via remote signal.

Monitoring devices include *voltage sensors* on distribution lines, *synchrophasers* on transmission systems for synchronized measurement of voltages, and (increasingly) *AMI meters* for voltage reaching consumer premises.

Communications and automation are enabled by *distribution management systems* that 1) receive information from multiple utility information systems (e.g., SCADA systems that monitor and control distributions systems and information systems that collect and store AMI data) and 2) analyze the data (on- or offline) to determine how to optimize the distribution system, and send control signals.

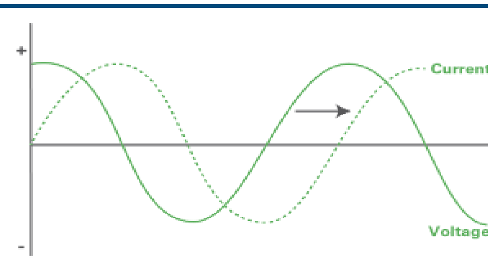
Adapted from DOE (2011).

Figure 7.5.1: Illustrative Overview of Direct and Alternating Current



Direct current is often depicted as a straight line. Alternating current is often depicted as a sine wave.

Figure 7.5.2: Illustrative Overview of Reactive Power



Reactive power occurs when voltage and current are out of phase.

Conservation voltage reduction is the reduction of feeder voltage (within allowable standards) on a distribution circuit to reduce energy consumption. CVR is different from voltage reduction required during periods of inadequate generation supply.

Volt/var optimization refers to the simultaneous and optimized control of voltage and reactive power (var) on the distribution system to minimize system losses.

Inverters convert direct current (DC) to alternating current (AC) electricity and vice versa. Inverters are used to connect renewables and storage to the electric grid. They require certain functionality to ensure safety.

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