State and Local
Energy and Environment Program

LOCAL GOVERNMENT CLIMATE AND ENERGY STRATEGY SERIES

Energy Efficiency in Affordable Housing

A Guide to Developing and Implementing Greenhouse Gas Reduction Programs

Energy Efficiency

U.S. ENVIRONMENTAL PROTECTION AGENCY
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EPA's Local Government Climate and Energy Strategy Series

The Local Government Climate and Energy Strategy Series provides a comprehensive, straightforward overview of greenhouse gas (GHG) emissions reduction strategies that local governments can employ. Topics include energy efficiency, transportation, community planning and design, solid waste and materials management, and renewable energy. City, county, territorial, tribal, and regional government staff and elected officials can use these guides to plan, implement, and evaluate GHG reduction and energy projects.

Each guide in the series provides an overview of project benefits, policy mechanisms, investments, key stakeholders, and other implementation considerations. Examples and case studies highlighting achievable results from programs implemented in communities across the United States are incorporated throughout the guides.

While each guide stands on its own, the entire series contains many interrelated strategies that can be combined to create comprehensive, cost-effective programs that generate multiple benefits. For example, efforts to improve energy efficiency can be combined with transportation and community planning and design programs to reduce GHG emissions, decrease the costs of energy and transportation for businesses and residents, improve air quality and public health, and enhance quality of life.

Local Government Climate and Energy Strategy Series

All guides in the series are available at ***https://www.epa.gov/statelocalenergy/local-government-strategy-series***.

ENERGY EFFICIENCY

- Energy Efficiency in Local Government Operations
- Energy Efficiency in K-12 Schools
- Energy Efficiency in Affordable Housing
- Energy-Efficient Product Procurement
- Combined Heat and Power
- Energy Efficiency in Water and Wastewater Facilities

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SOLID WASTE AND MATERIALS MANAGEMENT

- Resource Conservation and Recovery

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EXECUTIVE SUMMARY

Developing and Implementing Energy Efficiency Programs

Saving energy through energy efficiency improvements can cost less than generating, transmitting, and distributing energy from power plants. As shown in the box to the right, energy efficiency also provides a range of important environmental, public health, and economic benefits.

Local governments can promote energy efficiency by developing and implementing strategies that improve the efficiency of municipal facilities and operations and/or encourage energy efficiency improvements in residential, commercial, and industrial sectors. The energy efficiency guides in this series describe the process of developing and implementing strategies, using real-world examples, for improving energy efficiency in local government operations and in the community.[1]

Energy Efficiency in Affordable Housing

With the help of local governments, many low-income households are reducing housing costs and greenhouse gas (GHG) emissions by using energy more efficiently. Energy costs can contribute substantially to the overall financial burden of housing, and can make housing unaffordable for many low-income families. This guide describes how local governments have planned and implemented programs to reduce the energy-cost burden on low-income households while also generating other energy, environmental, and economic benefits for the local community and region. It is designed to be used by public housing authorities, other public and private entities that provide affordable housing assistance, local government staff, elected officials, and citizen groups.

Readers of the guide should come away with an understanding of options for improving energy efficiency in affordable housing, a clear idea of the steps and considerations involved in developing and implementing the various options, and an awareness of expected investment and funding opportunities.

The guide describes energy, environmental, and economic benefits of energy efficiency in affordable housing (Section 2); planning and design approaches (Section 3); key participants and their roles (Section 4); policy mechanisms that local governments have used to support programs for energy efficiency in affordable housing (Section 5); implementation strategies for effective programs (Section 6); investment and financing opportunities (Section 7); federal, state, and other program resources that may be able to help local governments with information or financial and technical assistance (Section 8); two case studies of successful local government programs for improving energy efficiency in affordable housing (Section 9); additional examples and information resources (Section 10); and finally, Section 11 includes references cited in the text. Additional examples of successful implementation are provided throughout the guide.

THE MANY BENEFITS OF ENERGY EFFICIENCY

Energy efficiency improvements can lead to positive impacts in each of the areas shown in the outer ring of the figure. For example, increasing energy efficiency can reduce GHG emissions, improve energy security, enhance industrial productivity, improve health and well-being, increase employment, reduce air pollution, and increase disposable income.

Source: International Energy Agency, 2014.

[1] *See the guides on local government operations, K-12 schools, energy-efficient product procurement, combined heat and power (CHP), and water and wastewater facilities in the Local Government Climate and Energy Strategy Series, available at* ***https://www.epa.gov/statelocalenergy/local-government-strategy-series***.

Relationships to Other Guides in the Series

Local governments can use other guides in this series to develop robust GHG reduction and energy programs that incorporate complementary strategies. For example, they can combine energy efficiency improvements in affordable housing with **smart growth** strategies, **urban heat island reduction** techniques, and **transportation control measures** to develop integrated plans for community development that maximize improvements to the economic and social well-being of low-income residents, while reducing GHG emissions and air pollution. Local governments can also integrate **CHP** systems and **energy-efficient products** into affordable housing to ensure ongoing energy and costs savings, and help achieve GHG reductions.

See the box to the right for more information about strategies that complement energy efficiency improvements in affordable housing. Additional connections to related strategies are highlighted throughout the guide.

RELATED GUIDES IN THIS SERIES

- **Community Planning and Design: *Smart Growth***
  Smart growth involves development that benefits the economy, the community, the environment, and public health. Smart growth principles favor the strategic location of transit services, residences, and commercial development, which can reduce the transportation costs of low-income households and improve housing affordability.
- **Community Planning and Design: *Urban Heat Island Reduction***
  Dark-colored buildings, paved surfaces, and reduced tree cover in urban areas create "islands" of warmth, with impacts on air quality, energy use, and public health. Low-income residents are among the most vulnerable to these impacts, and measures to reduce urban heat islands can help reduce home energy use while providing other environmental and health benefits.
- **Transportation: *Transportation Control Measures***
  Transportation control measures are strategies that reduce vehicle miles traveled and improve roadway operations to reduce air pollution, GHG emissions, and fuel use from transportation. Measures such as public transportation improvements and expanded commuter choices can provide additional reductions in the energy-cost burden of low-income households.
- **Energy Efficiency: *Combined Heat and Power***
  CHP, also known as cogeneration, refers to the simultaneous production of electricity and thermal energy from a single fuel source. Utilizing CHP systems in affordable housing can significantly improve home energy efficiency and help to reduce GHG emissions.
- **Energy Efficiency: *Energy-Efficient Product Procurement***
  Many local governments are saving energy by requiring that the energy-using products they purchase meet energy efficiency criteria. By promoting the use of energy-efficient products in affordable housing, local governments can help reduce energy loads and increase the cost-effectiveness of other energy efficiency activities, benefiting both low-income residents and building owners.

1. OVERVIEW

Local governments can create economic, environmental, and public health benefits for their communities by improving energy efficiency in affordable housing. Households across the nation spend $230 billion on energy to heat, cool, light, and live in their homes each year, and residential energy use accounts for more than 20 percent of the nation's total energy consumption (U.S. EIA, 2012, 2017). These energy costs contribute to the overall financial burden of housing, and can make housing unaffordable for many families.

Low-income households spend about twice as much on energy, as a percentage of income, as the average household (U.S. EIA, 2013b). In 2014, close to 40 million households spent 30 percent or more of their incomes on housing—the threshold used by the U.S. Department of Housing and Urban Development (HUD) to identify affordability (see text box to the right) (Harvard University, 2016). Low-income households may experience a higher energy cost burden for two main reasons: 1) the percentage of income used to pay for energy generally declines as income increases, and 2) outdated equipment and poor housing conditions can lead to higher than average energy use and costs. For example, many low-income households tend to have poor insulation, drafty doors and windows, and inefficient appliances.

The American Council for an Energy-Efficient Economy estimates that 35 percent of the energy cost burden experienced by low-income households could be alleviated if low-income housing were brought up to the efficiency level of the average U.S. home (ACEEE, 2016a). By designing energy efficiency programs to serve affordable housing, local governments can help address this energy burden while taking significant steps toward meeting their energy and environmental goals, and providing multiple benefits to owners and renters. Improvements in energy efficiency can reduce low-income households' vulnerability to energy price fluctuations; free up money for other uses; improve comfort, indoor air quality, and health; and create economic and environmental benefits for the local community and region, such as increased employment and reduced demand for federal assistance program resources (U.S. EPA, 2011). Local governments can maximize these benefits by using a whole-building approach to energy efficiency that treats the building as an integrated system, incorporating onsite or community-based renewable energy technologies[2] and green building techniques, and considering surrounding land uses and location when planning housing design and development.[3]

AFFORDABLE HOUSING

This guide focuses on strategies to improve energy efficiency in subsidized affordable housing that is intended for low-income households.

Subsidized affordable housing includes both *public* housing, in which a government agency pays all or a portion of the occupants' monthly housing cost; and *private* housing, whose owners receive tax credits and other subsidies to set aside a percentage of their dwellings for low-income households.

Owners of subsidized affordable housing may include:

- Local governments;
- Community development corporations (CDCs);
- Public housing authorities (PHAs); and
- Other public and private entities.

HUD defines affordability as meaning that no more than 30% of a household's annual income is spent on housing (U.S. HUD, 2007a). The affordable housing market is an amalgamation of programs operated by federal and state agencies and government-sponsored enterprises, each with its own set of rules, including income limits.

Local governments can work with a range of stakeholders to improve energy efficiency in affordable housing. Some local governments own and develop their own affordable housing, and can take direct action to implement energy efficiency projects in these developments. Local governments that do not own or manage affordable housing developments can leverage relationships with developers, homeowners, and other public and private organizations to improve energy efficiency in existing affordable housing, and to design new affordable housing to achieve superior energy performance.

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[2] *For more information on renewable energy opportunities, specifically for federally subsidized housing, see HUD's Renew300 Initiative website, available at* ***https://www.hudexchange.info/programs/renewable-energy/****.*

[3] *For example, local governments can integrate their energy efficiency efforts in affordable housing with smart growth and transportation strategies to put development in locations that are well-connected to the region by public transit, take advantage of existing infrastructure, and are affordable for residents with a range of incomes. For more information, see the Smart Growth and Transportation Control Measures guides in the Local Government Climate and Energy Strategy Series, available at* ***https://www.epa.gov/statelocalenergy/local-government-strategy-series****.*

Efforts to improve energy efficiency in affordable housing face a number of barriers, many of which can be addressed through effective program design. For example, owners and tenants of affordable housing often lack capital, access to credit, and the expertise necessary to implement energy efficiency improvements. In apartments where tenants pay the energy bills, owners may have little incentive to make efficiency upgrades, and program eligibility gaps can leave some low-income households struggling to pay their energy bills (Energy Programs Consortium, 2013). In addition to the examples throughout this guide, U.S. Environmental Protection Agency's (EPA's) *Bringing the Benefits of Energy Efficiency and Renewable Energy to Low-Income Communities* series provides case studies and profiles of programs that have successfully addressed these barriers (see the text box on page 23 for more information).

This guide focuses on how local governments can take an active role in improving energy efficiency in affordable housing units they own and develop, and advance energy efficiency in affordable housing owned and developed by other public and private entities, such as CDCs and PHAs.[4] It provides information on the benefits of improving energy efficiency in affordable housing, expected investment and funding opportunities, and case studies. Section 10, *Additional Examples and Information Resources*, provides a compilation of further examples and sources of information.

2. BENEFITS OF ENERGY EFFICIENCY IN AFFORDABLE HOUSING

Improving energy efficiency in affordable housing can have many energy, environmental, and economic benefits. These benefits generally accrue to the homeowner and/or renter, but can also extend to the local community and region. Local governments can promote energy efficiency in affordable housing to:

- *Reduce greenhouse gas (GHG) emissions and other environmental impacts.* Improving energy efficiency in affordable housing can help reduce emissions of GHGs and criteria air pollutants by decreasing consumption of fossil fuel-based energy. Fossil fuel combustion for electricity generation accounts for 37 percent of the nation's carbon dioxide (CO_2) emissions, a principal GHG; 68 percent and 14 percent of the nation's sulfur dioxide and nitrogen oxide emissions, respectively, which can lead to smog and acid rain; and trace amounts of airborne particulate matter that can cause respiratory problems for many people (U.S. EPA, 2016f, 2017a). An ENERGY STAR certified new home can achieve GHG emissions reductions of up to 2 metric tons of CO_2 each year (U.S. EPA, 2016a).[5]

The City of St. Louis, Missouri, has incorporated a number of affordable housing strategies into its sustainability plan, including a strategy to improve energy efficiency in public housing through a weatherization program, energy audits, lighting and appliance upgrades, green or reflective roofing installations, and building energy system upgrades. The city will count energy savings from these improvements toward its goal of reducing GHG emissions 80 percent by 2050. Under the St. Louis Climate Action Plan, released in 2017, the city will establish an energy efficiency concierge service to improve energy efficiency in multifamily affordable housing (St. Louis, 2013, 2017).

COST-SAVINGS BENEFITS ARE ACCRUING TO RESIDENTS AND BUILDING OWNERS

An Elevate Energy study assessed the economic and other benefits reported by residents and owners of an affordable multifamily development in Chicago following energy efficiency improvements that included air sealing, roof cavity insulation, and furnace replacement. Tenants in these buildings pay for their own gas and electricity.

The study found that post-retrofit energy savings, shared between building owners and tenants, amounted to 10 percent of the buildings' total utility expenses. Building owners' expenses for repairs and maintenance declined by 17% after the retrofits. Most residents reported improved comfort, 70% said they planned to renew their leases, and about 33% said they felt more confident and less stressed about paying rent and utility bills after the retrofit.

Source: Elevate Energy, 2014a.

Reducing energy consumption can also help achieve other local government environmental objectives, such as resource conservation and pollution prevention. For example, purchasing an ENERGY STAR certified energy-efficient clothes washer to reduce energy bills

[4] *This guide refers to these various stakeholders collectively as "developers."*

[5] *Energy use in the residential sector accounts for 20 percent of all U.S. GHG emissions from fossil fuel combustion (U.S. EPA, 2016f).*

can also help lower a water utility's costs and decrease the amount of used water that enters the wastewater system (U.S. EPA and U.S. DOE, 2008).

- *Reduce energy costs.* Energy costs consume 7 percent of total annual income for low-income urban households (compared with a national average of only 3.5 percent), and energy costs are typically the highest controllable operating expense in affordable multifamily housing (Energy Efficiency for All and ACEEE, 2016). Reducing operating expenses helps providers of affordable housing maintain reasonable rents, ensuring that housing remains affordable. According to EPA, ENERGY STAR certified homes are at least 10 percent more energy efficient than homes built to code and achieve a 20 percent improvement on average, while providing homeowners with better quality, performance, and comfort. The U.S. Department of Energy (DOE) estimates that improvements to existing homes such as eliminating air leaks and upgrading heating and cooling equipment can save homeowners between $200 and $400 per year on their utility bills on average (U.S. DOE, Undated).[6]

  In affordable housing rentals, utility savings can accrue to the renter or the building owner (Shafer, 2003).[7] In some affordable housing units, utility costs are embedded in rent payments, whereby the building owner will reap the direct benefits of energy efficiency improvements, with the resident benefiting indirectly from the potentially lower risk of a rent increase. In such cases, residents may have no obvious incentive to reduce their energy use and education is critical. When residents pay utility bills directly, they are the direct beneficiaries of much of the energy cost savings; building owners can still benefit from reduced energy consumption in building common areas, lower operations and maintenance costs, and reduced tenant turnover and vacancy rates (Elevate Energy, 2014b).

- *Create jobs and develop markets.* Investing in energy efficiency can stimulate the local economy and encourage the development of energy efficiency service markets. Across the nation, 2.2 million Americans were employed, in whole or in part, in the design, installation, and manufacture of energy efficiency products and services in 2017, an increase of 133,000 jobs over 2016 (U.S. DOE, 2017d).

KING COUNTY HOUSING AUTHORITY—WEATHERIZATION PROGRAM

The King County Housing Authority (KCHA) typically invests $4–5 million annually in weatherizing and repairing affordable housing units in King County, Washington. Weatherization can improve comfort and significantly reduce wasted energy. Weatherization measures include adding insulation; retrofitting heating, ventilation, and air conditioning (HVAC) systems; and weather-stripping exterior doors.

One of the housing authority's projects involved a deep energy retrofit to a multifamily housing complex in Kent, Washington, which reduced annual energy costs by 22% while improving comfort and air quality for residents.

Sources: NREL, 2014; KCHA, 2016.

- *Demonstrate leadership.* Promoting energy efficiency in affordable housing can help raise public awareness about energy conservation, environmental, health and wellness, economic, and other benefits of energy efficiency by making these benefits tangible for affordable housing residents. Increased awareness of these benefits encourages the broader adoption of energy efficiency throughout the community.

  In 2014, the Ann Arbor, Michigan, Housing Commission launched a high-profile renovation and new construction initiative for its affordable housing stock. The projects prominently feature energy efficiency and renewable energy, ranging from lighting and equipment upgrades to solar rooftop installations. The commission expects the efficiency upgrades to reduce its total energy costs by 20 percent, and one of the new developments includes a community center that will showcase advanced building energy technologies. The city's energy office developed brochures on energy efficiency for residents, and the commission has partnered with local schools and universities to develop educational projects (AAHC, 2017).

  Local governments can also offer incentives for including energy efficiency in affordable housing, thus encouraging developers, architects, contractors, property management firms, and retailers to invest in their own energy efficiency expertise and develop energy-efficient products and services (AHEE, 2007).

[6] *The average household utility bill is approximately $2,000 per year (U.S. DOE, Undated).*

[7] *Some PHAs provide subsidies to private landowners to develop and manage public affordable housing units.*

For more information on how local governments can lead by example through energy-efficient product procurement, see EPA's *Energy-Efficient Product Procurement* guide in the *Local Government Climate and Energy Strategy Series*.

- *Improve indoor air quality.* Improving energy efficiency can enhance indoor air quality when used with adequate ventilation systems. Properly installing insulation and sealing air leaks in a home's envelope and duct system, for example, can reduce heating and cooling energy costs and improve indoor air quality by ensuring an adequate supply of fresh air, minimizing infiltration of dust and pollen from attics and basements into living areas, and reducing noise and odors from outdoors (U.S. EPA, 2008b). These benefits can be especially significant for seniors or other people particularly susceptible to poor air quality.

EPA'S INDOOR AIR QUALITY GUIDELINES FOR UPGRADES TO MULTIFAMILY BUILDINGS

EPA has developed a set of voluntary indoor air quality guidelines to help building owners ensure healthy indoor environments during upgrades, retrofits, and renovations (including energy upgrades) to multifamily residential buildings. These guidelines provide assessment protocols for 24 priority issues, and describe critical minimum actions to correct deficiencies identified during assessments, incorporate minimum indoor air quality protections, and ensure that work does not cause or worsen indoor air quality or safety problems for occupants or workers.

The guidelines also include a set of actions to promote healthy indoor environments that can be taken during many building upgrade projects.

To help owners and developers implement the guidelines, EPA created an Excel-based tool for developing custom verification checklists tailored to the specific energy upgrade or other multifamily upgrade projects being undertaken.

The guidelines and checklist tool are available at ***https://www.epa.gov/indoor-air-quality-iaq/energy-savings-plus-health-indoor-air-quality-guidelines-multifamily-building***.

- *Increase comfort.* Improving energy efficiency can increase comfort for residents through:
  - *Drier basements*. Damp basements can lead to increased indoor humidity, structural damage, and mold. Improving home energy efficiency through proper insulation and duct sealing helps to control air flow, thereby controlling moisture levels and ensuring better air quality.
  - *Warmer floors and less drafty rooms in the winter.* Energy efficiency upgrades can reduce unwanted air infiltration and improve duct performance, which can help prevent chilly floors and reduce drafts during colder months.
  - *Less moisture on windows*. Higher-efficiency windows and lower indoor humidity levels can reduce moisture build up on windows and help prevent mold growth and damage to window sills (U.S. EPA, 2008b).
- *Increase property value.* Implementing energy efficiency projects in affordable housing can increase property values for owners. An energy-efficient house or multifamily building may command a higher sale price due to reduced utility costs. In addition, energy-efficient features can often mitigate structural damage, preserving a building's value. For example, sealing and insulating a home or multifamily building can reduce energy costs and prevent the formation of ice dams. Ice dams, which can damage roof drainage systems, are formed when warm air inside the building leaks into the attic, warming the underside of the roof and causing snow and ice to melt and refreeze as it runs off the roof (U.S. EPA, 2008b).
- *Improve building and community resilience.* Renewable energy and certain energy efficiency technologies, such as combined heat and power (CHP), can enable buildings to continue providing electricity and space conditioning to their residents during storms and other events that disrupt the electricity grid (U.S. DOE et al., 2013). CHP and renewable energy sources can be used in conjunction with energy storage technologies to form microgrids—local grids that can disconnect and operate autonomously from the main power grid. Microgrids can improve resilience by helping communities maintain power when the main electric grid is down (U.S. DOE, 2017c). See page 13 for more information on CHP technologies.
- *Reduce reliance on energy assistance programs.* Improving energy efficiency in affordable housing can decrease residents' reliance on energy assistance programs offered by utilities and state and federal government authorities. As a result, that funding can go toward other programs. For example, utility costs—in the form of subsidies to property owners and housing authorities or utility allowances to families living in private housing—comprise

15 percent of HUD's annual budget, amounting to $6.8 billion (Brookings Institution, 2010). Utility costs also account for 23 percent of the operating budgets of PHAs (Brookings Institution, 2010). Savings in this area could be used to increase funding to other housing and economic and community development programs.

- *Improve tenant retention and avoid utility arrearages.* Reducing the energy cost burden on affordable housing residents can help minimize turnover and vacancy rates. Owners of multifamily buildings have estimated the costs of filling a vacant unit at $900–$3,000, including cleaning, repainting, and performing deferred maintenance and upgrades that are difficult to complete when a unit is occupied (Elevate Energy, 2014b). When residents' living environments are comfortable and affordable, they are more likely to renew their leases. Lower energy costs also improve residents' ability to pay their utility bills, which have been rising faster than income since the 1980s (Harvard University, 2011).
- *Preserve affordability.* Utility costs, in addition to rent, are an important factor in determining a home's affordability (AHEE, 2007). Energy efficiency can help to ensure that low-rent housing remains affordable. Based on multiple studies of energy efficiency potential in multifamily affordable housing in the United States, cost-effective energy savings of 15–30 percent should be achievable in many buildings (Energy Efficiency for All, 2015).

The Kitsap County, Washington, Consolidated Housing Authority created the Home Rehabilitation Program to ensure that public housing in the county remains affordable by helping tenants reduce their energy and water bills. The program offers interest-free deferred loans and other financing options for efficiency upgrades and repairs (KCCHA, 2016).

3. PLANNING AND DESIGN APPROACHES FOR ENERGY EFFICIENCY IN AFFORDABLE HOUSING

While most local governments do not own or develop affordable housing, many work closely with developers who do. Local governments can use the approaches outlined in this section as a reference when collaborating with other affordable housing stakeholders (e.g., developers, community-based outreach agencies, nonprofits, and other organizations) to improve energy efficiency in affordable housing. Local governments can also take direct action to support energy efficiency in affordable housing using the strategies described in Section 5, *Opportunities for Local Governments to Support Energy Efficiency in Affordable Housing.*

EPA's ENERGY STAR program has developed many programs and tools that local governments can use to plan and implement programs to improve energy efficiency in affordable housing (see Table 1 on the next page, *ENERGY STAR Program Resources*). These resources, such as the Home Performance with ENERGY STAR program for existing homes, ENERGY STAR certified Homes program for new construction, ENERGY STAR Multifamily High Rise (MFHR) program, and ENERGY STAR for Existing Multifamily housing program, feature a comprehensive, whole-building approach to maximize the benefits of energy efficiency investments. For example, making a single energy efficiency improvement, such as upgrading to a more efficient HVAC system, can have positive effects, but if the duct work is leaky or the windows and doors are drafty, the resident will not experience the full benefits of energy efficiency. Using energy modeling or diagnostic tools in the planning process can help identify the most cost-effective, comprehensive opportunities for investment. A whole-house approach may also help create jobs in the community for home energy auditors, equipment installers, and people responsible for measuring and verifying that the work is done properly.

PINELLAS COUNTY, FLORIDA, REQUIRES AFFORDABLE HOUSING NEW CONSTRUCTION TO MEET ENERGY STAR SPECIFICATIONS

The Pinellas County Department of Community Development (PCDCD) promotes the production of energy-efficient affordable housing through its Model Homes Program. With zero-interest construction loans and access to low-cost infill land as incentives, participating builders and nonprofits construct and certify new homes to meet ENERGY STAR specifications. The PCDCD partners with the local utility, Progress Energy, to provide no-cost inspections and testing, and also reimburses builders for certification costs.

Homes include energy-efficient HVAC systems, properly installed insulation, energy-efficient windows, ENERGY STAR certified appliances, and compact fluorescent lighting. The utility costs for a Model Homes Program house is estimated at $60–$100 per month, around half of the county average.

Source: PCDCD, 2016.

TABLE 1. ENERGY STAR Program Resources

Title/Description	Website
ENERGY STAR Resources for Affordable Housing	
ENERGY STAR for Affordable Housing. This website provides information for planning energy efficiency improvements in affordable housing, including resources for new and existing construction, efficient products, and related programs.	***https://www.energystar.gov/index.cfm?c=affordable_housing.affordable_housing_low_income***
ENERGY STAR in Affordable Housing Case Studies. EPA has collected case studies on ENERGY STAR certified affordable housing projects that demonstrate how developers successfully incorporated energy-efficient designs in newly constructed affordable homes.	Please see the "Additional Resources" box on the right-hand side of the ENERGY STAR for Affordable Housing home page: ***https://www.energystar.gov/index.cfm?c=affordable_housing.affordable_housing_low_income***
White Paper on Utility Strategies for Implementing ENERGY STAR in Affordable Housing. This white paper describes opportunities for utilities to develop and implement energy efficiency programs to support affordable housing.	***https://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Utility_White_Paper_102206.pdf?1580-dd26***
ENERGY STAR Tools and Guidance for Existing Homes	
Home Improvement with ENERGY STAR. This website provides information and resources for consumers on the benefits of, and approaches to, improving energy efficiency in homes.	***https://www.energystar.gov/campaign/knowledgeCenter***
Home Performance with ENERGY STAR. DOE and EPA's Home Performance with ENERGY STAR program provides a comprehensive, whole-house approach to improving energy efficiency. Through this program, participating contractors offer whole-home diagnoses and develop home-specific recommendations for improving energy efficiency.	***https://www.energystar.gov/campaign/improvements***
My ENERGY STAR. This is a customizable platform where consumers can learn about energy-savings opportunities in their homes, track their actions and the impact of those actions, and discover special deals.	***https://www.energystar.gov/campaign/home***
ENERGY STAR Home Advisor. In this tool, a homeowner can create a profile of their home's energy efficiency features and receive a prioritized list of energy-saving recommendations customized to their home. This tool is integrated with the My ENERGY STAR platform.	***http://www.energystar.gov/homeadvisor***
ENERGY STAR Yardstick. This tool can be used to compare a home's energy efficiency to similar homes across the country. By answering a few basic questions, including entering the home's energy use, the Yardstick provides a score from 0 to 10. This tool is available as a web service and can also be used in an iframe.	***http://www.energystar.gov/yardstick***
ENERGY STAR Certified Products. This website provides information on energy efficiency specifications for more than 60 ENERGY STAR certified product categories, along with Product Finder and Rebate Finder search tools.	***https://www.energystar.gov/products***
ENERGY STAR Best Value Finder. This tool is a consumer resource for smart savings. It features ENERGY STAR refrigerators, televisions, light bulbs and room air conditioners being offered at the lowest prices. The tool offers location and product relevant rebates and deals shared by partners.	***https://www.energystar.gov/best-value-finder***
ENERGY STAR Ways to Save. This webpage provides advice, tools and resources to help consumers tackle energy savings in their homes. It features filterable lists of action items and projects you can take room by room to save energy, including actions for renters.	***https://www.energystar.gov/campaign/waysToSave***
ENERGY STAR Common Home Problems. EPA has compiled a list of solutions to common home problems that can help improve a home's energy efficiency and comfort.	***http://www.energystar.gov/index.cfm?c=home_improvement.hm_improvement_solutions***
ENERGY STAR Home Energy Raters. EPA has compiled a list of certified home energy raters who perform the required verification of ENERGY STAR homes, and who can help developers and homeowners ensure their homes meet energy efficiency performance standards.	***https://www.energystar.gov/index.cfm?fuseaction=new_homes_partners.locator***

Title/Description	Website
ENERGY STAR for Existing Multifamily. Information, tools, and resources for property managers to improve the energy efficiency of existing multifamily housing properties, and meet the parameters to earn recognition from ENERGY STAR.	*https://www.energystar.gov/buildings/owners_and_managers/existing-buildings/find_resources_your_property_type/energy_star_multifamily_housing*
ENERGY STAR Verified HVAC Installation (ESVI). This program promotes the importance of designing, installing, and optimizing proper, efficient HVAC systems for existing homes. Only contractors participating in an EPA-recognized, locally sponsored program can offer ESVI.	*http://www.energystar.gov/esvi*
ENERGY STAR Tips for Hiring a Heating and Cooling Contractor. EPA has developed a set of tips for selecting a qualified heating and cooling contractor.	*http://www.energystar.gov/index.cfm?c=heat_cool.pr_contractors_10tips*
ENERGY STAR Tools and Guidance for New Homes	
ENERGY STAR Certified Homes. EPA has developed program requirements for newly constructed homes to earn the ENERGY STAR certification. Meeting these requirements can save a household between 15% and 30% on energy costs, and result in a home built better from the ground up.	*https://www.energystar.gov/newhomes*
Features of ENERGY STAR Certified Homes. This website provides information on the main features and benefits of living in an ENERGY STAR certified home, and includes links to fact sheets and resources for homebuyers.	*https://www.energystar.gov/newhomes/explore_features_benefits*
ENERGY STAR Multifamily High Rise Program. EPA has developed specifications for certifying units in multifamily mid- and high-rise buildings. These buildings are designed to be at least 15% more energy efficient than a building built to minimum code requirements.	*http://www.energystar.gov/mfhr*
Indoor airPLUS Program. EPA has developed the Indoor airPLUS program to help builders meet market demand for improved indoor air quality and energy efficiency in newly constructed homes. Meeting the ENERGY STAR Certified Homes program requirements is a prerequisite to earning the Indoor airPLUS label.	*https://www.epa.gov/indoorairplus*
Green Building Begins with ENERGY STAR Blue. Information on how to incorporate energy efficiency into green home designs.	*https://www.energystar.gov/newhomes/green_homes*
ENERGY STAR Financial Calculators	
Cash Flow Opportunity Calculator. This tool can be used to determine how much new energy-efficient equipment can be purchased based on estimated cost savings; whether equipment should be purchased now using financing, or if it is better to wait and use cash from a future year's budget; and whether money is being lost by waiting for lower interest rates.	*https://www.energystar.gov/CFOcalculator*
Financial Value Calculator. This tool presents energy efficiency investment opportunities in terms of key financial metrics. It can be used to determine how energy efficiency improvements can affect organizational profit margins and returns on investments.	*https://www.energystar.gov/buildings/tools-and-resources/financial-value-calculator*
Energy-Efficient Products Savings Calculators. These calculators can be used to estimate the life-cycle and annual costs and savings of a variety of ENERGY STAR certified products.	*http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products*
Additional ENERGY STAR Resources and Tools	
ENERGY STAR for State and Local Governments. This website provides resources for state and local governments to use as they plan energy efficiency activities, including energy management guidelines, information on financing options, and tools and resources to measure and track energy use.	*https://www.energystar.gov/buildings/program-administrators/state-and-local-governments*
ENERGY STAR for Buildings and Plants. This website provides information and resources for buildings, including multifamily construction. Users can select the most appropriate tab to find ENERGY STAR resources for building owners and managers, service providers, program administrators, and tenants. This site also includes information on ENERGY STAR Tools and Resources, and Training.	*https://www.energystar.gov/buildings*

Title/Description	Website
ENERGY STAR Portfolio Manager. This free, online software tool allows building owners and managers to measure and track energy, water, and waste consumption in a building or group of buildings. Multifamily properties that have 20 or more units and whole building data can use ENERGY STAR Portfolio Manager to see their 1–100 ENERGY STAR score and 1–100 EPA Water Score—showing how their property compares in efficiency with similar properties nationwide—by setting up an account and inputting basic details about their property along with its corresponding energy and/or water consumption data. Properties that score a 75 or higher in the 1–100 ENERGY STAR score can use apply for ENERGY STAR certification through this tool.	*http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager*
ENERGY STAR Score for Multifamily Housing in the United States. This website provides information on the ENERGY STAR score, which can be used to compare energy consumption in multifamily buildings against similar buildings nationwide. The ENERGY STAR score ranges from 1 to 100; a score of 50 represents median energy performance, while a score of 75 or better indicates the building is a top performer and is eligible for ENERGY STAR certification.	*https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/how-1-100*
ENERGY STAR Utility Data Access Map. This interactive map allows users to input a zip code and find utilities that offer easier access to the data that is needed for benchmarking, including whether each offers whole-building data for multifamily properties.	*https://www.energystar.gov/buildings/owners_and_managers/existing_buildings/use_portfolio_manager/find_utilities_provide_data_benchmarking*
ENERGY STAR Policy and Program Map. This interactive map shows mandatory and voluntary benchmarking initiatives around the country.	*https://www.energystar.gov/buildings/program-administrators/state-and-local-governments/see-federal-state-and-local-benchmarking-policies*
ENERGY STAR Licensed Professional Finder. For those interested in receiving ENERGY STAR certification for their existing multifamily property, this search tool allows users to find licensed professionals in the area that are able to verify applications for certification. In addition, the search lets users filter by licensed professionals that offer pro-bono verification.	*https://www.energystar.gov/buildings/lp_finder*
The ENERGY STAR Challenge. The *ENERGY STAR Challenge—Build a Better World 10% at a Time* is a global call-to-action for industrial sites to reduce their energy intensity by 10% within five years. Any industrial site can participate, and those that achieve this goal will earn EPA recognition.	*https://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants/earn_recognition/energy_star_challenge_industry2*
ENERGY STAR Partner of the Year Award. Information is available on the annual ENERGY STAR Partner of the Year award, and profiles of the previous year's awardees, including affordable home builders, developers, and verifiers.	*https://www.energystar.gov/about/2016_energy_star_award_winners*
Change the World, Start with ENERGY STAR Campaign. This campaign encourages participants across the country to replace energy-inefficient lights with efficient ones, and achieve additional benefits by implementing other household measures. Many affordable housing developers are participating in this campaign.	*http://www.energystar.gov/index.cfm?fuseaction=globalwarming.showPledgeHome*
My ENERGY STAR Account (MESA). This tool enables ENERGY STAR partners to keep their contact information current, so that they do not miss important news and information about the ENERGY STAR program. In addition, MESA can serve as the entry point to the ENERGY STAR website and tools such as Portfolio Manager, Homes Builder, ENERGY STAR logo downloads, Marketing Toolkit, Home Performance, and the third-party certification body (qualified product exchange) tools.	*http://energystar.gov/mesa*
ENERGY STAR Partner Locator. This tool can be used to locate home builders and developers that have experience constructing ENERGY STAR certified homes. It can also be used to locate lenders that offer energy-efficient mortgages, utilities that offer incentives to homebuyers, and home energy raters.	*https://www.energystar.gov/index.cfm?fuseaction=new_homes_partners.locator*
Federal Income Tax Credits for Energy Efficiency. This site provides information on tax credits available for energy-efficient purchases. ENERGY STAR products eligible for tax credits are independently certified to save energy, save money, and protect the environment.	*https://www.energystar.gov/about/federal_tax_credits*
ENERGY STAR Training Center. EPA offers free online training sessions on a variety of energy efficiency and building performance topics for ENERGY STAR partners and stakeholders across the ENERGY STAR program areas, including new and existing residential and commercial construction.	*https://www.energystar.gov/index.cfm?c=pt_univ.pt_univ*

Improving Energy Efficiency in Existing Affordable Housing

A systematic approach to energy efficiency that includes evaluating home energy consumption and developing an action plan is the most effective way to achieve the benefits described in Section 2, *Benefits of Energy Efficiency in Affordable Housing*. This section outlines the approach recommended by EPA's ENERGY STAR Home Improvement program.

Energy consumption in affordable housing units depends on the size and layout. For example, individual units in a multifamily affordable housing building will have different energy demands than a single-family home. While the information provided here is directed primarily at improving energy efficiency in smaller single-family affordable homes, many of the basic concepts covered are relevant to improving energy efficiency in large multifamily buildings. When large, multifamily buildings have energy-consumption characteristics similar to those of commercial buildings, local governments and affordable housing developers can follow the steps outlined in EPA's *ENERGY STAR Guidelines for Energy Management*.[8]

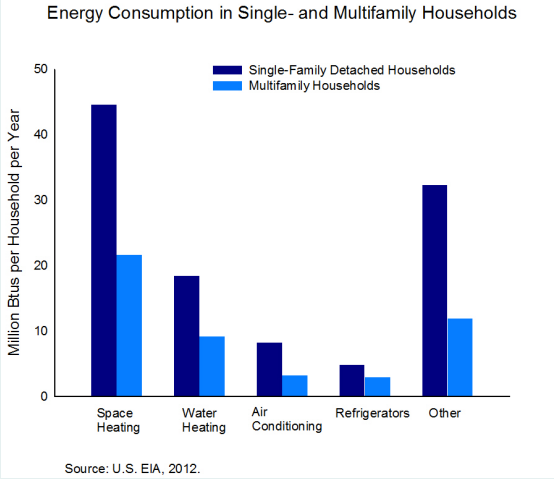
EVALUATE HOME ENERGY CONSUMPTION

The first step in improving energy efficiency in affordable housing is to gather energy consumption information. Figure 1 shows how energy is consumed by different end uses in a typical single-family and multifamily building.

- *Comprehensive energy audits.* A comprehensive energy audit conducted by a professional auditor can reveal opportunities to maximize the benefits of energy efficiency improvements. These auditors use a variety of techniques and advanced equipment to identify even small leaks in a home's envelope that can lead to wasted energy.

  Many local governments have established home energy-assistance programs working directly with homeowners and renters, or indirectly through other stakeholders to conduct comprehensive home energy evaluations. DOE's Weatherization Assistance Program (WAP) provides funding and technical guidance to state agencies, which in turn allocate the funding for low-income energy assistance to local governments, nonprofit organizations, and developers, according to their own rules. (See page 11 and Section 8, *Federal, State, and Other Program Resources,* for more information).

FIGURE 1. Energy Consumption in Single-Family and Multifamily Households.



Note: "Other" includes other appliances and lighting.

The Seattle, Washington, Office of Housing administers a home weatherization program that offers a free home energy audit to residents who meet certain low-income qualifications. Following the energy audit, the city will implement a weatherization package of energy efficiency projects to improve home insulation, venting, and envelope sealing. The program receives its funding from the DOE WAP through the Washington Department of Community, Trade, and Economic Development (Seattle, 2016).

In addition to government-funded audits through weatherization programs, local governments and developers can often obtain assistance from the many municipally owned utilities that offer free or discounted home energy audits.[9]

[8] *The ENERGY STAR Guidelines for Energy Management are available at* ***https://www.energystar.gov/buildings/about-us/how-can-we-help-you/build-energy-program/guidelines****. For more information on ENERGY STAR resources for buildings and plants, visit* ***http://www.energystar.gov/index.cfm?c=business.bus_index****.*

[9] *Visit* ***http://www.energystar.gov/index.cfm?c=home_improvement.hm_improvement_audits*** for *information on ENERGY STAR approved auditors.*

In Tallahassee, Florida, the *Your Own Utilities* program offers free energy audits to all local utility customers. Customers can use the information gathered through the free energy audit as the basis for energy efficiency projects, many of which the utility funds through a variety of rebates and financial incentives. The program is administered by the local utility, which is owned and operated by city employees and is responsive to the city's publicly elected governing body (Tallahassee, 2017).

One highly effective way to evaluate energy consumption is to work with the Home Performance with ENERGY STAR program. This EPA and DOE program provides a comprehensive, whole-house approach to improving energy efficiency. Through this program, participating contractors offer whole-home diagnoses and develop home-specific recommendations for improving energy efficiency. The quality of these diagnoses and recommendations are guaranteed by program sponsors (often state energy offices, utilities, or nonprofit energy efficiency organizations). These sponsors often provide training for participating contractors and conduct inspections to verify that contractors' work meets ENERGY STAR standards.[10]

- *Assistance for do-it-yourself (DIY) evaluations.* Local governments can also work with homeowners and renters, or collaborate with other stakeholders who do, to provide them with the information and tools to perform DIY energy evaluations, including:
  - *My ENERGY STAR*. This personalized website allows users to track their energy-saving activities, impact, and to-do items; along with one-stop access to rebates, coupons, and special offers. My ENERGY STAR collects and stores data from the ENERGY STAR Home Advisor and ENERGY STAR Yardstick (described below) to allow users to track their tasks and monitor their progress. See ***https://www.energystar.gov/campaign/home*** for more information.
  - *ENERGY STAR Home Advisor*. The ENERGY STAR Home Advisor guides a homeowner through a DIY energy assessment to create an ENERGY STAR Home Profile. Based on the Home Profile, this tool will provide customized, prioritized recommendations for improvements. From these recommendations, the user can create a "to-do" list of projects to tackle. See ***http://www.energystar.gov/homeadvisor*** for details.
  - *ENERGY STAR Yardstick.* Homeowners can use this tool to compare their home's annual energy use with that of similar homes across the country. By answering a few basic questions about the home, including its energy use, homeowners receive their home's Home Energy Yardstick score (on a scale of 0 to 10); insights into how much of their home's energy use is related to heating and cooling versus other everyday uses such as appliances, lighting, and hot water; links to guidance from ENERGY STAR on how to increase their home's score, improve comfort, and lower utility bills; and an estimate of their home's annual carbon emissions. See ***http://www.energystar.gov/yardstick*** for more information.

DEVELOP AN ACTION PLAN TO IMPROVE ENERGY EFFICIENCY

After evaluating the home's energy consumption, the next step is to develop and implement an energy efficiency action plan for existing homes using recommended practices, such as those outlined by ENERGY STAR. A comprehensive action plan considers the interactions of a home's energy-using systems (e.g., lighting, air distribution, heating, and cooling systems). Because the interactions are complicated, the best option for local governments might be to help homeowners, and other stakeholders who work with homeowners, access certified home energy raters who have energy efficiency expertise and can ensure that energy efficiency projects achieve the intended results. Local governments can also encourage homeowners, renters, and other stakeholders to participate in the Home Performance with ENERGY STAR program when planning energy efficiency projects.

The ENERGY STAR approach to improving energy efficiency in homes generally involves the following:

- *Purchase energy-efficient equipment and appliances*. Through ENERGY STAR, EPA develops energy efficiency specifications for more than 70 product categories. Relative to conventional products, ENERGY STAR certified products typically use 10 to 75 percent less energy and can offer consumer energy cost savings of as much as 75 percent (U.S. EPA, 2016h). Energy-efficient products can also reduce

[10] *ENERGY STAR has collected a list of local program sponsors, available at* ***https://www.energystar.gov/campaign/improvements/find_local_help/full_list***.

energy costs indirectly during the warmer months of the year, since they do not generate as much unwanted heat as conventional products, thus lowering cooling energy loads.

- *Seal and insulate efficiently*. Sealing and insulating a home's envelope is often the most cost-effective way to improve energy efficiency. Steps for sealing and insulating involve:

  1. Seal air leaks throughout the home to stop drafts, with the emphasis on sealing the attic lid.
  2. Add insulation to block heat loss in winter and heat gain in summer, but always seal bypasses and holes before adding insulation.
  3. Install ENERGY STAR certified windows when replacing windows.

  EPA estimates that sealing air leaks and adding insulation will save a typical U.S. home 15 percent on heating and cooling energy costs, or 11 percent of all energy costs (U.S. EPA, 2014), while installing ENERGY STAR windows would save 12 percent in energy costs on average (U.S. EPA, 2015a).

- *Heat and cool efficiently*. Heating and cooling demand accounts for up to 50 percent of a home's energy consumption (U.S. EIA, 2013a). EPA has identified the following six steps for improving the energy efficiency of heating and cooling systems once a home has been sealed and insulated efficiently:

  1. *Change air filters regularly*. Air filters should be checked monthly and changed at least every three months, since dirty filters restrict air flow and force heating and cooling systems to work harder (U.S. EPA, 2009).
  2. *Tune up HVAC equipment yearly*. Heating and cooling contractors can identify opportunities to improve HVAC system performance, which can reduce energy costs (U.S. EPA, 2009). EPA has collected a set of tips for selecting a heating and cooling contractor, available at ***http://www.energystar.gov/index.cfm?c=heat_cool.pr_contractors_10tips***.
  3. *Install a programmable thermostat*. A thermostat that can be programmed to increase or decrease home temperatures in sync with the times that the home is occupied can save as much as $180 in energy costs annually (U.S. EPA, Undated).
  4. *Seal heating and cooling ducts*. Leaks in heating and cooling ducts can lead to significant wasted energy. It is important to focus on sealing ducts that run through the attic, crawlspaces, unheated basements, and garages first before wrapping the ducts in insulation. These areas are unconditioned spaces where residents of the home spend little time, making leaks in these areas especially wasteful. Ducts inside the homes should also be sealed, and it is important to test static pressure after duct sealing to ensure the system has proper air flow to meet heating and cooling needs efficiently (U.S. EPA, 2009).
  5. *Install ENERGY STAR certified heating and cooling equipment*. HVAC contractors can design a system that meets a home's heating and cooling needs with equipment that will optimize airflow and comfort. ESVI requires a quality-assured verification procedure to ensure key performance metrics have been met (U.S. EPA, 2009).
  6. *Choose ENERGY STAR certified roofing products*. Reflective roof products can reduce the amount of air conditioning needed to cool buildings, and can reduce peak cooling demand by 10–15 percent. The energy savings that can be achieved by reflective roofing depend strongly on factors such as a building's design, insulation, climatic conditions, location, and building envelope efficiency (U.S. EPA, 2017c).

Local governments can refer homeowners and renters and other affordable housing stakeholders to additional information sources for guidance on improving energy efficiency in affordable housing units, including:

- *DOE programs*. DOE's Energy Saver program offers homeowners guidance on reducing energy costs in homes through energy efficiency and conservation measures. These measures include actions that homeowners can take in the short-term (e.g., behavioral changes to reduce energy costs in the winter) as well as longer-term, energy efficiency investments that can lead to significant energy cost savings (U.S. DOE, 2017b).

  The DOE WAP helps low-income families reduce their utility bills by improving energy efficiency in their homes. Since 1976, the program has provided weatherization assistance to more than 7 million families. The most recent evaluation of the program found that weatherization saved large multifamily buildings an average of 14 percent on heating fuel

costs and 6–11 percent on electricity costs (ORNL, 2015).

- *HUD energy programs*. HUD energy programs aim to reduce energy costs in HUD-assisted housing, including public housing and affordable housing in many areas. These programs provide new homeowners with guidance on improving energy efficiency, and identify opportunities for HUD-assisted housing units to incorporate ENERGY STAR products and services. HUD has developed several energy-saving guidance documents for public affordable housing, available at ***https://www.hud.gov/program_offices/public_indian_housing/programs/ph/phecc/resources***.

HUD's Mark-to-Market (M2M) Green Initiative for Affordable Multifamily Housing is a nationwide pilot initiative to encourage owners and purchasers of affordable, multifamily properties to rehabilitate and operate their properties using sustainable Green Building principles. These principles comprise sustainability, energy efficiency, recycling, and indoor air quality; and incorporate the "Healthy Housing" approach pioneered by HUD. The Green Initiative focuses on properties within HUD's Section 8 portfolio, specifically properties in the M2M Program administered by the Office of Affordable Housing Preservation. Learn more at ***http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/mfh/presrv/presmfh/greenini***.

HUD'S MULTIFAMILY UTILITY BENCHMARKING REQUIREMENTS AND RESOURCES

HUD strongly encourages utility benchmarking by companies, organizations, and agencies that own and manage the nation's housing stock. HUD specifically requires utility benchmarking in insured housing and for participants of certain voluntary programs, such as the Green Mortgage Insurance Premium (MIP) Reduction program and the Better Buildings Challenge.

- **The Green MIP Reduction program** offers reduced insurance premium rates for green multifamily housing to encourage owners to adopt higher standards for construction, rehabilitation, repairs, maintenance, and property operations.
- **The Better Buildings Challenge** provides financial and technical assistance to property owners and managers who make a public commitment to energy and/or water efficiency.

To support implementation, HUD has developed the **Multifamily Utility Benchmarking Toolkit**, which serves as a comprehensive guide to utility benchmarking for the multifamily sector, and is organized into three sections:

- **Benchmarking 101** describes the benefits of tracking utility data and explains how to begin the process of utility benchmarking, including an introduction to ENERGY STAR Portfolio Manager and several case studies.
- **Utility Benchmarking Step-by-Step** outlines a six-step approach to utility benchmarking, including developing a strategy that works for individual organizations, collecting and using utility data, and targeting energy- and water-efficiency improvements.
- **Policies and Programs** summarizes utility benchmarking requirements for various HUD programs, opportunities for financial assistance, and HUD programs that can support property owners in pursuing green retrofits.

For more information about HUD's benchmarking requirements and applicable programs, visit ***https://www.hudexchange.info/programs/utility-benchmarking/toolkit/policies-and-programs.***

To access HUD's Multifamily Utility Benchmarking Toolkit, visit ***https://www.hudexchange.info/programs/utility-benchmarking/toolkit***.

Source: U.S. HUD, 2017b.

Energy Efficiency in New Affordable Housing

In addition to working directly with homeowners and renters—and indirectly through other stakeholders—to improve energy efficiency in existing affordable housing, many local governments work with affordable housing developers to encourage energy efficiency in new affordable housing. This section describes how to incorporate energy efficiency in new affordable housing.

ENERGY-EFFICIENT NEW HOME FEATURES

Energy-efficient new homes include six principal energy-efficient features, including:

- *Effective insulation.* Effectively insulating a home's floors, walls, and attic ensures consistent temperatures throughout the building and prevents unwanted heat loss/gain, which can increase energy costs (U.S. EPA, 2008d).
- *High-performance windows.* Installing high-performance windows that include advanced energy efficiency technologies, such as protective coatings and tight-sealing frames, can keep heat in during the winter and prevent unwanted heat from entering the home in the summer (U.S. EPA, 2008k).
- *Tight construction and ducts*. Sealing holes and seams in the building's envelope and heating and cooling systems can help reduce heating and cooling loads and thus decrease the amount of energy required for these loads. Tight construction and ducts will enable homeowners to purchase smaller heating and cooling equipment, while still meeting heating and cooling loads. It is important to follow industry standards on duct design to ensure ducts are sized and installed correctly to optimize air flow to all rooms. The performance of ducts can be determined through testing by a qualified professional (U.S. EPA, 2008e).
- *Energy-efficient heating and cooling equipment*. Energy-efficient heating and cooling equipment can be quieter than conventional equipment and reduce indoor humidity, in addition to reducing the amount of energy required to heat and cool a home (U.S. EPA, 2008c, 2008f, 2008h). Using CHP systems that produce heat and electricity from a single fuel source can be an additional way to efficiently meet energy demands in multifamily housing developments. (See the text box at right and EPA's *Combined Heat and Power* guide in the *Local Government Climate and Energy Strategy Series* for more information on CHP technologies.)

COMBINED HEAT AND POWER

Multifamily affordable housing units can achieve improved energy efficiency by installing CHP systems that produce heat and electricity from a single fuel source. CHP is onsite electricity generation that captures heat that would otherwise be wasted, using it to provide thermal energy—such as steam or hot water—for space heating, cooling, domestic hot water, and industrial processes. In this way, and by avoiding distribution losses, CHP can achieve efficiencies of over 80%, compared to 50% for conventional technologies (e.g., grid-supplied electricity and an onsite boiler).

HUD and DOE have developed two guide books describing opportunities for CHP in multi-family housing and a screening tool to evaluate the potential for CHP systems in multifamily housing (see ***http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/library/energy***).

Sources: U.S. HUD, 2007b; U.S. EPA, 2016b.

- *Energy-efficient products.* Purchasing and installing energy-efficient products helps to reduce a home's supplemental energy loads. ENERGY STAR offers a range of products for residential use, including lighting fixtures, ventilation fans, and common household appliances (U.S. EPA, 2008j).
- *Third-party verification.* Independent home energy raters can provide energy-efficient design guidance and conduct onsite testing and inspections to verify that energy-efficient products and systems function as intended (U.S. EPA, 2008g).

PLANNING AND DESIGNING ENERGY-EFFICIENT NEW AFFORDABLE HOUSING

The features described above will achieve the greatest benefits when integrated in a comprehensive way that accounts for all the interactions between a home's energy-using systems. Affordable housing developers can find guidance on using a comprehensive, systematic approach to designing new homes for energy efficiency from several sources, including:

- *ENERGY STAR*. EPA has developed resources to guide developers through the process of designing and constructing energy-efficient new homes and apartments. Through the ENERGY STAR Certified New Homes program, EPA has issued energy efficiency standards specifying that homes be built to exceed the 2009 International Energy Conservation Code (IECC) energy efficiency requirements by at least 15 percent. (See the text box below on ENERGY

STAR certified new homes.) Homes built to ENERGY STAR standards typically produce energy cost savings of approximately 15 to 30 percent (U.S. EPA, 2015b). Across the nation, more than 840,000 homes have been designed to meet these standards. In addition, through the ENERGY STAR MFHR program, buildings are designed to be at least 15 percent more energy efficient than multifamily high-rise buildings built to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1. (See the text box below on the ENERGY STAR MFHR program.) As of 2015, more than 13,500 apartments have earned the ENERGY STAR certification (U.S. EPA, 2016e). When purchasing affordable housing units, local governments and other affordable housing stakeholders can give priority to homes that have earned the ENERGY STAR label.

With grant funding from the City of Toledo, Ohio, the nonprofit community development organization, NeighborWorks Toledo, completed construction on 40 affordable rent-to-own ENERGY STAR certified homes in 2014. Before building the homes, the organization worked with local contractors to develop several prototype houses as a way to explore approaches for meeting ENERGY STAR requirements. The prototype process proved invaluable to the contractors, most of whom had little previous experience in energy-efficient construction (U.S. EPA, 2016g).

- *DOE's Better Buildings Residential Program Solution Center*. DOE developed the Solution Center as a resource to help program administrators and partners plan, operate, and evaluate residential energy efficiency programs. It includes key lessons, best practices, handbooks, energy data facts, a glossary, and other resources (U.S. DOE, 2017a).

ENERGY STAR CERTIFIED NEW HOMES

ENERGY STAR certified homes are at least 10% more energy efficient than homes built to code and achieve a 20% improvement on average. To be eligible for certification, a home must be a:

- Detached dwelling unit (e.g., single family home); or
- Dwelling unit in any multifamily building with four units or less; or
- Dwelling unit in a multifamily building with three stories or fewer above-grade; or
- Dwelling unit in a multifamily building with four or five stories above-grade that has its own heating, cooling, and hot water system that is separate from the other units; and it occupies 80% or more of the occupiable three square footage of the building.

ENERGY STAR uses the Home Energy Rating System (HERS) to determine whether a home meets these requirements. This system produces a HERS Index score between 0 and 100, and uses computer software to evaluate the energy efficiency of a home compared with a computer reference home of identical size and shape. The computer reference home, which is assumed to meet the minimum requirements of the 2009 IECC,* is assigned a HERS Index score of 100. For every percent reduction in energy consumption compared to the reference home, the evaluated home receives a one-point decrease in its HERS Index score, with a score of 0 being assigned to a home that uses no energy. The 15% and 20% requirements established by ENERGY STAR correspond to HERS Index scores of 85 and 80, respectively. Other ENERGY STAR certified home guideline requirements include:

- Incorporation of energy-efficient duct systems that restrict leakage to no more than six cubic feet per minute per 100 square feet; and
- Inclusion of either ENERGY STAR certified heating and cooling equipment; ENERGY STAR certified windows; or a combination of five or more ENERGY STAR certified light fixtures, appliances, ceiling fans equipped with lighting fixtures and/or ventilation fans.

EPA updates its guidelines for ENERGY STAR certified homes periodically to ensure that ENERGY STAR continues to deliver homes that are high-quality and meaningfully more energy efficient than standard new construction homes.

A full description of eligibility criteria for the ENERGY STAR certified homes can be found at ***https://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_v3_guidelines***.

*The IECC is similar to the energy-related components of the International Residential Code (IRC), and is referenced in the IRC, but the two are not identical. The IRC is a standalone residential code that addresses plumbing, mechanical, fuel gas, and other home features in addition to energy. In states that adopt the 2012 IECC, the program is benchmarked to be 15% more efficient than the 2012 IECC.

Source: U.S. EPA, 2015b.

ENERGY STAR MULTIFAMILY HIGH RISE PROGRAM

Units in multifamily mid- and high-rise buildings can earn the ENERGY STAR certification through the MFHR program. MFHR projects are designed to be at least 15% more energy efficient than multifamily, high-rise buildings built to ASHRAE Standard 90.1.

A licensed professional verifies that each ENERGY STAR certified apartment includes:

- A complete thermal enclosure system, with comprehensive air sealing, insulation installed for best performance, and high-performance windows.
- A high-efficiency heating, cooling, and ventilation system with in-unit temperature control that is designed, installed, and tested for optimum performance.
- Energy-efficient lighting and appliances to provide reduced utility bills, high-quality performance, and longevity.
- EPA WaterSense toilets and showerheads, along with low-flow faucets in bathrooms and kitchens, for efficient water and energy use.

All eligibility requirements can be found on the Eligibility page at ***https://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_mfhr_prgm_reqs***.

Energy Efficiency in Green Affordable Housing

Home planning, design, and construction processes offer opportunities to integrate energy efficiency with other "green" features (e.g., lowering GHG emissions, improving indoor air quality, sustainable site selection) that provide additional environmental, resource conservation, and health benefits. In addition to enhancing a home's environmental profile, incorporating energy efficiency can improve the cost-effectiveness of green building. Because of this, energy efficiency is often considered first in green building design.

An energy-efficient green home design should incorporate the same six features as new energy-efficient homes (as described on page 13). Developers can follow guidelines from EPA's Indoor AirPlus Program to design for improved air quality in the indoor environment development (for more information, see the text box to the right). Developers can also look to other green building programs and standards to add additional environmental features, including water efficiency, recycling, and site sustainability (U.S. EPA, 2008a).

Such programs include the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED), the EarthCraft Affordable Housing Initiative, Enterprise Green Communities, and the National Association of Home Builder's (NAHB's) Green Building Program (EarthCraft House, 2008; NAHB, 2008; U.S. GBC, 2008; Enterprise Green Communities, 2010). Developers can also refer to state green building standards. For more information on these programs see Section 8, *Federal, State, and Other Program Resources*. For information on broader sustainability-related considerations in the siting and context of green affordable housing from a community perspective, see EPA's *Smart Growth* guide in the *Local Government Climate and Energy Strategy Series*.

"GREEN BUILDINGS"

Many terms are used to describe buildings that incorporate energy efficiency and other environmental features, including *green buildings, high-performance buildings,* and *sustainable buildings*. However, some green buildings do not adequately incorporate energy efficiency.

This section uses the term "green building" as an all-encompassing description of buildings that incorporate energy efficiency *plus* other energy and environmental features that are cost-effective and practical, including:

- Renewable energy supply
- CHP
- Sustainable site design that minimizes stress on the local landscape
- Water efficiency and quality
- Green materials and resources that minimize consumption and waste
- Indoor air quality

The City of Boston, Massachusetts, launched a ratepayer-funded Green Affordable Housing Initiative in 2006, which led to the redevelopment of an existing 16.5-acre affordable housing development in South Boston known as "Old Colony." The Old Colony redevelopment, which replaces 1940s-era structures with modern, efficient townhouses and apartment buildings, had to meet a minimum efficiency requirement of LEED certification (Boston, 2012). The project has since reached a LEED Platinum rating (U.S. GBC, 2018).

California adopted the California Green Building Standards in 2015. The standards include voluntary measures, which local municipalities are strongly encouraged to adopt, that have three tiers of efficiency levels for new construction. Tier 1 and Tier 2 buildings have design rating standards that are 15 and 30 percent more efficient than mandatory standards, respectively. Tier 3 buildings achieve the Zero Net Energy Design designation (California Building Standards Commission, 2016).

EPA'S INDOOR AIRPLUS PROGRAM

EPA's Indoor airPLUS Program addresses both the energy efficiency and indoor air quality components of green buildings. These specifications require that a building not only be labeled as ENERGY STAR certified, but also include additional home design and construction features that help to control moisture; improve ventilation and filtration; and reduce risks associated with radon, pests, volatile organic compounds, and combustion pollutants.

Source: U.S. EPA, 2016d.

EPA WATERSENSE LABEL

The EPA WaterSense label is for products that are independently tested to meet water-efficiency and performance criteria. Labeling criteria have been established for plumbing fixtures (toilets, faucets, showerheads, and urinals), new homes, and training programs for irrigation professionals. In general, products that receive the WaterSense label are 20% more water-efficient than conventional products. In addition to conserving water, these products can reduce the amount of energy required to deliver and treat water.

Source: U.S. EPA, 2017e.

4. KEY PARTICIPANTS

Local governments work with a range of participants to plan and implement programs to improve energy efficiency in affordable housing:

- *Mayor or county executives.* Many affordable housing energy efficiency programs are initiated by a local government executive. In some localities, the executive has the authority to appoint members to the local PHA's board and can work with these members to promote energy efficiency in public affordable housing.

  In 2016, the mayor of Boston announced that the city was making $14 million available for affordable housing in the city. Developers using city funds for affordable housing projects must follow specific guidelines for energy efficiency and design, in accordance with the mayor's Housing a Changing City: Boston 2030 housing plan. The plan calls for increasing energy efficiency in existing housing units and reducing carbon impacts in all new housing developments, through actions such as integrating home energy assessments into the permitting process, funding building system upgrades, and exploring the development of a system to rate homes and apartments based on their energy efficiency (Boston, 2014, 2016).

- *City or county councils.* Many city and county councils are responsible for adopting local affordable housing energy efficiency standards. Like local

executives, these representative bodies can have the authority to appoint members to the local PHA's board, facilitating coordination between the local government and the PHA, including collaboration on energy efficiency work.

- *Local and regional planning organizations.* Local governments often involve staff from government agencies when planning and implementing affordable housing energy efficiency programs. Staff from energy, environment, and community planning and development departments, in particular, can contribute their expertise in working with local developers, communicating environmental benefits to homeowners and the public, and collaborating with electric and gas utilities.

NEW YORK CITY MAYOR LAUNCHES MAJOR LOW-INCOME HOUSING RETROFIT PROGRAM

In 2015, the mayor of New York City announced a $100 million energy-saving program to upgrade and retrofit thousands of buildings owned by the New York City Housing Authority. Billed as the largest energy-savings program for any PHA in the nation, the city estimated it would generate tens of millions of dollars in energy cost savings, reduce GHG emissions, and create 500 jobs.

The retrofit program is part of the mayor's 2014 green building plan, which aims to reduce GHG emissions from energy use in city-owned buildings by 35% from 2005 levels by 2024. The green building plan is a key element of the mayor's strategy to reduce the city's GHG emissions by 80% below 2005 levels by 2050.

Source: New York City, 2015.

Local government planners, who are responsible for creating the plans that determine how and where development occurs, often serve as advisors to the policymakers who develop local energy efficiency policies, especially when such policies involve code amendments. Planners can develop energy-efficient building standards, enforce local energy efficiency ordinances, and incorporate steps for improving energy efficiency in affordable housing into strategies for reducing GHG emissions.

Metropolitan planning organizations (MPOs) can play an important role in helping local governments develop integrated approaches to energy-efficient affordable housing and public transportation. These organizations are responsible for coordinating with state and local governments, transit agencies, and the public to fulfill regional transportation planning requirements established by federal law. Local governments and MPOs can work together to maximize the affordability of new and redeveloped affordable housing by taking into consideration the proximity to transportation options. For more on how MPOs and other regional planning organizations can help, see EPA's *Transportation Control Measures* and *Smart Growth* guides in the *Local Government Climate and Energy Strategy Series*.

CITY OF DENVER PARTNERS WITH NONPROFIT TO REDUCE ENERGY COSTS IN AFFORDABLE HOUSING

In 2016, the Denver, Colorado, Office of Strategic Partnership awarded $750,000 to Energy Outreach Colorado to improve energy efficiency services in at least 600 affordable housing units and in the facilities of 10 nonprofit organizations that serve low-income households. The City of Denver has been partnering with Energy Outreach Colorado since 2008, using the organization's expertise and network of connections to manage a range of energy efficiency improvements.

Energy Outreach Colorado, established in 1989 by the State of Colorado as an independent nonprofit organization to expand low-income energy services across the state, implements Colorado's weatherization program along with a growing number of other energy services for low-income households. One of the organization's innovations is to provide energy efficiency upgrades to facilities operated by other nonprofits that serve low-income households, such as shelters, safe houses, and residential treatment centers. The upgrades allow those organizations to reduce their overhead costs and devote a greater share of their budgets to direct services.

For more information, see the case study on Energy Outreach Colorado in EPA's series, *Bringing the Benefits of Energy Efficiency and Renewable Energy to Low-Income Communities*, available at ***https://www.epa.gov/statelocalenergy/energy-outreach-colorado-nonprofit-hub-energy-assistance***.

Source: Energy Outreach Colorado, 2016.

- *Private developers and nonprofit organizations.* Local governments can work with private developers that develop and own affordable housing and use these firms' resources and technical expertise to maximize energy efficiency improvements and generate economic benefits for the community. In addition, many local governments also work closely with organizations that develop and manage affordable housing—such as CDCs and community development financial institutions (CDFIs)—to ensure that local affordable housing needs are met. CDCs are community-based, nonprofit organizations that work to revitalize low-income areas with economic development, affordable housing, neighborhood

planning, and other initiatives. CDFIs are private financial institutions dedicated to providing affordable financing to disadvantaged households and communities.

The City of Santa Monica, California, collaborated with the Community Corporation of Santa Monica (a city-wide CDC that facilitates the development, rehabilitation, and operation of housing for low- and moderate-income households) to develop a LEED Platinum high-efficiency 32-unit affordable housing project that features a green roof, passive cross-ventilation, and tankless water heaters. The Community Corporation's experience with green building techniques and energy-efficient design dates back to the 1980s, and it built some of the nation's first LEED Platinum affordable housing developments (Santa Monica, 2013).

- *PHA executive directors and board members.* These individuals can provide high-level support for energy efficiency improvements that can be critical for mobilizing resources, sustaining momentum, and creating links to other local government clean energy work.

The executive director of the Akwesasne Housing Authority in Hogansburg, New York, is charged with developing safe and affordable housing for the St. Regis Mohawk Tribe. The executive director and staff facilitated the development of a tribal strategic energy plan that focuses heavily on energy efficiency and renewable energy, and reached out to local universities and state and federal agencies to create a network for technical assistance. Recent projects include an energy-efficient and renewable-powered housing complex for older adults; a free, home-energy assessment program; and a community solar installation (U.S. DOE, 2015).

- *State housing finance authorities (HFAs).* HFAs are state-chartered entities that are responsible for ensuring adequate affordable housing by distributing federal funds, usually obtained from HUD. Most HFAs are headed by a board of directors appointed by the state, but otherwise operate independently of state government. Other HFAs exist as agencies or departments within the state government. Many HFAs offer incentive programs for local governments and provide opportunities for qualifying PHAs to obtain funds for energy efficiency improvements. (For more information on funding opportunities available through HFAs, see Section 7, *Investment and Financing Opportunities*.)

- *State energy offices and public utility commissions (PUCs).* State energy offices and PUCs can help local governments and developers evaluate the cost-effectiveness of energy efficiency programs for affordable housing. PUCs often require utilities to implement low-income energy efficiency programs. These agencies also often offer energy efficiency rebates and low-cost energy financing opportunities, and provide targeted technical assistance.

The Pennsylvania PUC established an aggressive requirement for utilities to obtain at least 5.5 percent of their energy efficiency portfolio savings from low-income programs or low-income participants in multifamily affordable housing programs (Pennsylvania PUC, 2015).

- *HUD.* Federal government agencies provide many technical and financial resources to affordable housing developers and owners, including local governments, private developers, and PHAs, to improve energy efficiency in affordable housing. HUD, in particular, administers a broad range of programs to assist low-income affordable housing residents and to encourage private affordable housing developers to use energy-efficient practices. These programs sometimes provide direct assistance to private affordable housing developers, but more often, HUD's programs are implemented through state and local governments, PHAs, and HFAs. HUD also has many energy efficiency guides for developers, including a guide to incorporating energy efficiency into Home Investment Partnerships Program (HOME)-funded affordable housing development (for more information, see the text box on the next page).

- *U.S. Department of Agriculture (USDA).* USDA also finances affordable multifamily and single-family housing properties across rural America. The department provides funding for new construction, home repair, and renovation through various programs, and these resources can be leveraged to enhance energy efficiency and reduce energy costs for residents. More information on USDA's housing programs is available at ***http://www.rd.usda.gov***.

- *Certified home energy raters.* Certified home energy raters are trained to provide independent, quality verification of home energy performance. These professionals can help select design measures in the planning phase. Once the construction or renovation is nearly completed, home energy raters can be employed to perform a final energy efficiency inspection to determine whether a new home meets energy efficiency criteria, such as ENERGY STAR's certified new homes standard.

INCORPORATING ENERGY EFFICIENCY INTO HOME-FUNDED AFFORDABLE HOUSING DEVELOPMENT

The HUD manual, *Building ENERGY STAR Qualified Homes and Incorporating Energy Efficiency and "Green" Building Practices into HOME-Funded Affordable Housing Development,* provides developers and jurisdictions participating in the HOME program with technical and operational information assistance for incorporating energy efficiency into affordable housing. The manual includes strategies and approaches for incorporating energy efficiency into existing and new affordable housing developments, and provides information on how local governments can require or encourage these strategies and approaches.

The manual is available at ***https://portal.hud.gov/hudportal/documents/huddoc?id=19758_200809energystar.pdf.***

For more information on HUD's HOME program, see Section 7, *Investment and Financing Opportunities.*

- *Energy service companies (ESCOs).* Many affordable housing developers and owners have worked with ESCOs to improve energy efficiency in affordable housing. ESCOs provide technical expertise on energy efficiency projects and often offer performance contracting options. These contracts can include a performance guarantee that payments not exceed the savings generated.[11] (For more information on energy performance contracting, see Section 7, *Investment and Financing Opportunities*.)

The Boulder Housing Authority in Colorado has entered into a performance contract with an ESCO to retrofit housing with energy efficiency improvements (Boulder Housing Partners, Undated).

[11] *HUD regulations govern how and when a federally funded PHA may enter into a performance contract with an ESCO.*

- *Utilities and other energy efficiency program administrators.* Many investor-owned utilities and other energy efficiency program administrators (e.g., independent or nonprofit energy services providers) offer technical and financial assistance (such as free energy audits and energy-efficient product rebates) to customers through programs that promote investments in energy efficiency. In addition, affordable housing developers sometimes work with utilities to get technical assistance on incorporating energy-efficient features into housing designs.

  Many municipally owned utilities offer energy efficiency assistance to affordable housing residents. Local governments and developers can work with these utilities to provide information to affordable housing renters and owners on rebates or other incentives for energy efficiency investments in residential buildings.

The nonprofit municipal gas and electric utility in Jacksonville, Florida, administers the Neighborhood Energy Efficiency Program, in partnership with the City of Jacksonville's Department of Housing and Neighborhoods, to help low-income residents reduce their energy costs through energy and water-efficiency upgrades. The program uses Census data to identify low-income households and installs energy- and water-saving products free of charge, such as efficient light bulbs, weather stripping and caulking, faucet aerators, and low-flow showerheads. Attic insulation is also installed at no cost in homes with less than three inches of insulation (JEA, 2016).

- *Property management companies.* Affordable housing owners sometimes contract with private property management companies. Because these companies are responsible for ensuring proper operations and maintenance, involving them in discussions about energy efficiency improvements and educating company staff can help ensure that energy efficiency measures remain effective. Training maintenance personnel can be a particularly helpful strategy for ensuring that energy efficiency investments produce the intended results.

- *Professional services firms.* Nearly all affordable housing projects require the expertise of professional service providers, such as licensed architects, engineers, contractors, and specialized consultants. These professionals can help select energy efficiency features and provide guidance on ensuring that energy

efficiency performance goals are met. Involving professional service firms can have the added benefit of creating regional jobs.

DETROIT UTILITY LEVERAGES PARTNERSHIPS TO REACH LOW-INCOME HOUSEHOLDS

DTE Energy, an electric and gas utility based in Detroit, Michigan, partners with more than 30 city and county agencies to provide energy efficiency services to low-income households. Its low-income programs served more than 140,000 households between 2009 and 2014, with upgrades that reduced their electricity costs by 6% and natural gas bills by 14% on average.

Its partnerships allow the utility to reach and engage low-income customers through multiple pathways, leverage other funding sources, reduce costs, and improve customer satisfaction. The *diversity* of DTE Energy's network plays an important role in its low-income programs' effectiveness: the utility partners with community action agencies, food banks, neighborhood associations, veterans' organizations, Habitat for Humanity, affordable housing organizations, and others to provide multiple points of outreach and a variety of opportunities for low-income households to participate in.

For more information, see the program profile on DTE Energy in EPA's series, *Bringing the Benefits of Energy Efficiency and Renewable Energy to Low-Income Communities,* available at ***https://www.epa.gov/statelocalenergy/dte-energy-low-income-energy-efficiency-assistance-program-profile.***

Source: U.S. EPA, 2016c.

The Chattanooga, Tennessee, Housing Authority partnered with the private architectural firm, Hefferlin + Kronenberg, to design an 18-unit affordable townhouse development in North Chattanooga. The architects used a classic "salt box" form, consistent with traditional houses in the region, while incorporating both passive solar and photovoltaics into the design. The houses are built to Enterprise Green Communities criteria (which require meeting ENERGY STAR New Homes building standards, the installation of ENERGY STAR lighting and appliances, and other energy efficiency measures), and the solar panels provide 10 percent of the development's electricity needs (Hefferlin + Kronenberg, 2012).

5. OPPORTUNITIES FOR LOCAL GOVERNMENTS TO SUPPORT ENERGY EFFICIENCY IN AFFORDABLE HOUSING

Local governments have used many strategies to support energy efficiency in affordable housing:

- *Executive initiatives.* Some programs have been initiated by the mayor or a county executive. Making energy efficiency an integral part of a mayor's or county executive's affordable housing priorities can be an effective way to mobilize resources and sustain momentum.

  In Chicago, Illinois, the mayor created the Chicago Bungalow Association in 2000 to help preserve affordable bungalow houses in the city. The association provides free energy efficiency upgrade grants of up to $4,000 to income-eligible bungalow owners, and has retrofitted almost 3,700 bungalows to date. These upgrades have saved more than 1 million kWh of electricity (enough to power 100 Chicago households for a year) and 2.3 therms of natural gas, equivalent to $900,000 in gas savings annually (Chicago Bungalow Association, 2016).

- *Local government resolutions.* City and county councils are often involved in initiating energy efficiency in affordable housing programs, especially when additional local funds must be allocated. In some localities, council resolutions have mandated energy-efficient design and/or performance for affordable housing.

  The City Council of Charlottesville, Virginia, passed a resolution in April 2008 mandating that all new affordable housing built with city-assisted funding or in-kind services must be constructed to ENERGY STAR standards or to comparable standards approved by the city. The resolution also required city staff to provide educational materials on energy efficiency to developers, residents, and homeowners (Charlottesville, 2008).

- *Local development agency standards or requirements*. Many local government development and community planning departments have initiated improvements by adopting design standards or requirements for affordable housing new construction and major renovation projects that include energy efficiency specifications.

The City of Boulder, Colorado, SmartRegs ordinance, adopted by the Boulder City Council in 2010, requires all licensed rental units to meet an energy efficiency standard by December 31, 2018, to maintain their renting licenses. The city designed the program to help meet its energy and climate goals. As of September 2016, 75 percent of evaluated rental units were compliant, saving $1.5 million kWh of electricity and avoiding 2,800 metric tons of CO_2 emissions, equivalent to the annual emissions of nearly 600 passenger cars (Boulder, 2016a, 2016b).

- *Local government planning processes*. Many local governments have used the planning process to establish goals or requirements for improving energy efficiency in affordable housing. These goals and requirements are sometimes incorporated into broader plans, such as smart growth plans, which may include mixed-use, transit-oriented development to reduce personal vehicle use.

Under the City of Los Angeles' 2015 sustainability plan, the city has begun developing new policies to improve the energy efficiency of existing affordable housing. The City Council approved the first of these policies in December 2016, when it established the Existing Buildings Energy and Water Efficiency Program. The program requires city-owned buildings (and privately owned buildings with 20,000 square feet or more in gross floor area) to benchmark and publicly report their energy and water use using the ENERGY STAR Portfolio Manager (Lukito and Drake, 2016; Los Angeles, 2017).

In its comprehensive plan, the City of Charlottesville, Virginia, set goals that include maintaining and improving its affordable housing, while providing financial incentives to support housing that is sustainable and energy efficient. Specific elements of the plan include encouraging new construction to meet ENERGY STAR, LEED, or EarthCraft Virginia standards wherever feasible; providing tax abatements to new or existing housing that are at least 30 percent more efficient than required under the state energy code; and supporting the rehabilitation of older affordable housing to improve energy efficiency (Charlottesville, 2013).

- *Incentives for developers.* Many local governments have established incentives to encourage developers to incorporate energy efficiency into their designs for affordable housing. These incentives typically fall within the following categories:
  - *Conditional land donations.* Some local governments have offered to donate land to developers in return for the developers incorporating advanced energy efficiency features into their designs.

In 2007, the City Council in Issaquah, Washington, authorized the city to request developer qualifications for a sustainable affordable housing project in the Issaquah Highlands community that included 146 energy-efficient affordable housing units, a community center, a childcare center serving 150 children, YWCA regional offices, and an education center. As an incentive to developers, the city not only offered the land at no cost, but also offered to forgo any permit-related fees for both land use and building permits. Completed in 2011, the development features ENERGY STAR appliances and other energy efficiency measures, including highly efficient elevators, super-insulated walls, optimized use of daylighting, and sun shades to reduce cooling energy use. Solar water heaters provide 40 percent of the project's hot-water needs. The development achieved LEED NC Gold, BuiltGreen 4-Star, and Evergreen Sustainable Development standards, and received five recognition awards from local and national agencies and organizations (YWCA Issaquah, 2012, 2016).

In 2012, Bloomfield, Connecticut, donated land to the Hartford Habitat for Humanity for six energy-efficient, single-family homes. To qualify for the homes, families' household incomes needed to be below 60 percent of the area's median income (FHLBBoston, 2016).

- *Specialized grants and loans.* Many local governments offer specialized grants and loans to developers who design affordable housing units to achieve superior energy efficiency. Other local governments, such as Asheville, North Carolina, include credits for meeting energy efficiency criteria when scoring and selecting development design proposals to receive low-interest loans from the local government (Asheville, 2016).

Portland, Oregon, used its five-year, $2.5 million Green Investment Fund (2005–2009) to provide grants for demonstration affordable housing units that incorporated energy efficiency and environmental features. For example, the fund supported the construction of the Dolph Creek Townhomes, which were evaluated to be over 44 percent more efficient than the average townhome built in Portland (Dolph Creek Townhome, 2010).

- *Fee waivers.* Some local governments have elected to waive permit review fees and other costs for affordable housing projects if developers meet certain energy efficiency, environmental, or transit-oriented development criteria.

The City of Austin, Texas, created a program to promote both affordable housing and transit-oriented development. The S.M.A.R.T. (Safe, Mixed-Income, Accessible, Reasonably-Priced, Transit-Oriented) Housing program provides developers with sliding-scale fee waivers and expedited permit reviews for affordable home projects. Multifamily homes must be within a quarter mile of a bus route, or the developer must provide a strategy for alternative transportation (Austin, 2008). For more on Austin's efforts to improve energy efficiency in multifamily affordable housing, see Section 9, *Case Studies*.

- *Local ordinance variances*. Many local governments have adopted zoning ordinances that allow zoning exemptions for housing developments that include affordable units. These exemptions, which typically include density bonuses and increased design flexibility, are sometimes contingent on the development meeting specific energy efficiency requirements.

Seattle, Washington, passed an ordinance in 2006 that awards height and density bonuses to residential developments that are affordable and achieve LEED Silver certification, which includes energy efficiency specifications (Seattle, 2016).

6. STRATEGIES FOR EFFECTIVE PROGRAM IMPLEMENTATION

Once programs and policies to improve energy efficiency in affordable housing have been initiated, local governments can use the strategies described in this section to overcome barriers to energy efficiency and help ensure their programs are effectively and efficiently implemented.

Common barriers to energy efficiency projects in affordable housing include:

- Higher upfront costs for energy-efficient equipment and appliances;
- Uncertainty about the credibility of benefits claims;
- Insufficient information about product-specific incremental benefits;
- Split incentives when the developer or landlord does not have a stake in the home's eventual energy performance;
- Lack of information about financing opportunities; and
- Lack of availability of energy-efficient products or services (U.S. EPA, 2005).

This section provides examples of implementation strategies that local governments have used in two categories: 1) strategies for developing and enhancing energy efficiency programs by working with local developers and other local stakeholders in the immediate community; and 2) strategies that involve working with federal, state, and local government agencies. Strategies to help overcome financial obstacles are discussed in Section 7, *Investment and Financing Opportunities.* EPA's *Bringing the Benefits of Energy Efficiency and Renewable Energy to Low-Income Communities* series provides additional examples of strategies to successfully deliver energy efficiency programs (see the text box on the next page for more information).

BRINGING THE BENEFITS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY TO LOW-INCOME COMMUNITIES

EPA's State and Local Energy and Environment Program offers case studies and program profiles to help officials in state and local energy, environmental, housing, and social services agencies; nonprofits; and utilities understand promising practices and successful models that they can use to reduce GHG emissions by bringing energy efficiency and renewable energy to low-income communities.

The profiles and case studies highlight effective programs at the state and local levels that have led to the successful adoption of energy efficiency and renewable energy in low-income communities. The series highlights promising practices, such as:

- Reducing upfront costs
- Partnering with trusted organizations
- Creating one-stop hubs for energy assistance
- Addressing eligibility gaps
- Adopting a whole-building approach
- Addressing split incentives
- Considering community solar

EPA selected programs for inclusion in this series based on their demonstrated ability to achieve results through on-the-ground implementation; their potential to be scalable, replicable, and sustainable; and to highlight a diverse range of communities (geography, size) and types of programs.

The case studies, profiles, and other resources are available at ***https://www.epa.gov/statelocalenergy/bringing-benefits-energy-efficiency-and-renewable-energy-low-income-communities***.

Strategies for Working with Developers and Other Affordable Housing Stakeholders in the Community

- *Use a team approach that includes working with trusted organizations.* Many local governments bring together teams of stakeholders to improve energy efficiency in affordable housing. By capitalizing on existing relationships with federal and state government agencies, private developers, utilities, and other organizations, local governments can create linkages between these parties to help incorporate energy efficiency in existing and new affordable homes. Organizations and agencies that already provide services to low-income households can offer a familiar, trusted conduit for support, information, and education, which can help the process of assessing needs and delivering energy efficiency services to owners and residents of affordable housing.

- *Provide guidelines to developers.* Several local governments have adopted guidelines for developers to help them incorporate energy efficiency and green features in affordable housing. Guidelines can provide information on additional sources of assistance and funding opportunities. For example, local governments can provide developers with information on state and local financial incentives for purchasing ENERGY STAR certified equipment and appliances (see EPA's ENERGY STAR product rebate finder at ***http://www.energystar.gov/index.cfm?fuseaction=rebate.rebate_locator***). Guidelines can also serve as communications material to inform the public of the local government's efforts to improve energy efficiency.

  Seattle, Washington, developed a green affordable housing guide that includes resources and information on energy efficiency and other green features that can be used to reduce operational costs in city-funded affordable housing. The city also developed additional technical resources for affordable housing managers to support cost-effective green building maintenance (Seattle, 2016).

  The Portland, Oregon, Office of Sustainable Development created green affordable housing guidelines for the local Development Commission to be distributed to prospective developers, as well as posted other green building publications and case studies on its website at *http://www.portlandonline.com/bps/index.cfm?c=48817*. The case studies include residential, commercial, and nonprofit green building projects; and provide details on the costs and benefits, operations, construction, design, overview, and keys to success in each phase (Portland, 2010).

- *Get third-party verification.* HERS[12] raters can provide independent verification of home energy efficiency for homeowners and renters, and can help affordable housing developers during the design and construction phases by reviewing plans, recommending energy efficiency measures, conducting onsite energy efficiency testing, and

[12] *Standards for HERS ratings are developed by the Residential Energy Services Network (RESNET). For more information, see* ***http://www.resnet.us***.

ensuring that homes meet ENERGY STAR's standards (U.S. EPA, 2008i). Obtaining a HERS rating is a requirement for the ENERGY STAR label for new homes.

The Housing Authority of the County of Riverside, California, requires developers to hire a HERS inspector to verify energy performance in new construction and energy upgrades to existing construction before building owners can be approved for an energy-efficient utility allowance. These allowances, which adjust a tenant's rent calculation to account for reduced utility costs after energy efficiency improvements (effectively increasing the proportion of rent that goes to the owner), can help cover the costs of energy-efficient equipment or retrofit projects in multifamily affordable housing (Housing Authority of the County of Riverside, 2016).

- *Purchase energy-efficient products in bulk.* Affordable housing developers often purchase products on an as-needed basis in small quantities from retailers. However, many have found that they can often save money by purchasing products directly from product manufacturers or wholesalers, some of which offer discounts on bulk purchases.

- *Sponsor or coordinate training sessions for developers, agency staff, and maintenance teams.* Many local governments have sponsored or coordinated training sessions to provide local contractors, housing organizations, and local government staff with information on energy efficiency features for homes and overall approaches to improving energy efficiency in affordable housing.

  Many affordable housing developers rely on facility management teams to ensure that energy efficiency measures in multifamily affordable housing developments continue to produce results. Some local governments, private developers, and PHAs provide these teams with training in maintaining and operating equipment and systems in an energy-efficient manner.

Working with the DOE, the PHA of Islip, New York, trained its maintenance staff to implement basic cost-effective, energy efficiency measures—such as air sealing, insulating water heaters, installing low-flow showerheads, upgrading lighting—as part of the normal refurbishment process that affordable housing units go through between occupancies. Improvements made during a pilot project reduced whole-house energy use by 10 percent, saving an estimated $200–$250 per year. The PHA has made efficiency improvements part of its standard apartment turnover protocol (U.S. DOE, 2014). The Philadelphia Housing Authority also uses an energy efficiency turnover protocol; see Section 9, *Case Studies*.

- *Participate in Home Performance with an ENERGY STAR sponsor.* EPA and DOE's Home Performance with ENERGY STAR program provides a comprehensive, whole-house approach to improving energy efficiency. Through this program, contractors offer homeowners and renters whole-home diagnoses and develop home-specific recommendations for improving energy efficiency. Local governments can participate as program sponsors by providing training and site inspections to ensure contractors are providing quality services to homeowners. Some municipally owned utilities, including Columbia Water and Light in Columbia, Missouri; Austin Energy in Austin, Texas; and the Sacramento Municipal Utility District in Sacramento, California, serve as local sponsors (U.S. EPA, 2017d).

- *Engage affordable housing residents.* Local governments, affordable housing developers, building owners, and other stakeholders can help homeowners and renters get the most out of energy efficiency improvements in their units by educating them on how to properly operate a home to lower utility costs. This approach is especially critical for influencing the behavior of residents whose energy costs are paid by the building owner, since the renters themselves have little financial incentive to use less energy.

- *Engage affordable housing owners and managers*. Local governments and affordable housing developers can increase participation in energy efficiency programs through education and outreach to building owners and managers, focusing on staff who make decisions on energy efficiency improvements and program participation (ACEEE, 2016b).

The District of Columbia Sustainable Energy Utility (DCSEU) has a team of employees dedicated to conducting energy efficiency outreach to low-income multifamily buildings in Washington, DC. Account managers search for potential projects and build relationships

with decision-makers. This targeted outreach helps DCSEU meet its goals for energy savings and program participation (ACEEE, 2016b).

- *Engage the public*. Local governments can use outreach events to educate the public about the benefits of energy efficiency and GHG emission reductions (U.S. EPA, 2005). Design charrettes often provide an effective way to bring together multiple stakeholders, including the public, in the planning and design processes; serve as a forum for discussing goals, concerns, and strategies; and produce buildings that are energy-efficient and responsive to stakeholder needs.

The Fresno, California, Housing Authority collaborated with area small businesses to rehabilitate and construct affordable housing units using funds under a HUD Rental Assistance Demonstration Construction Project (Fresno, 2013).

- *Coordinate energy efficiency programs and align them with broader energy and environmental goals.* Coordinating efforts across programs can capture efficiencies, eliminate redundancies, and simplify processes for owners and residents of affordable housing. Establishing a one-stop hub for low-income, energy efficiency programs creates a single point of contact and allows programs to serve multiple needs.

  For example, investing in energy efficiency in affordable housing can contribute to community smart growth initiatives. Creating a range of housing opportunities and choices is considered one of the principles of smart growth, and the availability of affordable housing can have a significant impact on how communities grow. Local governments can help improve the affordability of housing by encouraging development in locations with access to a variety of transportation options (another principle of smart growth). Housing constructed and sited for energy efficiency and access to public transportation can reduce the strain on community resources, such as water; and reduce homeowners' and renters' utility and transportation payments (U.S. EPA, 2008l). For more on how local governments implement activities that encourage smart growth in their communities, see EPA's *Smart Growth* guide in the *Local Government Climate and Energy Strategy Series*.

Strategies for Working with Federal, State, and Local Government Agencies

- *Participate in federal programs that promote energy efficiency in affordable housing*. Local governments can use tools and guidance from the ENERGY STAR Multifamily High-Rise Program or any of the other federal programs listed in Section 8, *Federal, State, and Other Program Resources*. Participating in or partnering with these programs can help local governments keep informed about best practices, funding opportunities, case studies, and new information resources.

STATE ENERGY PROGRAM HELPS LOCAL COMMISSION IMPROVE LOW-INCOME HOUSING

With a grant and technical assistance from the Maryland Department of Housing and Community Development under the state's EmPOWER Maryland Limited-Income Multifamily Energy and Housing Affordability Program, the Housing Commission of Anne Arundel County, Maryland, was able to improve living conditions for residents of its affordable housing developments.

Residents saw their energy bills fall by 15% after the retrofits, which included installing energy-efficient windows, weather-stripping front doors, adding insulation around pipes and in attics, and installing programmable thermostats and energy-efficient refrigerators.

Residents also reported quality-of-life improvements. For instance, they stated that the new windows increased the amount of fresh air in their households since the new windows were easier to open and close than the original ones. Residents also noted that the air duct maintenance improved the air flow through vents and made the air easier to breathe for children with allergies.

For more information, see the case study on EmPOWER Maryland in EPA's series *Bringing the Benefits of Energy Efficiency and Renewable Energy to Low-Income Communities,* available at ***https://www.epa.gov/statelocalenergy/empower-maryland-leveraging-relationships-and-experience.***

Source: Maryland DHCD, 2017.

The New Bedford Housing Authority in Massachusetts certified 9 of its 46 affordable housing developments to ENERGY STAR standards. Upgrades to the buildings, some of which were built in the early 1970s, included air sealing and insulation along with new energy-efficient lighting and appliances (New Bedford Housing Authority, 2015). The

housing authority used many funding sources and programs to complete a range of energy efficiency upgrades to nearly all of its properties, saving more than $1 million in energy costs in 2011–2012 alone (U.S. HUD, 2013).

- *Form alliances with state agencies.* Local governments can maximize the effectiveness of their energy efficiency activities by partnering with state agencies, such as public utilities commissions, state energy offices, and departments of transportation; and state HFAs can offer additional expertise and often help local governments provide developers with information on available incentives. Alliances may also be an effective way to develop and implement policy tools that reduce split incentives, such as green leases (leases that include an energy management plan to ensure that both tenants and owners benefit from efficiency improvements) or virtual net metering (a bill-crediting system for solar power installations), helping to address the split incentive barrier.
- *Work with other local governments*. Working with other local governments can increase the regional benefits of improving energy efficiency in affordable housing. For example, increased regional demand for energy-efficient products and services can lead to business and employment growth. In addition, working with other local governments can increase implementation effectiveness by facilitating information-sharing on many topics, including energy efficiency measures, behavioral factors affecting energy efficiency retrofits, costs, and funding opportunities.

The Louisville, Kentucky, Metro Housing Authority shared information with the Lexington Housing Authority in Massachusetts on using ENERGY STAR labeling for new, energy-efficient affordable housing units (LMHA, 2006).

In addition to the strategies described in this section, many organizations and programs offer criteria, expertise, and in some cases funding to help local agencies work with developers to improve energy efficiency in affordable housing. (See Section 8, *Federal, State and Other Program Resources*, for more information.)

7. INVESTMENT AND FINANCING OPPORTUNITIES

Energy efficiency improvements in affordable housing often involve capital investments that can range in size and length of payback periods. There are many financing opportunities that can help local governments and developers manage the costs of these investments.

Investment

Improving energy efficiency in local government facilities and operations is an investment that earns a return over time. The size and payback period of this investment varies depending on the extent of the upgrade and the resources required. While some energy efficiency improvements require substantial upfront investment, the costs can often be quickly recovered. Using a life-cycle cost analysis, which measures the lifetime costs of design and construction, maintenance and replacement, and other environmental impacts, can help the cost-effectiveness of energy efficiency upgrades.

BOULDER COUNTY HOUSING AUTHORITY—ENERGY CONSERVATION PROGRAM

The Boulder County (Colorado) Housing Authority has partnered with the cities of Longmont, Boulder, and Fort Collins; the state Division of Housing; and the federal Department of Health and Human Services Low-Income Home Energy Assistance Program (LIHEAP) Crisis Intervention Program to establish the Longs Peak Energy Conservation Program for weatherization. This program offers opportunities for adding insulation, furnace tune-ups, duct sealing, lighting retrofits, appliance replacements, and hot water heater replacements. The program is funded by the Colorado Energy Office and the DOE.

Source: Boulder County Housing Authority, 2016.

Life-cycle cost analyses can reveal short payback periods for many energy efficiency investments. Incorporating investments with short payback periods into a comprehensive energy efficiency upgrade can help reduce the overall payback period for the entire project (Zobler and Hatcher, 2008). For example, purchasing energy-efficient products, which have short payback periods, can generate significant energy cost savings that can shorten the payback period for the building upgrade as a whole. Similarly, behavioral adjustments, such as setting thermostats at lower temperatures in the winter, can often be implemented at no cost yet produce significant savings and reduce the payback period of a comprehensive upgrade. Table 2, *ENERGY STAR*

Specification Overviews: Energy Savings and Payback Periods, demonstrates how purchasing many ENERGY STAR certified products requires no cost premium compared with conventional products.

More extensive energy efficiency projects (e.g., designing new energy-efficient developments) often require greater upfront spending, but costs can vary considerably. Several studies have found that the upfront "green cost premium" for green affordable housing averages around 2 percent, but the costs are more than offset by utility and other savings (New Ecology, 2006; UMass Lowell's Center for Family, Work & Community, 2006; Southface, 2016).

Besides the ENERGY STAR tools listed in Table 1, *ENERGY STAR Program Resources,* on page 6, many other tools exist to help local governments and developers calculate the estimated investment required for specific energy efficiency projects. Typically, these tools can also be used to calculate the projected energy cost savings and simple payback periods associated with an energy efficiency project, which can be useful when identifying priority investments and making the case for energy efficiency (e.g., if a local government wants to encourage private developers to incorporate energy efficiency into affordable housing developments). These tools include the following:

- *Home Energy Saver Cost Calculator.* This calculator from DOE and the Lawrence Berkeley National Laboratory provides recommended energy efficiency measures and estimated costs, savings, payback periods, and rates of return for energy efficiency investments. Users can obtain either basic results by entering their zip code, or more customized results (i.e., a more tailored suite of recommendations and an overall investment strategy) by entering specific building energy use and design characteristics (LBNL, 2016). The calculator is available at ***http://www.homeenergysaver.lbl.gov/consumer/***.
- *Building Energy Software Tools Directory.* This site provides links to many building simulation tools that can be used to analyze energy use and efficiency upgrade options in the design, construction, operation, and maintenance of new and existing buildings in the United States. The directory is available at ***http://www.buildingenergysoftwaretools.com/***.

TABLE 2. ENERGY STAR Specification Overviews: Energy Savings and Payback Periods

Product Category	Percent Energy Savings Compared with Conventional Product	Payback Period
Appliances		
Dehumidifiers	30%	< 1 year
Dishwashers	10%	Generally cost-effective over the lifetime of the product
Refrigerators and freezers	10%	Generally cost-effective over the lifetime of the product
Room air cleaners	40%	0 years (typically no retail cost premium)
Room air conditioners	10%	~ 5 years
Electronics		
Cordless phones	40%	0 years (typically no retail cost premium)
Digital video disc (DVD) products	35%	0 years (typically no retail cost premium)
Soundbars	60%	0 years (typically no retail cost premium)
Televisions	30%	0 years (typically no retail cost premium)
Envelope		
Roof products	NA	< 4 years
Windows	12%	Varies regionally
Lighting		
Light emitting dioxide (LED) lamps	80%	< 1 year
Residential-style light fixtures	80%	< 1 year
Office Products		
Computers	20%	0 years (typically no retail cost premium)
Copiers	25%	0 years (typically no retail cost premium)
Monitors	20%	0 years (typically no retail cost premium)
Multifunction devices	15–60% (inkjet v. laser)	0 years (typically no retail cost premium)
Printers	20%	0 years (typically no retail cost premium)
Scanners	20%	0 years (typically no retail cost premium)

Product Category	Percent Energy Savings Compared with Conventional Product	Payback Period
Heating and Cooling		
Air source heat pumps	5%	< 5 years
Boilers	10%	To be determined
Ceiling fans with lighting	60%	< 2 years
Furnaces	15%	Generally cost-effective over the lifetime of the product
Geothermal heat pumps	60%	Varies regionally
Light commercial HVAC	5%	Varies regionally
Ventilating fans	50%	~ 5 years
Other		
Water coolers	35%	< 1 year
Vending machines	40%	0 years (typically no retail cost premium)

[a] ENERGY STAR promotes products that reduce GHG emissions by meeting the highest energy conservation standards by developing performance-based specifications that must be met in order to earn the label. These specifications are established to recognize products that are cost-effective for the purchaser, offer at least equivalent functionality and features as standard products, and are proven and broadly available. EPA reassesses these specifications as market conditions change. These specifications, which are used as the basis for ENERGY STAR labeling, are developed using a systematic process that relies on market, engineering, and pollution savings research and input from industry stakeholders. Specifications are revised periodically to be more stringent, which has the effect of increasing overall market energy efficiency (U.S. EPA, 2012). EPA and DOE screen all of the specifications annually to determine if any require reassessment. These assessments may lead to a specification revision, a specification being sunset, or no action being taken depending on market readiness for the next level. To view current ENERGY STAR criteria and specifications under review or revision, please visit *energystar.gov/specifications*.

Source: U.S. EPA, 2017b.

Financing

Upfront costs can be a barrier to improving energy efficiency in affordable housing. However, delaying cost-effective, energy efficiency improvements can also be costly since an activity *not* undertaken can result in increased utility bills (Zobler and Hatcher, 2008). This section describes the financing vehicles and funding sources that can help overcome financial barriers.

FINANCIAL VEHICLES

Financing refers to accessing new funds through means such as loans, bonds, energy performance contracts, lease-purchase agreements, and grants to pay for energy efficiency upgrades. Financial vehicles that can be used to finance energy efficiency improvements in affordable housing are described below.

- *Energy performance contracting*. Many affordable housing developers and owners have used energy performance contracts with ESCOs to improve energy efficiency in affordable housing at no upfront cost. An energy performance contract is an arrangement with an ESCO or energy service provider that allows a local government to finance energy-saving capital improvements—usually over a 7–15 year term—with no initial capital investment, by using money saved through reduced utility expenditures. Energy performance contracts bundle energy-saving investments (e.g., energy audits, design and specification of new equipment, ongoing maintenance, measurement and verification of product performance, indoor air quality management, personnel training).

  An ESCO often provides a guarantee that energy cost savings will meet or exceed annual payments covering all activity costs. Such guaranteed savings agreements are the most common type of performance contract in the public sector.[13] If the savings are not achieved, the ESCO pays the difference. Some performance contracts include a reserve fund to cover potential shortfalls, while others provide security enhancements in the form of performance bonds or letters of credit. In some instances, performance insurance may be available (Zobler and Hatcher, 2008).

  ESCOs often offer financing as part of the performance contract. However, because ESCOs are private sector firms that typically borrow at taxable, commercial rates, it is often possible for a public-sector entity to secure better financing arrangements by taking advantage of lower, tax-exempt interest rates available to government entities.

  The nation's PHAs have entered into more than 300 energy performance contracts since 1987, leveraging over $1.4 billion in third-party financing for energy efficiency improvements in more than 300,000 units (U.S. HUD, 2016b).

[13] *Another type of agreement is an "own-operate" agreement, in which the ESCO maintains ownership of the facility, and sells back its "output" to the local government entity.*

ENERGY PERFORMANCE CONTRACTS FOR PHAS

When PHAs enter into energy performance contracts with ESCOs for energy efficiency improvements to affordable housing, they can negotiate to have the ESCO propose multiple packages of energy conservation measures. This allows the PHA to review a range of cost estimates and make energy efficiency investment decisions based on available resources and the relative potential benefits of each proposed package.

Source: ORNL, 2000.

Between 2015 and 2017, the Housing Authority of the Birmingham District, in Birmingham, Alabama, financed improvements of 14 developments, consisting of more than 4,100 affordable housing units, through a 17-year energy performance contract with an ESCO that guarantees the savings. The $37.4 million project is helping the housing authority reduce energy costs by an estimated 25 percent, equivalent to $3.6 million annually. The ESCO upgraded water and lighting; replaced refrigerators; improved building envelopes; and upgraded the heating, cooling, and air conditioning equipment (Ameresco, 2015).

- *Energy-efficient mortgages.* An energy-efficient mortgage gives borrowers the opportunity to finance cost-effective, energy efficiency improvements in their homes as part of a single mortgage. It helps borrowers expand their debt-to-income qualifying ratios on loans, which can enable them to qualify for larger loan amounts that can lead to more extensive energy efficiency improvements. Conventional energy-efficient mortgages enable lenders to increase the borrower's annual income (and therefore the size of the loan they are eligible for) by adding the dollar amount of the expected energy savings. While these mortgages are often used to purchase new, energy-efficient homes, energy-efficient mortgages can often be used to improve energy efficiency in existing homes (sometimes called energy-improvement mortgages) (U.S. EPA, 2007). For more on finding lenders who offer energy-efficient mortgages, visit ***https://www.energystar.gov/newhomes/mortgage_lending_programs/energy_efficient_mortgages***.

- *Federal home loans.* The Federal Housing Finance Agency requires its 11 district banks to allocate 10 percent of their income to fund its Affordable Housing Program. This program provides targeted grants and interest rate subsidies to developers through district banks (FHFA, 2018). These funds can be used to preserve affordable housing or to help pay for reconstruction and rehabilitation costs. The district banks can also encourage energy-efficient affordable housing design.

The Housing Authority of the City of Meriden, Connecticut, received a $1.5 million grant and a $2.4 million subsidy from the Federal Home Loan Bank of Boston to build 60 affordable housing units designed and certified to Enterprise Green Communities standards, which include low per-unit energy consumption, healthy indoor air quality, and the use of sustainable and high recycled-content products and finishes (FHLBBoston, 2016).

- *Federal government grants.* Affordable housing stakeholders can apply for grants from federal government agencies, including DOE and HUD. Information on specific federal grant opportunities is provided in the following section on funding sources.

- *On-bill financing.* On-bill financing offers a way for home or building owners to overcome the high upfront capital costs of making energy efficiency upgrades, which can be a financial and psychological barrier to making investments in energy efficiency. The capital used to cover the costs of one or more efficiency measures is then paid back through charges added to monthly utility or annual property tax bills. On-bill financing tools that can help address barriers faced by low- and moderate-income home owners and renters include tariffed installation programs and clean energy municipal financing. In these programs, capital is raised through bond issues, public funds, utilities, or other private funds rather than issuing lines of credit to home owners and tenants directly (UC Berkeley, 2009; U.S. HUD, 2009).

- *Property assessed clean energy (PACE) financing.* In states with enabling legislation, PACE financing is a way of financing energy efficiency investments through loans from the local government. The loan can be repaid through special assessments on property taxes; or through other locally collected taxes or bills, such as utility, water, or sewer bills. Only participants in the program are subject to a special assessment, and the investments made are linked to the property rather than the occupant. If a property owner or tenant participating in a PACE program moves, the

repayment obligation transfers to the new owner or tenant (DSIRE, 2016). In 2016, HUD's Federal Housing Administration (FHA)-issued guidance clarifying the circumstances under which it will insure mortgages on properties that include PACE assessments. FHA will now approve purchase and refinance mortgage applications in states that treat PACE obligations as special assessments similar to property taxes (U.S. HUD, 2016a).

The Texas State Legislature authorized PACE financing in 2013, and it is being adopted by a growing number of municipalities across the state. In 2016, voters in Dallas, Texas, approved the city's proposed PACE financing program (Dallas Economic Development, 2016). Dallas PACE covers energy efficiency upgrades for multifamily residential buildings with five or more units. PACE will cover 100 percent of the cost of the upgrades, and owners can repay the low-cost loan over a 10- or 20-year period (Texas PACE Authority, Undated). PACE can be used to improve energy efficiency in some types of multifamily affordable housing, particularly HUD-assisted private properties, PHA properties participating in HUD's Rental Assistance Demonstration program, and properties funded by the USDA's Rural Development program (EDF and Texas PACE Authority, 2016).

- *Refinancing incentives.* Fannie Mae's Green Preservation Plus program is a partnership between the FHA and Fannie Mae to refinance energy efficiency and water upgrades in older affordable multifamily housing properties. Buildings must be at least 10 years old, and energy and water retrofits must account for at least 5 percent of the original mortgage amount. Borrowers must track and report their energy and water use, along with costs, using the ENERGY STAR Portfolio Manager (Fannie Mae, 2016).

  The Freddie Mac Multifamily Green Advantage program provides better pricing and additional funding for borrowers looking to improve the energy or water efficiency of their property. Under the Green Up and Green Up Plus options, borrowers can receive reimbursement for a property analysis report of up to $3,500 upon Freddie Mac's purchase of their loans. If they choose to perform the improvements identified in the assessment that will result in the minimum required energy or water consumption savings, they are eligible to receive better pricing and underwriting for the expected energy savings. Borrowers are required to track energy and water use in the ENERGY STAR Portfolio Manager, and comply with annual reporting requirements (Freddie Mac, 2017).

FUNDING SOURCES

Many sources are available to fund energy efficiency improvements in affordable housing. They can be accessed through the financial vehicles described above to provide the capital for energy efficiency upgrades.

- *HUD programs.* Many HUD programs can be used to improve energy efficiency in affordable housing:
  - *HOME.* The HUD HOME Program, the nation's largest block grant to state and local governments for creating affordable housing, allocates approximately $1 billion annually for the purchase and rehabilitation of affordable housing units by state and local governments (called "participating jurisdictions"). The participating jurisdictions then set their own program requirements for how these funds are distributed. State and local grantees often make these funds available to developers for new construction, rehabilitation, rental assistance, administration costs, and other uses associated with affordable housing. Local jurisdictions must meet a minimum eligibility of $335,000 (based on HUD's grant formula) to receive allocations. Jurisdictions that do not meet the $335,000 threshold can partner with neighboring localities (U.S. HUD, 2017a). HUD encourages program jurisdictions to use ENERGY STAR certified products and standards for HOME-funded housing (U.S. HUD, 2008).
  - *Self-Help Homeownership Opportunity Program (SHOP).* SHOP funds nonprofit organizations and consortia to purchase and develop or improve affordable housing. The funds are intended to provide homeownership opportunities to low-income populations that would otherwise be unable to purchase a home. Eligible homebuyers apply through SHOP grantees and are expected to contribute time and effort during the construction process instead of financial payment. Many local governments have worked with SHOP grantees to promote affordable housing. Local governments can also work with SHOP grantees to encourage the use of energy-efficient designs (U.S. HUD, 2016c).
  - *Community Development Block Grant (CDBG) program.* This program provides funding to local governments to address a range of community development needs. Funds are appropriated directly

to certain local governments, called "entitlement communities"; or are appropriated to states, which then allocate funds to local governments. No less than 70 percent of a local government's allocation must be used to support low- and moderate-income populations. Funds from the CDBG program can be used to finance energy efficiency improvements.

INCORPORATING ENERGY EFFICIENCY INTO HUD CHOICE NEIGHBORHOOD-FUNDED AFFORDABLE HOUSING DEVELOPMENT

HUD's Choice Neighborhoods initiative, the successor to its HOPE VI program, supports locally driven strategies to address struggling neighborhoods with distressed public or HUD-assisted housing through a comprehensive approach to neighborhood transformation. It catalyzes this transformation by supporting the rebuilding of distressed housing into energy-efficient, mixed-income housing that is physically and financially viable.

For work on buildings, the program requires owners of new construction and substantial rehabilitation projects in multifamily housing to meet the requirements of EPA's ENERGY STAR Homes certification. HUD encourages grantees to go beyond the minimum requirements for energy and water efficiency; and encourages grantees to use recognized green rating programs, such as LEED, ENERGY STAR Plus Indoor Air Package, and ENERGY STAR Advanced New Home Construction.

For more information on HUD's Choice Neighborhoods program, see ***https://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/cn***.

- *HFAs and other state agencies.* Developers of affordable housing can obtain funding from HFAs through many programs, many of which are funded through HUD. For example, through the federal Low-Income Housing Tax Credit program, HFAs receive an annual allocation of housing tax credits from the Internal Revenue Service. HFAs award these tax credits to affordable housing projects that meet qualifying criteria determined by the state, but which must include specific federal requirements. The tax credits are then sold by awardees to raise equity, thus reducing the debt they would otherwise incur. This use of equity translates into lower rents for low-income residents. Many HFAs administer their own programs.

In some states, such as Delaware and Utah, HFA funding is contingent on the affordable housing project meeting energy efficiency criteria (Delaware State Housing Authority, 2008). For example, for affordable housing units in the State of Utah to receive funding through the Olene Walker Housing Loan Fund, which manages more than $8 million per year in HUD and state funds, the units must be ENERGY STAR certified (OWHLF, 2016).

Local governments and developers can also get funding from other state agencies, including state energy and planning agencies. Many state agencies administer energy efficiency programs that often include affordable housing components.

The Illinois Department of Commerce and Economic Opportunity administers the Energy-Efficient Affordable Housing Construction Program that provides grants to developers for incorporating energy efficiency into new and renovated affordable housing developments. The program, which has generated energy cost savings of over $12 million since 1988, enables developers to build affordable housing developments that typically use between 50 and 75 percent less energy than conventional developments (Illinois, 2015).

- *Affordable housing trust funds.* Affordable housing trust funds have been established by many state and local governments to provide financing for affordable housing. The allocation of funds is sometimes contingent on projects meeting specific energy efficiency requirements.

Asheville, North Carolina, established a Housing Trust Fund to fund affordable housing development. Applicants that incorporate green-building elements and have high energy efficiency ratings, determined by a third-party rating agency, receive higher priority during the selection process (Asheville, 2016).

- *USDA programs*. USDA offers several programs that distribute federal funds to rural communities. These programs are available for affordable housing development and rehabilitation projects (USDA, Undated).
  - *Multifamily Housing Direct and Guaranteed Loan Program*. This program awards points to new construction and revitalization proposals that include energy efficiency improvements through

the use of the ENERGY STAR program (USDA, 2007a, 2007b).

  - *Energy Efficiency and Conservation Loan Program*. This program finances energy efficiency and conservation projects for residential, commercial, and industrial consumers through loans. Eligible rural utilities can borrow money and re-lend it to develop new and diverse energy service products within their territories, including programs to strengthen the energy efficiency of the affordable housing stock (USDA, 2015).

- *Government tax incentives.* Many federal, state, and local tax incentives, credits, and rebates are available for energy efficiency investments.

  - EPA's ENERGY STAR website includes a summary of current federal tax credits for energy efficiency for homeowners at ***http://www.energystar.gov/index.cfm?c=tax_credits.tx_index***.

  - DOE maintains a searchable directory of state and local tax credits and rebates for energy efficiency and renewable energy projects at ***https://energy.gov/savings/search***.

  - The Database of State Incentives for Renewable Energy provides access to a range of state and local energy efficiency and renewable energy tax incentives and other policies at ***http://www.dsireusa.org/***.

- *Nonprofit organizations.* Affordable housing developers and homeowners can get funding and financing for energy efficiency in homes from nonprofit organizations. Local governments that have existing relationships with such organizations can facilitate collaborative projects involving nonprofits and developers. For example, GRID Alternatives, a renewable energy nonprofit, partners with many local governments and tribes to attract and implement funding for solar power projects on low-income buildings. Some CDFIs may provide financing for energy efficiency projects; a list of certified CDFIs in the United States is available at ***https://www.cdfifund.gov/Pages/FAQ.aspx***.

- *Other federal grant opportunities.* Several federal government agencies, including DOE and HUD, offer grants to organizations (including local governments) that provide funds that can be used for energy efficiency programs. A searchable database of current and upcoming federal grants is available at ***http://www.grants.gov/***.

8. FEDERAL, STATE, AND OTHER PROGRAM RESOURCES

Federal, state, and regional agencies and organizations can be important sources of information and financial and technical assistance for energy efficiency programs, as described below.

Federal Programs

- *Building America.* This DOE initiative is a private-public partnership that encourages energy efficiency in new and existing homes across the country. Building America has developed best practices guides based on a home's particular climate zone.

  Website: ***http://energy.gov/eere/buildings/building-america-bringing-building-innovations-market***.

- *ENERGY STAR.* Many ENERGY STAR programs provide technical assistance and guidance on improving energy efficiency in affordable housing. The Home Performance with ENERGY STAR initiative encourages the use of ENERGY STAR standards to facilitate whole-building, energy efficiency improvements in existing residences. The initiative's website includes information on whole-building design, home energy inspections, diagnostic testing and installation, and quality assurance inspections. ENERGY STAR also offers tools, such as the Home Energy Yardstick and the ENERGY STAR Home Advisor, which can be used to compare home energy performance with other homes and develop a list of recommended energy efficiency measures.

  The ENERGY STAR Certified Homes and ENERGY STAR Multifamily High-Rise programs provide certification for new, energy-efficient homes, including in multifamily residential buildings. Certified homes are at least 20 percent more energy efficient than homes built in accordance with the 2009 IECC (with customized requirements in states where the energy code already exceeds the 2009 IECC). Multifamily, high-rise buildings must be at least 15 percent more energy efficient than required for the energy code under which the building is permitted, which varies from state to state.

CAMPAIGNS AND INCENTIVE PROGRAMS FOR ENERGY EFFICIENCY

ENERGY STAR maintains a directory of national, state, and local programs that offer recognition and other incentives for energy efficiency improvements, available at ***https://www.energystar.gov/buildings/program-administrators/state-and-local-governments/campaigns***.

Incentives include tax credits and other financial or administrative benefits, free technical support and energy audits, and public recognition.

The ENERGY STAR Program for Existing Multifamily housing offers certification for existing multifamily properties, as well as tools such as ENERGY STAR Portfolio Manager that allows property owners and managers to measure and track energy, water, and waste usage. To be eligible for certification, multifamily properties need to be benchmarked in Portfolio Manager with at least 12 months of whole-building energy data, and achieve an ENERGY STAR score of at least 75, indicating that the property performs better than at least 75 percent of similar buildings nationwide. To apply for certification, information must be verified by a Licensed Professional (either a Professional Engineer or Registered Architect), and submitted to EPA for approval. To assist affordable housing owners, a subset of Licensed Professionals has offered to conduct verification pro-bono, and they can be found via the online search tool called the "Licensed Professional Finder."

For more information on ENERGY STAR resources for energy efficiency in affordable housing, see Table 1*, ENERGY STAR Program Resources*, on page 6.

Website:
https://www.energystar.gov/index.cfm?c=affordable_housing.affordable_housing_low_income.

- *DOE WAP.* This program helps low-income families reduce their utility bills by improving energy efficiency in their homes. It provides weatherization services to approximately 40,000 homes each year using DOE funds, saving these households an average of $280 per year on their energy bills. WAP's direct funding recipients, state-level agencies, contract with local governments and community action agencies to provide weatherization services, which supports approximately 8,500 direct and indirect jobs per year.

  Website: ***http://energy.gov/eere/wipo/weatherization-and-intergovernmental-programs-office***.

- *EPA State and Local Energy and Environment Program*. Offers free analytical tools, data, and technical expertise about energy efficiency, renewable energy, and other emerging technologies to help state, local, and tribal governments achieve their environmental, energy, and economic objectives.

  Website: ***http://www.epa.gov/statelocalenergy***.

  - EPA offers information to help state and local energy, environmental, housing, and social service agencies; nonprofits, and utilities understand successful models they can use to reduce GHG emissions by bringing energy efficiency and renewable energy to low-income communities. These resources include case studies and program profiles (see the text box on page 23), a webinar series, and *Energy Efficiency and Renewable Energy in Low-Income Communities: A Guide to EPA Programs.*

    Website:
    https://www.epa.gov/statelocalenergy/bringing-benefits-energy-efficiency-and-renewable-energy-low-income-communities.

- *HUD.* HUD administers many programs that support the nation's supply of affordable housing and provides assistance to affordable housing residents. In addition to the funding programs described in Section 7, *Investment and Financing Opportunities*, HUD administers programs to share information on energy efficiency and affordable housing, including:

  - *Public Housing Energy Conservation Clearinghouse (PHECC).* PHECC is an online information source about energy conservation practices that can be implemented in multifamily affordable housing units.

    Website:
    https://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/phecc.

  - *Energy Performance Contracting.* Through its Energy Performance Contracting program, HUD provides PHAs with information about working with ESCOs to improve energy efficiency in public affordable housing. The program offers educational materials and information on training sessions for PHA staff.

Website:
http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/phecc/eperformance.

- *ENERGY STAR and HUD.* HUD has collected information on how ENERGY STAR programs can be integrated with HUD programs. This website has specific information on using ENERGY STAR for HUD's HOME program.

  Website:
  https://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/affordablehousing/programs/home/greenhome.

- *HUD Programs that Support Energy Efficiency*. This website has specific information on Choice Neighborhoods and many other HUD programs, PHAs, and tribes that support energy efficiency.

  Website:
  https://portal.hud.gov/hudportal/HUD?src=/program_offices/economic_development/eegb/programs.

- *USDA Rural Housing Programs*. USDA offers many opportunities to enhance energy efficiency in the more than 14,000 affordable multifamily rental housing properties it finances across rural America. For example, the Multi-Family Preservation and Revitalization Program provides priority points to housing renovation projects that propose to include energy efficiency measures, such as participation in the Enterprise Community Partners' Green Communities program, participation in local energy-efficient building programs, replacing existing equipment and building features with ENERGY STAR certified items, and more.

  Website: ***http://www.rd.usda.gov/programs-services/housing-preservation-revitalization-demonstration-loans-grants***.

State Programs

- *HFAs.* Many HFAs administer energy efficiency programs that PHAs can rely on as a source of information. The Greater Minnesota Housing Fund, for example, has collaborated with the Family Housing Fund and Enterprise Community Partners to develop Minnesota Green Communities, an initiative that supports the creation of affordable housing with reduced energy costs, use of materials beneficial to the environment, and conservation-minded land use planning.

- *PUCs.* Affordable housing developers can work with state PUCs to improve energy efficiency in affordable housing. Affordable housing developers can also benefit from PUC programs that provide direct assistance to affordable housing residents.

ALABAMAWISE

AlabamaWISE is a statewide community energy program, funded by the Alabama Department of Economic and Community Affairs and DOE's Better Building Program, which empowers Alabama families to take control of their home's performance.

The program offers advice on energy-efficient home improvements, serves as a clearinghouse for contractor referrals, and provides low-interest loans for energy efficiency improvements.

Nexus Energy Center, the nonprofit organization that implements AlabamaWISE, has begun a separate program dedicated to assisting low-income households with energy efficiency upgrades.

Source: Nexus Energy Center, 2017.

The Maine PUC worked with the Maine HFA to administer a low-income appliance replacement program that replaced inefficient refrigerators and installed compact fluorescent lights (CFLs) in low-income households, reducing energy costs for both residents and building owners (Efficiency Maine, 2007).

- *State Energy Offices.* Affordable housing developers can work with state energy offices to tailor energy efficiency activities to synchronize with state energy efficiency programs, develop training materials for residence maintenance staff, and organize information sessions for local residents.

Other Programs

- *Association for Energy Affordability (AEA).* AEA provides a full range of services to achieve energy efficiency in new and existing buildings to foster and maintain affordable and healthy housing and communities, especially those with low incomes. Working in California, New York, and Illinois, AEA representatives engage in a broad range of educational, technical, and construction management activities such as energy efficiency program design and implementation, and training in weatherization and industry certification.

  Website: ***http://aea.us.org/***.

ELEVATE ENERGY

Chicago-based Elevate Energy designs and implements energy efficiency programs in 11 states around the country, with an emphasis on helping low-income communities. Through its Energy Efficient Building Services program, the organization offers building owners free, comprehensive energy efficiency services, including an energy assessment, guidance on cost-effective solutions, access to financing options, quality assurance, and follow-up. This full-service approach maintains building owners' engagement and trust throughout the upgrade process.

Since the program's launch in 2007, more than 620 affordable multifamily buildings (comprising 28,600 units) have completed upgrades in Illinois and Michigan alone. These retrofits have avoided more than 49,400 metric tons of CO_2, equivalent to the annual emissions from the energy use of approximately 5,200 average American homes.

For more information, see the program profile on Elevate Energy in EPA's series, *Bringing the Benefits of Energy Efficiency and Renewable Energy to Low-Income Communities,* available at ***https://www.epa.gov/statelocalenergy/elevate-energy-energy-efficiency-services-affordable-multifamily-buildings***.

Source: Elevate Energy, 2017.

- *Center for Neighborhood Technology (CNT).* The CNT provides information and resources to help planners, developers, and local officials make decisions about community development. Several of these resources are relevant for improving energy efficiency in affordable housing. For example, CNT's Housing and Transportation Affordability Index is a free, online mapping tool that encourages city planners to think about affordability in terms of location efficiency.

  Website*:* ***https://www.cnt.org/***.

- *EarthCraft Affordable Housing Initiative*. EarthCraft provides technical services such as design reviews and charrettes, energy modeling, HVAC load calculations, pressure testing of building envelopes and duct systems, energy auditing and rate analysis, mold and moisture assessments, and ENERGY STAR facilitation and certification. EarthCraft Multifamily is a green building program developed by the Greater Atlanta Home Builders Association and Southface. Launched in 2004, EarthCraft Multifamily was the first multifamily-specific green building program in the nation and now serves multifamily affordable and market-rate housing units, including for new construction, renovation, gut rehabilitation, and adaptive reuse. EarthCraft also builds affordable houses in partnership with other organizations; in Virginia in collaboration with Habitat Humanity, it has built and certified over 220 homes since 2007.

  Website: ***http://www.earthcraft.org/builders/programs/earthcraft-house/***.

- *Energy Efficiency for All (EEA)*. EEA is a partnership of the Energy Foundation, Elevate Energy, the National Housing Trust, and the Natural Resources Defense Council dedicated to linking the energy and housing sectors together to tap the benefits of energy efficiency for millions of low-income families. EEA collaborates with owners, managers, businesses, and advocates to achieve energy savings in multifamily properties. The partnership works with electric and gas utilities and their regulators interested in innovative energy efficiency program designs, and advises housing finance agencies on best practices in building owner engagement and finance products.

  Website: ***http://energyefficiencyforall.org/***.

- *Enterprise Green Communities.* Enterprise Green Communities has helped to build more than 38,000 environmentally sustainable and energy-efficient homes for low-income families since 2004. The organization provides funds and technical expertise to help developers, builders, and policymakers make the transition to a green future for affordable housing and has developed the Green Communities Criteria, a framework of environmental and energy efficiency standards for home design.

  Website: ***http://www.enterprisecommunity.org/solutions-and-innovation/green-communities***.

- *Green Affordable Housing Coalition*. This coalition is a national, member-drive action network that advocates for the development and preservation of green affordable housing. It provides members with an opportunity to share the latest research, discuss potential policy solutions, coordinate outreach and advocacy efforts, and network with organizations with similar missions. Member organizations can use the coalition as a platform through which to disseminate information, discuss details of key policy proposals, and coordinate outreach and advocacy efforts.

  Website: ***http://www.greenaffordablehousingcoalition.org/***.

- *Habitat for Humanity.* Habitat for Humanity is a nonprofit organization that has constructed more than 800,000 affordable homes worldwide and served 9.8 million residents since 1976. Through its Environmental Initiative, the organization promotes cost-effective construction methods that incorporate energy and environmental features, and raises awareness of energy and environmental benefits. Habitat for Humanity has developed a series of energy bulletins, ENERGY STAR resources, and other technical information relating to incorporating energy efficiency in new Habitat for Humanity homes.

  Website: ***http://www.habitat.org/impact/our-work/home-construction/technologies***.

- *ICLEI Local Governments for Sustainability (ICLEI).* ICLEI is a membership association of local governments that have committed to adopting sustainable approaches for addressing climate change and other environmental threats through a range of activities, including energy efficiency. ICLEI members receive access to a suite of tools and resources for planning and implementing their energy efficiency programs, including software, with training, technical and communications assistance, information-sharing, best practices, and opportunities for recognition.

  Website: ***http://www.icleiusa.org/***.

- *Local Initiatives Support Coalition (LISC).* LISC is a nonprofit organization that focuses on assisting communities in revitalizing distressed neighborhoods by promoting sustainable objectives, such as improving energy efficiency in affordable housing. LISC works with local governments and community members to obtain access to loans, grants, and other funding sources; and technical and informational assistance for neighborhood revitalization projects.

  Websites: ***http://www.lisc.org/*** and ***http://www.naco.org/resources/programs-and-initiatives/resilient-counties-initiative***.

- *NAHB.* NAHB has created a green building program that has developed many resources for home builders, including the International Code Council/ASHRAE 700-2015 National Green Building Standard™, the first residential green building standard to undergo the full consensus process and receive approval from the American National Standards Institute. NAHB, the International Code Council, and ASHRAE have partnered to develop the third edition of the nationally recognized standard, which was approved and published in 2016. Developers and builders can also choose from a suite of green scoring tools (***http://www.homeinnovation.com/greenscoring***) to assess building and project designs.

  Website: ***http://www.nahb.org/en/research/nahb-priorities/green-building-remodeling-and-development.aspx***.

- *National Housing Trust.* The National Housing Trust is a nonprofit organization that protects and improves existing affordable rental homes so low-income people and families can live in quality neighborhoods with access to opportunities. The National Housing Trust has preserved or helped to preserve more than 25,000 affordable homes through technical assistance, public policy advocacy, working with investors to buy and renovate affordable homes that are deteriorating or are on the verge of being converted to more expensive housing, and providing loans to help developers purchase and renovate affordable homes.

  Website: ***http://www.nhtinc.org/index.php***.

- *Regional Initiatives.* Many local governments have used multi-jurisdiction initiatives to mobilize resources for improving energy efficiency in affordable housing.

  The Cape Light Compact, which represents 21 towns and two counties on Cape Cod and Martha's Vineyard, Massachusetts, has helped facilitate plans for the development of more than 60 affordable housing units for both public and private landowners. These units are to be developed in accordance with both LEED and ENERGY STAR standards (Cape Light Compact, 2007).

- *U.S. Green Building Council.* The U.S. Green Building Council administers a LEED for Homes Initiative for Affordable Housing. The initiative has developed a set of guiding principles for green affordable housing, and offers educational opportunities and technical assistance.

  Website: ***http://www.usgbc.org/resources/guiding-principles-green-affordable-housing.***

9. CASE STUDIES

The following case studies describe two local government programs that are improving energy efficiency in affordable housing. Each case study describes the program's initiation, other features, and benefits.

Philadelphia Housing Authority and the City of Philadelphia: Reducing Energy Costs for Public and Private Affordable Housing

Philadelphia has several major initiatives underway to improve energy efficiency in affordable housing, both in publicly owned buildings and in subsidized, private affordable housing units. Key among these are a major, $100-million energy performance contract to improve energy efficiency in all units owned by the Philadelphia Housing Authority (PHA) and the city's 10-year $1 billion Philadelphia Energy Campaign to improve energy efficiency, which includes a goal to retrofit 25,000 low-income residences. Through these initiatives, Philadelphia is taking a comprehensive approach to improving energy efficiency in affordable housing, with the Philadelphia PHA (a municipal authority that works in partnership with the city government) focusing on its own properties and the city government targeting its efforts more broadly to reach privately owned, low-income housing.

PROGRAM INITIATION

In 2011, based on its leaders' interest in reducing utility costs and environmental impacts in Philadelphia PHA-owned buildings and units, along with HUD's increasing emphasis on sustainability in public housing, the Philadelphia PHA commissioned an independent assessment of its sustainability activities. The Philadelphia PHA Board of Commissioners followed up in 2012 by establishing a formal sustainability policy that provides an organizing framework for its energy efficiency, renewable energy, and green building activities (Philadelphia Housing Authority, 2012). The policy includes commitments to reduce energy consumption; increase the use of renewable energy; and minimize environmental impacts in the areas of waste, water, energy, and air quality. In 2013, the Philadelphia PHA created a Green Action Plan that includes 21 goals related to improving energy efficiency (Philadelphia Housing Authority, 2013b). It also joined the DOE's Better Buildings Challenge, committing to a 20 percent reduction in the energy intensity of its buildings by 2020 (Philadelphia Housing Authority, 2013a). In 2016, the Philadelphia PHA entered into a performance contract to improve both the energy efficiency and resilience of its properties (Philadelphia Housing Authority, 2016).

PROFILE: PHILADELPHIA, PENNSYLVANIA

Area: 141.7 square miles

Population: 1,533,000 (2013)

Structure: The Philadelphia PHA's Energy Finance and Sustainability Department oversees energy efficiency programs for the city's publicly owned affordable housing. The Philadelphia Energy Authority manages a broader campaign to improve energy efficiency in public and private low-income residences.

Program Scope: The Philadelphia PHA initiatives and the Philadelphia Energy Campaign aim to improve energy efficiency in affordable housing, both in city-owned buildings and in subsidized private affordable housing units.

Program Creation: The Philadelphia PHA established a formal sustainability policy in 2012 and created a Green Action Plan in 2013. The City of Philadelphia launched its Philadelphia Energy Campaign in February 2016.

Program Benefits: The Philadelphia PHA's performance contract to improve energy efficiency in all of its units is expected to yield $6 million in annual energy savings. The 10-year, $1 billion Philadelphia Energy Campaign includes a goal to reduce energy bills in 25,000 low-income residences.

PROGRAM FEATURES

The Philadelphia PHA's recent energy initiatives include:

- An **energy performance contract** (estimated at $100 million) that will install energy- and water-saving measures, along with upgrades to improve resilience, in 20,000 units, for an estimated $6 million in annual energy savings on utility bills. The implementing ESCO for the performance contract is hiring Philadelphia PHA residents to act as site liaisons, training them in communications, leadership, safety, energy conservation, and green technology (Philadelphia Housing Authority, 2016).
- A **commitment to a 20 percent reduction** in the energy intensity of its buildings (including multifamily residences) by 2020, under DOE's Better Buildings Challenge. The Philadelphia PHA is one of 163 multifamily partners in the Better Buildings Challenge, a broad campaign covering many types of

buildings; DOE expanded the challenge to include multifamily buildings in 2013 (Philadelphia Housing Authority, 2013a).

- An **energy efficiency turnover protocol** that ensures energy efficiency upgrades are made to vacated units as they are being prepared for new tenants. Developed in partnership with DOE's Building America Program in 2014, the protocol is designed to reduce energy use in upgraded units by 8 percent (roughly $80 per unit annually). During unit turnover, maintenance staff follow an illustrated 20-item energy efficiency checklist that includes sealing, caulking, and insulating common sources of energy loss (ducts, water tanks, entry doors, plumbing and electrical penetrations, etc.) (U.S. DOE, 2016).
- A **Green Action Plan** that includes 21 goals related to improving energy efficiency, such as benchmarking residential energy use, upgrading lighting and HVAC systems, adopting Enterprise Green Communities standards for retrofits, and ensuring all new developments meet ENERGY STAR criteria. Each goal is accompanied by a set of specific strategies and actions to achieve it, a list of responsible parties, and indicators of success (Philadelphia Housing Authority, 2013b).

The city-led Philadelphia Energy Campaign complements Philadelphia PHA's initiatives, aiming to create 10,000 jobs in the skilled trade, energy retrofit, and clean energy sectors; reduce building energy consumption by 20 percent; and avoid 790,000 metric tons of CO_2 emissions over 10 years (Philadelphia Energy Authority, 2017). The campaign, which focuses on municipal buildings, K-12 schools, low-income residential housing, and small business, includes a goal to improve energy efficiency in 25,000 low-income residences. It plans to achieve its goals through a combination of grants, loans, pilot projects, and coordination with other city programs. For example, the campaign is implementing a multi-partner pilot project for improving energy efficiency in multifamily housing that can serve as a model for scale-up throughout the city. The pilot project will identify and evaluate financing options for energy upgrades in multifamily housing while working with partners and building owners to benchmark energy use and implement upgrades to lighting and controls, repair and replacement of HVAC systems, and improvements to roofing and windows (Philadelphia Energy Authority, 2016).

The campaign defines the low-income residential sector as any residential buildings or units located in Census tracts where 50 percent of the residents are at 80 percent or less of the area's median income. It complements Philadelphia PHA's efforts by reaching low-income residents of private housing (both single- and multifamily).

PROGRAM RESULTS

To meet its Better Buildings Challenge commitments, the Philadelphia PHA used a $50,000 grant from the Energy Foundation in 2015 to compile a database of energy consumption and expenses, and to begin benchmarking all 4,350 of Philadelphia PHA's conventional and senior housing units, encompassing 7.4 million square feet of floor space and 1,589 utility meters. In 2017, the Philadelphia PHA contracted with an energy benchmarking firm to provide monthly benchmarking services and expand benchmarking coverage to 100 percent of Philadelphia PHA's portfolio. Establishing benchmarks will allow the Philadelphia PHA to measure its progress toward the Better Buildings Challenge target, while also helping it document improvements made under other energy efficiency programs (Philadelphia Housing Authority, 2017).

Philadelphia PHA's energy efficiency turnover protocol has resulted in energy efficiency upgrades to more than 3,400 units as of mid-2017. The Philadelphia PHA has also created a green operation and maintenance manual for its operations and maintenance staff, and is applying green construction standards for new and retrofit projects (using ENERGY STAR, LEED, and Enterprise Green Communities standards). It has established energy performance standards for products to be purchased for new construction and retrofits (Philadelphia Housing Authority, 2017).

To aid in Philadelphia PHA's retrofit efforts under the Green Action Plan, the local electric and natural gas utility committed to providing the Philadelphia PHA with 10,000 CFL light bulbs and 1,000 energy-efficient refrigerators. As of 2017, this program had distributed more than 3,000 CFL bulbs and processed 220 applications for refrigerator replacement (Philadelphia Housing Authority, 2017).

In other initiatives falling under the Green Action Plan, the Philadelphia PHA has committed to educating residents and staff to be more engaged in reducing energy use. Key members of Philadelphia PHA's staff have received HUD Green Academy training as well as training in energy procurement, energy codes, Enterprise Green Communities standards, weatherization, performance contracting, and energy assessments. The Philadelphia PHA has also implemented a number of new green construction projects between 2015 and 2017,

contributing toward its Green Action Plan goals, including a 55-unit project of townhouses, multi-unit apartment buildings, and a triplex building that met Enterprise Green Communities, ENERGY STAR, and LEED standards; a 57-unit townhouse project that met Enterprise Green Communities Standards; and a 21-unit townhouse project that met ENERGY STAR standards (Philadelphia Housing Authority, 2017).

Coordinated under the umbrella of its sustainability policy and Green Action Plan, Philadelphia PHA's diverse energy efficiency initiatives add up to a comprehensive suite of measures that are expected to save millions of dollars annually in energy costs while improving living conditions for its residents. The Philadelphia PHA is leading by example, given its position as the nation's fourth-largest housing authority and the largest landlord in the State of Pennsylvania. The City of Philadelphia energy campaign's affordable housing projects complete the picture, complementing Philadelphia PHA's work by reaching a broader set of affordable multifamily properties in the city that are outside Philadelphia PHA's purview. Together, these initiatives will improve the energy efficiency of Philadelphia's existing affordable multifamily housing stock while ensuring that new construction is designed and built to rigorous energy standards.

Website: ***http://www.PHA.phila.gov/***.

Austin, Texas: Energy Conservation Audit and Disclosure Ordinance for Multifamily Buildings

The City of Austin, Texas, developed a coordinated strategy of energy audit and disclosure requirements, utility rebate incentives, and efficiency upgrade financing options for residential, commercial, and multifamily buildings (both market rate and affordable). Most of the city's existing affordable housing units are in older, privately owned buildings, and all of the Housing Authority of Austin's subsidized units are in multifamily buildings. Austin's strategy is helping to advance energy efficiency in the city's aging multifamily affordable housing inventory by showing property managers and residents how energy is consumed in their buildings, offering a pathway to more cost-efficient energy solutions, and creating market pressure on building owners to implement energy efficiency upgrades.

PROGRAM INITIATION

In 2007, the Austin City Council passed a climate protection resolution that established a broad range of initiatives and goals to reduce the city's GHG emissions (Austin City Council, 2007). Subsequent discussions on developing programs and policies to implement the goals led to a proposal for an Energy Conservation Audit and Disclosure (ECAD) ordinance to encourage energy efficiency improvements in privately owned buildings (NREL, 2011). City staff, the real estate industry, energy professionals, commercial property managers, and the Austin apartment community worked together to develop the ordinance. The City Council approved the ordinance in 2008, amending it in 2011 to include condominiums, revise some deadlines, and modify energy use reduction requirements for energy-intensive buildings (Austin Energy, 2013). While the ordinance was not designed specifically to reduce energy costs for low-income households, it is expected to have that effect.

PROFILE: AUSTIN, TEXAS

Area: 272 square miles

Population: 885,400 people (2013)

Structure: City of Austin staff, the real estate industry, energy professionals, commercial property managers, the Austin apartment community, and consumer advocates worked together to develop the ECAD ordinance. The City of Austin's City Council passed and amended the ordinance. Austin Energy programs help high energy users reduce their energy use.

Program Scope: The ECAD ordinance requires energy audits and energy disclosure at the time of sale and/or the time of lease for residential homes (defined as 1–4 units) and multifamily buildings (5 or more units) over 10 years old, and annual energy benchmark reporting of all commercial buildings over 10,000 square feet.

Program Creation: The Austin City Council passed the ordinance in 2008 and amended it in 2011 to include condominiums and to make several improvements to the disclosure requirements.

Program Benefits: The energy disclosure requirements place pressure on building owners to improve energy efficiency and reduce costs to tenants. Multifamily buildings (which house many of the city's low-income residents) that are designated as high energy users must reduce their energy use by 20 percent. These reductions help contribute toward the City of Austin's climate plan goals while improving energy affordability for residents.

By creating a market-driven incentive for building owners to improve energy efficiency in their properties, the ECAD ordinance helps the city achieve energy goals identified in the city's 2007 climate protection resolution and the 2015 Austin Community Climate Plan (ACCP). The 2007 resolution included goals of 800-MW energy

savings by 2020 and 900-MW energy savings by 2025. The 2015 ACCP adopted new goals for reaching net-zero, community-wide GHG emissions by 2050 by identifying more than 130 city-wide actions to reduce GHG emissions from energy, transportation, and materials and waste sources (Austin, 2015).

Simultaneously, the ordinance helps improve energy affordability among residents of the city's multifamily buildings—particularly in the older buildings that it targets, which generally have lower rents than new construction and thus attract higher proportions of low- or middle-income renters, but also tend to be the least energy efficient (University of Texas at Austin, 2015).

PROGRAM FEATURES

The multifamily component of Austin's ECAD ordinance has three major features (Austin Energy, 2017a):

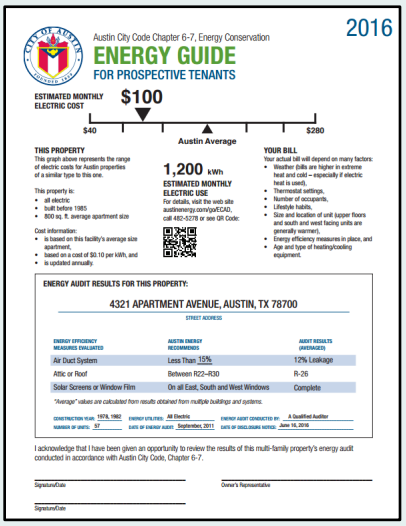
- **Disclosure requirements**. The ordinance offers building owners several approaches for compliance. For single-family homes more than 10 years old, an energy efficiency audit is required at the time of sale. Commercial properties must benchmark their energy use annually. Owners of multifamily properties that are at least 10 years old must perform an energy audit and disclose the results to their tenants. Buildings with an energy intensity greater than 150 percent of an established baseline are designated "High Energy Use," and are required to implement energy efficiency improvements that will reduce the building's energy intensity by 20 percent.

  Multifamily properties with five or more units must complete an energy audit of the residential units. These audits must be performed when the property turns 10 years old, with new audits conducted every 10 years thereafter, and the results must be disclosed to current and prospective tenants.

  After an ECAD energy audit is completed, the multifamily property owner receives the results from the registered energy auditor. The owner must post these results, including the Austin Energy Guide summary (see Figure 2), at the property for current residents to view, and provide them to prospective residents at the time of lease application.

  For High Energy Use properties (those using more than 150 percent of the average energy consumption of other multifamily properties in the Austin Energy service area), multifamily property owners must disclose to their tenants—within 30 days after receipt of the audit results—that the property has higher than average electricity energy use (see Figure 3). Owners must state the percentage by which the building's electric energy use exceeds the average, and state that the property's high energy consumption may result in higher-than-average energy bills for tenants.

FIGURE 2. Sample ECAD Energy Disclosure Notice.


Austin City Code Chapter 6-7, Energy Conservation

2016

ENERGY GUIDE

FOR PROSPECTIVE TENANTS

ESTIMATED MONTHLY ELECTRIC COST $100

$40 Austin Average $280

THIS PROPERTY

This graph above represents the range of electric costs for Austin properties of a similar type to this one.

This property is:
- all electric
- built before 1985
- 800 sq. ft. average apartment size

Cost information:
- is based on this facility's average size apartment,
- based on a cost of $0.10 per kWh, and
- is updated annually.

1,200 kWh ESTIMATED MONTHLY ELECTRIC USE

For details, visit the web site austinenergy.com/go/ECAD, call 482-5278 or see QR Code:

YOUR BILL

Your actual bill will depend on many factors:
- Weather (bills are higher in extreme heat and cold – especially if electric heat is used),
- Thermostat settings,
- Number of occupants,
- Lifestyle habits,
- Size and location of unit (upper floors and south and west facing units are generally warmer),
- Energy efficiency measures in place, and
- Age and type of heating/cooling equipment.

ENERGY AUDIT RESULTS FOR THIS PROPERTY:

4321 APARTMENT AVENUE, AUSTIN, TX 78700

STREET ADDRESS

ENERGY EFFICIENCY MEASURES EVALUATED	AUSTIN ENERGY RECOMMENDS	AUDIT RESULTS (AVERAGED)
Air Duct System	Less Than 15%	12% Leakage
Attic or Roof	Between R22–R30	R-26
Solar Screens or Window Film	On all East, South and West Windows	Complete

*"Average" values are calculated from results obtained from multiple buildings and systems.

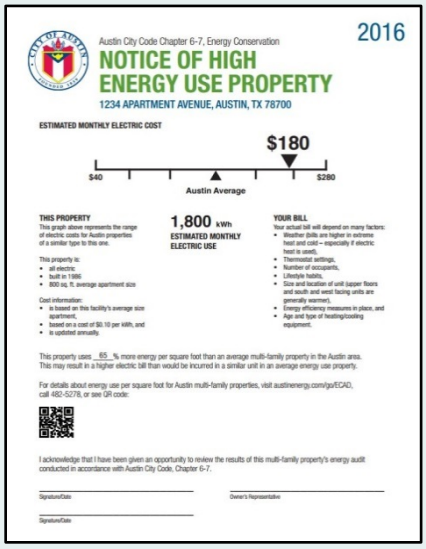
CONSTRUCTION YEAR: 1978, 1982 ENERGY UTILITIES: All Electric ENERGY AUDIT CONDUCTED BY: A Qualified Auditor
NUMBER OF UNITS: 57 DATE OF ENERGY AUDIT: September, 2011 DATE OF DISCLOSURE NOTICE: June 16, 2016

I acknowledge that I have been given an opportunity to review the results of this multi-family property's energy audit conducted in accordance with Austin City Code, Chapter 6-7.

Signature/Date Owner's Representative

Signature/Date

FIGURE 3. Sample Disclosure of High Energy Use.


Austin City Code Chapter 6-7, Energy Conservation

2016

NOTICE OF HIGH ENERGY USE PROPERTY

1234 APARTMENT AVENUE, AUSTIN, TX 78700

ESTIMATED MONTHLY ELECTRIC COST $180

$40 Austin Average $280

THIS PROPERTY

This graph above represents the range of electric costs for Austin properties of a similar type to this one.

This property is:
- all electric
- built in 1986
- 800 sq. ft. average apartment size

Cost information:
- is based on this facility's average size apartment,
- based on a cost of $0.10 per kWh, and
- is updated annually.

1,800 kWh ESTIMATED MONTHLY ELECTRIC USE

YOUR BILL

Your actual bill will depend on many factors:
- Weather (bills are higher in extreme heat and cold – especially if electric heat is used),
- Thermostat settings,
- Number of occupants,
- Lifestyle habits,
- Size and location of unit (upper floors and south and west facing units are generally warmer),
- Energy efficiency measures in place, and
- Age and type of heating/cooling equipment.

This property uses 65 % more energy per square foot than an average multi-family property in the Austin area. This may result in a higher electric bill than would be incurred in a similar unit in an average energy use property.

For details about energy use per square foot for Austin multi-family properties, visit austinenergy.com/go/ECAD, call 482-5278, or see QR code:

I acknowledge that I have been given an opportunity to review the results of this multi-family property's energy audit conducted in accordance with Austin City Code, Chapter 6-7.

Signature/Date Owner's Representative

Signature/Date

- **Reduction requirements**. Multifamily properties designated as High Energy Use are given 18 months to reduce their energy use through the implementation of energy efficiency improvements. Owners are required to work with Austin Energy to implement an energy efficiency improvement plan that will reduce the building's energy intensity by 20 percent. To meet that target, properties are required to bring their attic insulation up to R-30, install solar shades or solar film on windows that receive more than one hour of sunlight per day, seal air duct systems, and install high-efficiency lighting. They are not required to replace windows or HVAC systems, or undertake major deconstruction projects.

  Non-compliance with the energy audit, disclosure, or reduction requirements outlined in the ECAD ordinance can result in fines ranging from $500 to $2,000.

- **Financial and technical assistance.** The city's municipal utility, Austin Energy, offers rebates and financing options for qualifying energy efficiency upgrades to help high-use buildings meet the 20 percent reduction requirement. Austin Energy has developed a range of energy-improvement "packages" for property owners to choose from to help reduce the burden of upgrading the property. Austin Energy offered bonus rebates to multifamily properties when the ordinance was first established as an extra incentive to encourage them to make improvements.

  Incentives available for new multifamily construction projects include the city's SMART Housing program, which provides fee waivers and an expedited review process to developers of new affordable housing that set aside 5–10 percent of housing units as affordable. These units must also meet the Austin Energy Green Building Program minimum energy efficiency rating.

PROGRAM RESULTS

The ordinance took effect in June 2009, with a phased implementation that began with audits for single-family homes conducted at the time of sale, expanding in 2011 to multifamily energy audits and disclosure at the time of lease, and then in 2014 to annual commercial buildings energy benchmarking. Results from the audits are shown on the Austin Open Data Portal (*https://data.austintexas.gov/browse?q=ecad*), which allows tenants to compare building results and make more informed decisions before purchasing or leasing a property in Austin.

By 2015, 850 (85 percent) of multifamily communities in Austin had been audited, and Austin Energy issued more than $8 million in energy efficiency rebates for multifamily communities from 2013 to 2017. The resulting energy efficiency improvements have helped reduce energy costs in the city's older multifamily buildings, making them more affordable to low-income residents. The compliance rates for commercial and single-family homes are lower, at 62 percent, although compliance has been growing steadily due to an increased awareness of the program and more extensive outreach by city staff (Austin Energy, 2017b).

Website:
http://austinenergy.com/wps/portal/ae/energy-efficiency/ecad-ordinance/energy-conservation-audit-and-disclosure-ordinance/.

10. ADDITIONAL EXAMPLES AND INFORMATION RESOURCES

Title/Description	Website
Examples	
Austin, Texas. The Housing Authority of the City of Austin implemented a modernization project at the Thurmond Heights housing complex. Using grant funding from HUD, the PHA installed insulation, energy-efficient windows, new electrical systems to support tankless water heating, and central air conditioning in all units and buildings. This project earned the PHA an Award of Merit from the National Association of Housing and Redevelopment Officials.	*https://www.hacanet.org/mission-vision/sustainability/*
Boston, Massachusetts. The Boston Housing Authority partnered with Action for Boston Community Development and other organizations to implement energy efficiency improvements in PHA's housing developments. Leveraging funding from the state's Low-Income Multifamily Program, the partners provided incentives for installations of high-efficiency boilers, furnaces, and heat pumps; attic and wall insulation; energy-efficient lighting; and solar hot water systems. As of 2016, these improvements had generated an estimated energy savings of approximately $24 million over 10 years.	*http://www.bostonhousing.org/en/News/Mayor-Walsh-Celebrates-$24-8-Million-Energy-Partne.aspx*

Title/Description	Website
Bronx, New York. The 1212 Martin Luther King apartment complex was the first apartment complex in the nation to earn the ENERGY STAR label.	*http://greenhomenyc.org/building/1212-mlk-apartments/*
Chicago, Illinois. The Chicago Housing Authority is saving close to $1 million in energy and water costs annually after installing 17,000 faucet aerators and low-flow showerheads in 14,500 units.	*https://www.cityofchicago.org/content/dam/city/progs/env/SustainableChicago2015.pdf*
Cincinnati, Ohio. The Cincinnati Metropolitan Housing Authority is saving more than $875,000 annually from improving energy efficiency in more than 4,600 units. The improvements cost the PHA approximately $7.2 million.	*https://portal.hud.gov/hudportal/documents/huddoc?id=DOC_10709.pdf*
Duluth, Minnesota. The Duluth Energy Efficiency Program ensured that energy efficiency was integrated in rebuilding efforts in low-income households after a major flood.	*https://www.epa.gov/sites/production/files/2017-01/documents/duluth_profile_508.pdf*
King County, Washington. KCHA is cutting utility costs in its older residences by 10–30% by installing energy-efficient windows, adding more insulation, and installing ENERGY STAR roofs, among other upgrades.	*https://www.kcha.org/about/environmental/building/*
Longmont, Colorado. Longmont's Community Housing Program offers a fee reduction for projects that incorporate certain building features, including energy efficiency and energy conservation measures.	*https://www.longmontcolorado.gov/departments/departments-e-m/housing-and-community-investment/housing-programs/affordable-housing-incentives*
Minneapolis, Minnesota. The Minneapolis PHA used HUD's Energy Performance Contracting program to improve the energy efficiency of 40 high-rise affordable housing developments.	*https://archives.huduser.gov/fieldworks/0600/fworks3.html*
New York, New York. The 90-unit Melrose II affordable housing development in the Bronx was designed using high-performance, energy-efficient technologies. The design measures included programmable thermostats, energy-efficient HVAC systems, low-emissivity windows, and fluorescent lighting. These design features are expected to reduce annual energy costs for each unit by $988.	*http://www.nrel.gov/docs/fy05osti/38448.pdf*
Pittsburgh, Pennsylvania. Energy and water-efficiency upgrades implemented in 2008–2011 under an energy performance contract were expected to save the Housing Authority of the City of Pittsburgh more than $4 million over a 10-year period. Under the terms of the contract, the performance contracting firm conducted lighting retrofits and installed water-conserving fixtures, radiator control valves, boiler controls, and domestic hot water temperature controls in eight of the authority's housing communities.	*https://portal.hud.gov/hudportal/documents/huddoc?id=pittsburghfy13pln.pdf*
San Francisco, California. In 2005, San Francisco announced that the city would be the first in the country to use a green construction standard for all new affordable housing units. San Francisco chose to use Enterprise Green Communities criteria, which include ENERGY STAR standards for buildings, lighting, and appliances. The first development constructed using the criteria, the nine-story Plaza Apartments, was designed to exceed California's Title 24 energy code by 18%.	*https://web.njit.edu/abs/green/plaza.htm*
Santa Barbara County, California. The Santa Ynez Band of Chumash Indians used trusted community members as messengers and cultivated partnerships that led to community-wide improvements in energy efficiency and the creation of a job training program.	*https://www.epa.gov/sites/production/files/2016-06/documents/chumash_community_energy_efficiency_and_renewable_energy_project_profile_.pdf*
Santa Monica, California. The City of Santa Monica has developed a green design checklist to provide guidance to affordable housing developers.	*http://www.smgov.net/uploadedFiles/Departments/OSE/Categories/Green_Building/Green%20Affordable%20Housing%20Checklist.pdf*
Wilmington, North Carolina. The Wilmington Housing Authority provides training to residents semi-annually to assist them in reducing energy costs.	*http://www.ameresco.com/press/unprecedented-public-housing-resident-rewards-saving-energy-wilmington-nc*
Wyandotte County, Kansas. The Unified Government of Wyandotte County Division of Housing and Community Development has adopted a standard operating procedure for affordable housing unit construction and renovation projects that use public funds. The standard operating procedure requires that projects meet ENERGY STAR qualifications.	*http://archives.hud.gov/local/ks/news/pr2008-04-10.cfm*
Multiple Locations, Minnesota. The Minnesota Sustainable Housing Initiative has developed several case studies of energy efficiency retrofits to multifamily affordable housing in Minnesota.	*http://www.mnshi.umn.edu/projects/EE4A.html*

Title/Description	Website
Multiple Locations, South Carolina. The Help My House program, piloted in South Carolina by a group of rural electric cooperatives, provides loans for energy efficiency improvements in low-income households through low-interest loans that are paid through customers' utility bills.	*https://www.epa.gov/sites/production/files/2016-06/documents/help_my_house_profile_6-1-16_508.pdf*
Multiple Locations, Multiple States—Duke Energy Neighborhood Energy Saver Program. Duke Energy, an electric and gas utility serving the Southeast and Midwest, uses a community approach to quickly reduce energy bills for many participants.	*https://www.epa.gov/sites/production/files/2017-01/documents/duke_energy_profile_508.pdf*
Multiple Locations, Multiple States—Elevate Energy: Energy Efficiency Services for Affordable Multifamily Buildings. This Chicago-based nonprofit organization designs and implements full-service energy efficiency programs in 11 states around the country, with an emphasis on helping low-income communities.	*https://www.epa.gov/sites/production/files/2017-01/documents/elevate_energy_profile_508.pdf*
Multiple Locations, Multiple States—Energy Efficiency Case Studies. The California-based nonprofit affordable housing developer LINC Housing Corporation has published short case studies of affordable housing energy efficiency upgrades in Massachusetts, Maryland, and California.	*http://www.linchousing.org/art/pdf/tca-3_14_eecs.pdf*
Multiple Locations, Multiple States—DOE Better Buildings Case Studies. DOE's Better Buildings Program has developed case studies on energy efficiency upgrades in multifamily housing in Chicago and Colorado.	*https://energy.gov/sites/prod/files/2016/01/f28/bbrn_multifamily_casestudy_1-19-16.pdf*
Multiple Locations, Multiple States—HUD Performance Contracting Case Studies. The PHECC, administered by HUD, maintains a collection of case studies highlighting successful implementation of energy performance contracts in public housing.	*https://www.hud.gov/program_offices/public_indian_housing/programs/ph/phecc/eperformance/epcsuccess*
Information Resources	
Affordable Housing Energy Efficiency Handbook. The Affordable Housing Energy Efficiency Alliance has developed this guide to introduce energy efficiency concepts and benefits for the affordable housing market.	*http://www.h-m-g.com/multifamily/aheea/Handbook/default.htm*
***Affordable Housing Ordinances/Flexible Provisions*.** This web resource provides examples of local government ordinances that have been used to encourage developers to invest in affordable housing.	*http://mrsc.org/Home/Explore-Topics/Planning/Specific-Planning-Subjects,-Plan-Elements/Affordable-Housing-Ordinances-Flexible-Provisions.aspx*
An Affordable Housing Guide Owner's Guide to Utility Allowances. The California Housing Partnership Corporation created this guide to utility allowances, which can address split incentives and help finance energy efficiency improvements in multifamily housing developments.	*http://chpc.net/wp-content/uploads/2016/04/UA-Guide_April-2016Web.pdf*
Best Practices for Effecting the Rehabilitation of Affordable Housing. The two volumes of this HUD guidance document provide a framework for conducting rehabilitation of affordable housing. The guidance includes technical analyses and case studies.	*https://www.huduser.gov/portal/publications/affhsg/bestpractices.html*
Best Practices for Utilities Deploying Data Tools for Multifamily Properties. This report by the nonprofit consortium EEA describes best practices in using data tools to provide information on energy use to multifamily building owners and residents.	*http://www.mnshi.umn.edu/projects/EE4A.html*
Beyond the Light Touch: Next Steps for Improving Energy Efficiency in Multifamily Affordable Housing. This webinar, hosted by EPA in January 2016, discusses barriers, opportunities, and strategies for improving energy efficiency in multifamily affordable housing.	*https://www.epa.gov/statelocalenergy/beyond-light-touch-next-steps-improving-energy-efficiency-multi-family-affordable*
***Building America*.** This DOE initiative is a private-public partnership that encourages energy efficiency in new and existing homes across the country. Building America has developed multiple best practice guides based on a home's particular climate zone.	*http://energy.gov/eere/buildings/building-america-bringing-building-innovations-market*
Building Energy-Efficient Affordable Housing. This document, developed by Michigan Habitat for Humanity, provides a strategic outline of goals for improving energy efficiency in affordable housing throughout the state.	*http://ced.msu.edu/upload/reports/Building%20Energy%20Efficient%20Affordable%20Homes,%20final.pdf*
Building ENERGY STAR Qualified Homes and Incorporating Energy Efficiency and "Green" Building Practices into HOME-funded Affordable Housing. This HUD resource provides technical and operational guidance to HOME participating jurisdictions to help them develop ENERGY STAR certified homes.	*https://www.hudexchange.info/resources/documents/EnergyStarAndHOME.pdf*

Title/Description	Website
Choosing a Green Building Professional. This Green Affordable Housing Coalition fact sheet provides tips and strategies for selecting developers of green affordable housing.	*http://www.frontierassoc.net/greenaffordablehousing/FactSheets/GAHCfactsheets/4-GreenPro.pdf*
Clean Energy Financing Programs: A Decision Guide for States and Communities. This EPA guide describes financing-program options, key components of financing programs, and factors for states and communities to consider as they make decisions about getting started or updating their clean energy programs.	*https://www.epa.gov/sites/production/files/2015-08/documents/financingprogramsresourceguide.pdf*
Community Guide to Creating Affordable Housing. This report by the Business and Professional People for the Public Interest provides information on how local governments can encourage private development of affordable housing.	*http://www.bpichicago.org/documents/CommunityGuidetoCreatingAffordableHousing.pdf*
Database of State Incentives for Renewable Energy**.** This database provides access to a range of state and local energy efficiency and renewable energy incentives and policies.	*http://www.dsireusa.org/*
***d*CHPP** (Combined Heat and Power Policies and Incentives Database) is an online database that allows users to search for CHP policies and incentives by state or at the federal level.	*https://www.epa.gov/chp/dchpp-chp-policies-and-incentives-database*
Durability and Maintenance. This Green Affordable Housing Coalition fact sheet provides suggested criteria for assessing the relative durability and maintenance benefits of green building in the affordable housing sector.	*http://www.frontierassoc.net/greenaffordablehousing/FactSheets/GAHCfactsheets/19%20Durability%20and%20Maintenance%20final.pdf*
Education Materials for Energy Saving**.** This HUD website provides a number of resources and tips for affordable housing residents that can lead to reduced energy consumption.	*http://www.hud.gov/offices/pih/programs/ph/phecc/residents.cfm*
Energy Efficiency and Renewable Energy in Low-Income Communities: A Guide to EPA Programs. This EPA guide helps state and local staff connect with EPA initiatives that can assist them in expanding or developing their own energy efficiency, renewable energy, and climate initiatives in ways that benefit low-income communities.	*https://www.epa.gov/statelocalenergy/energy-efficiency-and-renewable-energy-low-income-communities*
Energy-Efficient and Green HOME Housing**.** This HUD resource provides links to data, technical assistance resources, and other information on energy efficiency and environmentally friendly affordable housing, including ENERGY STAR certified buildings.	*https://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/affordablehousing/programs/home/greenhome*
Energy Performance Contracting Resources. This HUD website provides links to guidance on performance contracting for housing authorities.	*https://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/phecc/eperformance*
ENERGY STAR* Certified *Products Purchasing and Procurement**.** This website provides information on the costs and benefits of purchasing ENERGY STAR certified products. It also provides information on how energy-efficient procurement programs can be developed.	*https://www.energystar.gov/index.cfm?c=pt_reps_purch_procu.pt_reps_purch_procu*
ENERGY STAR for New Homes**.** This ENERGY STAR program provides guidance for designing ENERGY STAR certified new homes that are at least 15% more energy efficient than the 2009 IRC.	*https://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.pt_bldr*
ENERGY STAR Savings at Home**.** This ENERGY STAR page provides links to tools, resources, and DIY strategies for homeowners to improve energy efficiency in their households.	*https://www.energystar.gov/campaign/home*
Federal Housing Finance Agency**.** The Federal Housing Finance Agency regulates the nation's federal housing loan banks. This page provides information on current affordable housing goals for the banks.	*https://www.fhfa.gov/PolicyProgramsResearch/Programs/AffordableHousing*
Freddie Mac Multifamily: Targeted Affordable Housing. This site provides links and information to loans for financing multifamily affordable housing in underserved areas, including cash loans, bond credit enhancements, tax-exempt loans, and others.	*https://mf.freddiemac.com/product/tah.html*
Frequently Asked Questions about Energy-Efficient Mortgages. This ENERGY STAR fact sheet provides answers to common questions about how energy-efficient mortgages work.	*http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/EEM_faq.pdf*
Green Affordable Housing Coalition**.** The coalition's website provides information on designing and financing green affordable housing units. It has collected many fact sheets on green initiatives in the public housing sector.	*http://www.frontierassoc.net/greenaffordablehousing/Index.shtml*

Title/Description	Website
Green Buildings Checklist. The City of Santa Monica has developed a green design checklist to provide guidance to affordable housing developers.	***http://www.smgov.net/uploadedFiles/Departments/OSE/Categories/Green_Building/Green%20Affordable%20Housing%20Checklist.pdf***
The Greenbuilt Way to Affordable Housing. The Green Built Home program offers resources to assist project developers in incorporating energy efficiency and sustainability in affordable housing. The program provides checklists, handbooks, and a third-party verification program to certify individual homes and recognize builders and developers who commit to achieving high standards of environmental performance. The program has certified more than 10,000 homes and multifamily units in Wisconsin.	***https://weigogreener.org/g_bh.php***
***Habitat Home Construction Technologies*.** Habitat for Humanity maintains a website that provides resources for energy efficiency and sustainability in affordable housing.	***https://www.habitat.org/impact/our-work/home-construction/technologies***
***Healthy Homes Program*.** This HUD program provides information on improving health and safety of the nation's housing stock. Energy efficiency improvements can have the indirect benefit of improving health and safety in homes.	***http://portal.hud.gov/hudportal/HUD?src=/program_offices/healthy_homes/hhi***
High Profile at Low Cost: Introducing A Multi-Family Residential Market to High-Performance Building Design and Construction. This report describes the experiences of the Louisville Metro Air Pollution Control District in its efforts to design energy-efficient, affordable housing units.	***https://www.hud.gov/sites/documents/DOC_10728.PDF***
Home Energy Saver Cost Calculator. This calculator provides recommended home energy efficiency measures and estimated costs, savings, payback periods, and rates of return for energy efficiency investments.	***http://hes.lbl.gov/consumer/***
***How to Promote ENERGY STAR through CDBG*.** This HUD guidance encourages local governments to incorporate ENERGY STAR into their CDBG-funded activities.	***https://portal.hud.gov/hudportal/documents/huddoc?id=13-01cpdn.pdf***
Incorporating Energy Efficiency into Multifamily, Affordable Housing Rehabilitation Projects. This summary of a September 2015 call hosted by DOE's Better Buildings Challenge discusses challenges and best practices in incorporating energy efficiency improvements into multifamily affordable housing upgrades.	***https://energy.gov/sites/prod/files/2015/12/f27/bbrn_MF_AffordableHousing_GreenRehab_092415.pdf***
***Incremental Costs, Measurable Savings*.** This Enterprise Green Communities analysis documents the costs and benefits of implementing energy- and water-efficiency improvements in affordable housing.	***http://www.enterprisecommunity.org/resources/incremental-costs-measurable-savings-update-14174***
Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low-Income and Underserved Communities. This EEA report describes energy burdens in 48 of the largest U.S. cities and strategies for reducing them.	***http://www.energyefficiencyforall.org/sites/default/files/Lifting%20the%20High%20Energy%20Burden_0.pdf***
***Low-Income Home Energy Assistance Project*.** This Department of Health and Human Services project provides information and financial assistance to low-income households to pay for energy costs.	***https://www.acf.hhs.gov/ocs/programs/liheap***
***Low-Income Home Energy Assistance Project Clearinghouse*.** The LIHEAP Clearinghouse, a Department of Health and Human Service project, provides information to state, tribal, and local LIHEAP providers. The clearinghouse collects and disseminates information on low-income, energy issues specifically.	***https://liheapch.acf.hhs.gov/***
***Low-Income Solar Policy Guide*.** This online resource from GRID Alternatives, Vote Solar, and the Center for Social Inclusion provides guiding principles, policy tools, and successful models for expanding access to solar power and solar jobs in low-income communities.	***http://www.lowincomesolar.org/***
***National Association for Housing Redevelopment Officials (NAHRO)*.** NAHRO provides housing and community development authorities with a range of information resources pertaining to providing housing for low-income citizens.	***http://www.nahro.org/***
Preserving Multifamily Workforce and Affordable Housing: New Approaches for Investing in a Vital National Asset. This report by the Urban Land Institute and Neighborworks America profiles ways to preserve multifamily affordable housing, including using below-market debt funds, private equity vehicles, and real estate investment trusts.	***http://uli.org/wp-content/uploads/ULI-Documents/Preserving-Multifamily-Workforce-and-Affordable-Housing.pdf***

Title/Description	Website
***Program Design Guide: Energy Efficiency Programs in Multifamily Affordable Housing*.** This report, by the nonprofit consortium EEA, describes best practices for energy efficiency programs to reach multifamily affordable housing.	*http://www.energyefficiencyforall.org/sites/default/files/Full%20Program%20Design%20Guide.pdf*
Public Housing Authorities Directors Association (PHADA). The PHADA serves as a clearinghouse of PHA experiences, including energy efficiency activities.	*http://www.PHAda.org/index.php*
The Public Housing Energy Conservation Clearinghouse. This HUD program provides PHAs with a collection of resources for implementing energy-conservation activities in public housing units.	*https://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/phecc*
Reaching More Residents: Opportunities for Increasing Participation in Multifamily Energy Efficiency Programs. This American Council for an Energy-Efficient Economy report summarizes the challenges to program participation and identifies best practices that programs can use to achieve high participation, drawing on data from 30 multifamily energy efficiency programs and 13 interviews with program administrators on their efforts to build program participation.	*http://bcpiac.com/wp-content/uploads/2016/06/Ross-Jarrett-York_2016_Reaching-more-residents.pdf*
Regulatory Barriers Clearinghouse. This HUD website provides information on regulatory barriers to develop affordable housing, and for each type of barrier it provides a potential solution.	*https://www.huduser.gov/portal/rbc/home.html*
Residential Energy Services Network. RESNET is a nonprofit organization dedicated to standardizing building energy performance certification. RESNET is responsible for administering the HERS rating system.	*http://www.resnet.us*
Rural Development Housing & Community Facilities Programs. This website provides access to multiple USDA programs that provide financial assistance to local governments for developing public housing.	*https://www.rd.usda.gov/about-rd/agencies/rural-housing-service*
State Housing Finance Agencies. The National Council of State Housing Agencies maintains a list of state HFAs that can provide resources to PHAs.	*http://www.ncsha.org/housing-help*
Top 15 Green Building Ideas. This Green Affordable Housing Coalition fact sheet provides 15 suggestions for greening affordable housing units.	*http://www.frontierassoc.net/greenaffordablehousing/FactSheets/GAHCfactsheets/12-GreenIdeas.pdf*
Washington State Evergreen Sustainable Development Standard. The Evergreen standard was adopted by the State of Washington to establish minimum energy efficiency and environmental criteria for affordable housing projects applying for state Housing Trust Fund assistance.	*http://www.commerce.wa.gov/wp-content/uploads/2015/12/ESDS-2.2.pdf*
Weatherization Assistance Program. The DOE WAP works with local governments and residents to implement weatherizing measures that improve energy efficiency and occupant health.	*https://www.energy.gov/eere/wipo/weatherization-assistance-program*
Zero Energy Ready Homes. DOE's Housing Innovation Awards program recognizes innovations in designing and constructing homes with no net energy costs.	*http://energy.gov/eere/buildings/zero-energy-ready-home*

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