EPA

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

2007

Partnership Update

Contents

2007 PARTNERSHIP UPDATE

For additional information about the CHP Partnership and its accomplishments, tools, and services, please visit <www.epa.gov/chp>, e-mail <chp@epa.gov>, or call 703-373-8108.

EPA's CHP Partnership

The U.S. Environmental Protection Agency (EPA) is pleased to present its *Combined Heat and Power (CHP) Partnership Update* for 2007.

2007 was an active year for the CHP Partnership! The Partnership now consists of 245 Partners, including energy users, energy service companies, CHP project developers and consultants, and equipment manufacturers, as well as federal, state, and local government agencies. The Partnership has been actively working with all stakeholders in the CHP community to support CHP project development and to get the word out about CHP's energy, economic, and environmental benefits. A significant decrease in greenhouse gas emissions can be attributed to the Partnership through these efforts:

Through 2007, the CHP Partnership has helped install more than 335 CHP projects, representing 4,450 megawatts (MW) of capacity. These emissions reductions are equivalent to:

Removing the Annual Emissions of More Than 2.0 Million Automobiles

OR

Planting More Than 2.4 Million Acres of Forest

In addition to providing direct project assistance and education and outreach, the Partnership enthusiastically encourages public recognition of outstanding CHP projects. Over the past two years, the Partnership presented seven ENERGY STAR® CHP Awards at key events throughout the country—rewarding efficient CHP projects that demonstrate leadership in environmental performance.

What Is the EPA CHP Partnership?

EPA established the CHP Partnership in an effort to publicize the potential energy, environmental, and economic benefits of using CHP to meet a greater portion of our nation's growing energy demand.

Through the CHP Partnership, EPA offers numerous tools and services that are designed to increase the deployment of CHP in the United States. The CHP Partnership:

- Provides technical, economic, and regulatory assistance for proposed projects.
- Maintains a current list of state and federal CHP and biomass incentives, including grants, tax incentives, regulatory treatment, and utility rates favorable to clean distributed generation projects.
- Facilitates Partner marketing and networking.
- Provides guidance and tools to help energy users become educated CHP champions.
- Promotes the environmental benefits of CHP through the ENERGY STAR CHP Awards, the CHP Emissions Calculator, and Partner Greenhouse Gas Reduction Reports.
- Engages in strategic market analysis and development.
- Informs state and federal policymakers on best practices to promote the development of clean energy.

The EPA CHP Partnership is open to industry; institutions; energy users; and state, local, and tribal governments interested in developing CHP projects and/or promoting the benefits of CHP. If you are interested in joining, please visit <www.epa.gov/chp/partnership/how-to-join.html> or contact us at <chp@epa.gov>, or at (703) 373-8108.

Partner Accomplishments

CHP Partners provide reports to EPA annually about projects in which they are involved that are either operational or in development (e.g., in construction, in engineering, or proposed). Data reported by Partners through December 31, 2007, show that EPA's CHP Partners were responsible for at least 75 percent of all CHP installations in the United States from 2001 through 2007 (Figure 1). In addition, CHP Partners were responsible for approximately 50 percent of the CHP capacity (MW) in the United States from 2001 through 2007 (Figure 2). From 2004 through 2007, 78 percent of national CHP capacity is attributable to CHP Partners!

Figure 1: Total Number of New Installations Added per Year

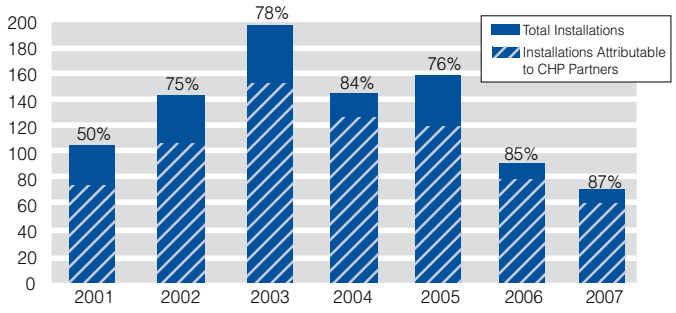
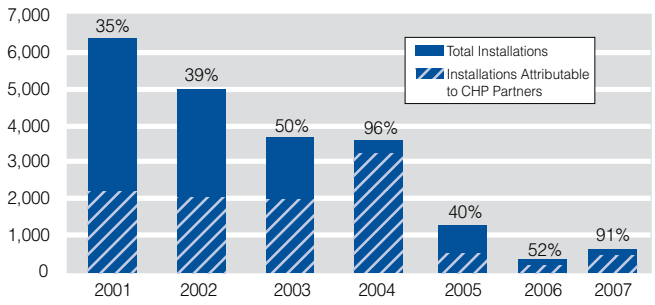


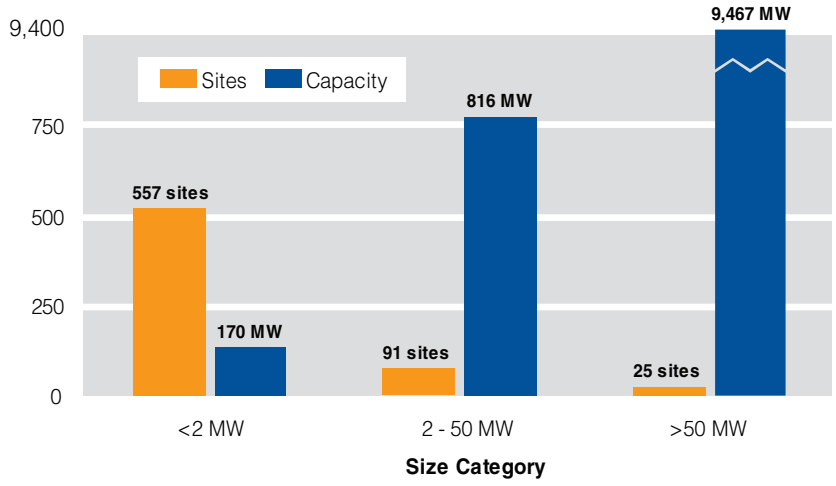
Figure 2: Total New Capacity of CHP Projects Added per Year



System Sizes

Of all CHP projects reported by Partners as operational between 2001 and 2007, 83 percent have been less than 2 MW in size (Figure 3). These smaller projects account for only 1.6 percent of installed capacity, while 91 percent of installed capacity is attributable to the 25 largest reported projects (greater than 50 MW, Figure 3).

Figure 3: Total Installed Projects by Size Category (2001–2007)

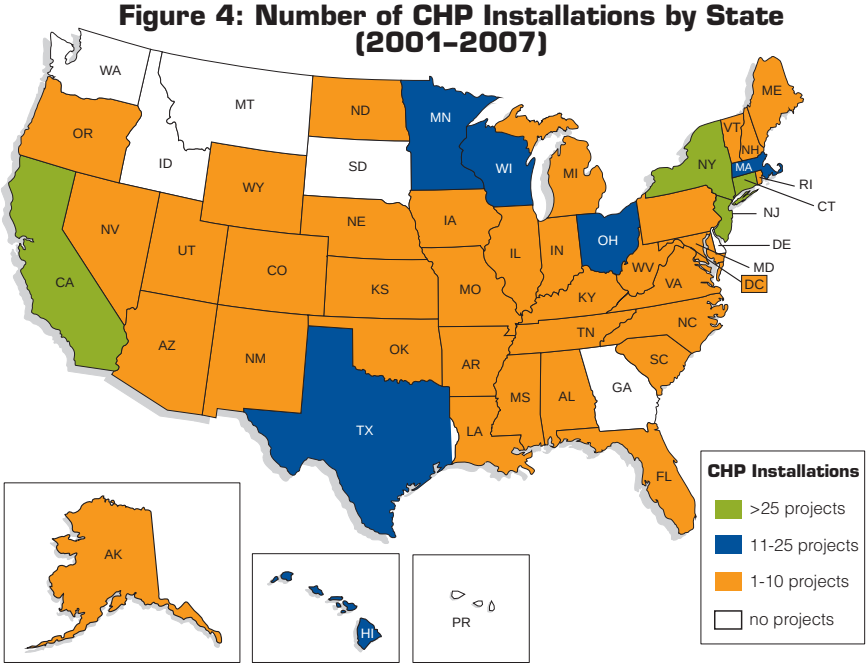


Partner Accomplishments

Geographic Distribution

Based on Partner-reported data, CHP systems are currently operating in 45 states. The highest concentrations of installed CHP systems are in California, Hawaii, Minnesota, Ohio, Texas, and the northeastern states (Figure 4).

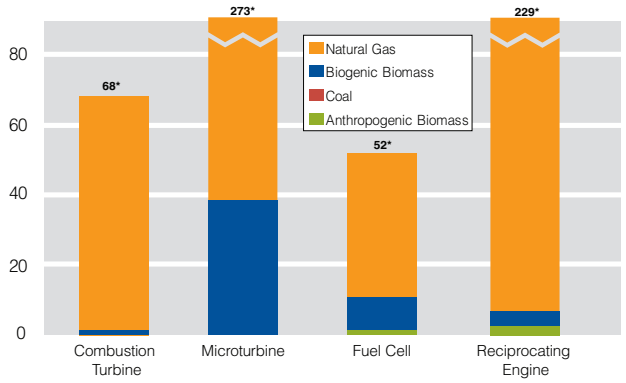
Figure 4: Number of CHP Installations by State (2001–2007)



Fuel Use

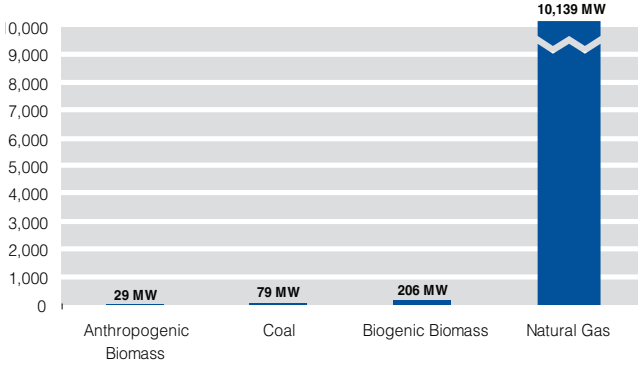
Of the four most commonly installed prime movers used in CHP systems, 91 percent are fueled with natural gas, while 9 percent are fueled with biomass (Figure 5). With less commonly installed prime movers, there is more variety in the fuel type used to power the system (Figure 5). Of all operational CHP projects reported by Partners, 97 percent of CHP capacity is fueled by natural gas, with the remaining 3 percent fueled by biomass and coal (Figure 6). For projects reported as in development, approximately 30 percent are projected to be fueled with biomass; however, natural gas will still remain the predominant fuel type for CHP systems.

Figure 5: Total Number of Installations by Fuel and Prime Mover (2001—2007)



*Total number of installations by prime mover

Figure 6: Total Installed Capacity by Fuel Type (2001—2007)



	Boiler	Backpressure Turbine	Condensing Turbine	Extracting Turbine	Stirling Engine	Multiple Prime Movers
Natural Gas	1	16	1			12
Biogenic Gas	2	4		2		2
Coal		5		2		
Anthropogenic Biomass		1	2		1	

Future Development

Based on Partner-reported data through 2007, Partners expect to install almost 1,850 MW of new capacity from 2008 to 2012 (Figure 7). CHP Partners have reported a total of 185 projects in development for 2008 through 2012. Based on this data, a significant concentration of new installations are expected to be installed in states that actively promote the development of CHP as a means to support their clean energy goals, such as California, Texas, Connecticut, and New York (Figure 8).

Figure 7: Projected Growth in Number of CHP Installations by State (2008–2012)

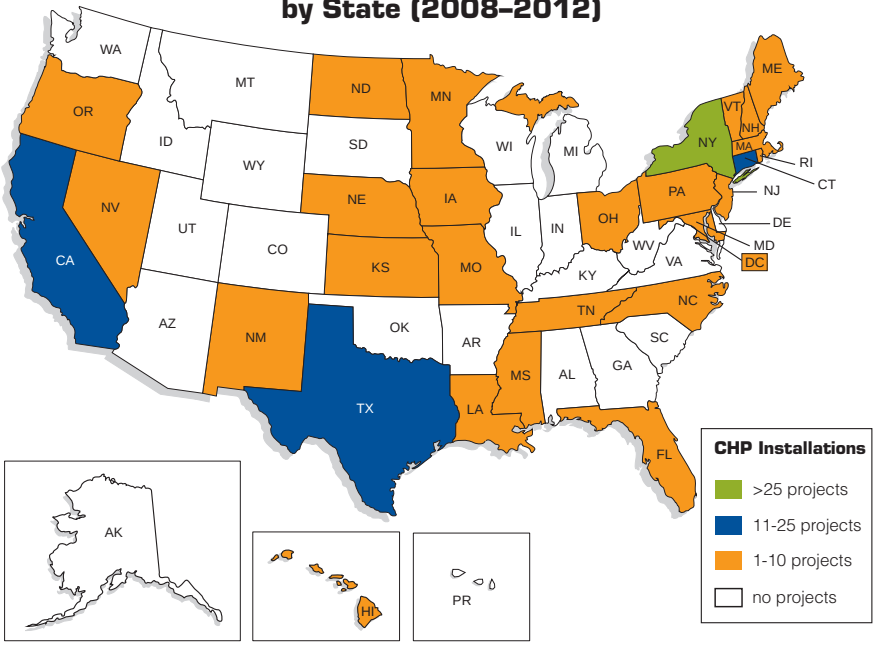
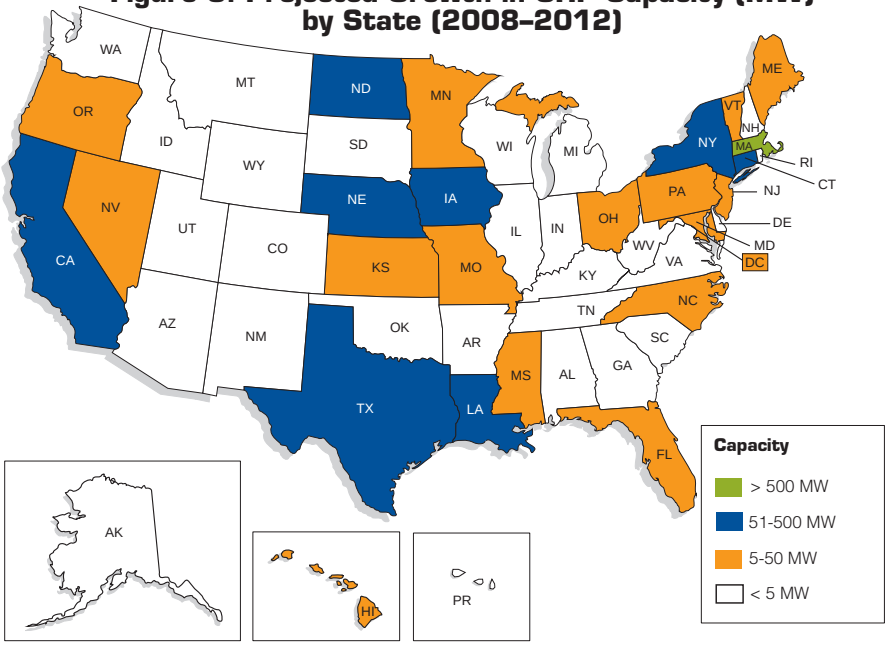


Figure 8: Projected Growth in CHP Capacity (MW) by State (2008–2012)



Strategic Markets for CHP

As part of its broader outreach and education efforts to expand knowledge of the benefits and applications of CHP, the CHP Partnership has undertaken targeted efforts to increase CHP use in three specific market sectors: dry mill ethanol production, casinos and hotels, and wastewater treatment facilities. In addition to these sectors, in 2007, the Partnership began working on emerging market opportunities for CHP in data centers and as an energy efficiency and cost saving option for utilities and municipalities. The Partnership's work in these strategic markets includes:

- Evaluating the technical fit for CHP within the market sector.
- Conducting market-specific research.
- Performing outreach to sector stakeholders, including energy users, associations, and relevant state agencies.
- Providing project assistance to promote the installation of CHP in the sector.

The Partnership has found common elements in each of the three markets it has examined:

- CHP is a strong technical fit for many facilities within the sector.
- CHP is commercially available and has been proven effective in many applications.
- CHP can be a compelling investment depending on local electricity prices and fuel costs.
- CHP offers additional values and benefits, including offset equipment costs, increased reliability, and emission reductions.
- CHP has been underutilized in the market to date.

Key highlights of findings and opportunities in each of the sectors are presented below. If you are interested in learning more about EPAs findings in these market sectors or you have any market intelligence or suggestions to share with EPA about its work in these sectors, please contact Neeharika Naik-Dhungel at <naik-dhungel.neeharika@epa.gov>.

Dry Mill Ethanol Production

The U.S. ethanol industry has grown significantly in the last several years, with production nearly tripling from 1,630 million gallons per year (mgy) in 2000, to 4,855 mgy in 2006. As of April 2008, more than 145 plants are operational in the United States, with a total capacity of approximately 8,500 mgy, and an additional 61 plants are under construction or are undergoing an expansion, with a collective capacity of approximately 5,000 mgy. Much of the current biofuel industry growth is in dry mill ethanol production, which uses corn to produce ethanol. Energy is the second largest cost of production for dry mill ethanol plants, surpassed only by the cost of the corn itself. Driven by rising energy prices, the dry mill industry has increased its energy-efficiency profile in recent years. Seventeen dry mill ethanol plants now use CHP to generate steam and electricity reliably and efficiently on site; another seven are under construction.

In 2007, the Partnership completed "The Impact of Combined Heat and Power on Energy Use and Carbon Emissions in the Dry Mill Ethanol Process," an analysis that compares energy requirements at state-of-the-art conventional and CHP-powered ethanol production facilities to show energy savings and greenhouse gas emission reductions resulting from CHP. The report can be viewed on the CHP Web site at <www.epa.gov/chp/documents/ethanol_energy_balance.pdf>. Based on this analysis, total fuel consumption for producing ethanol—considering both fuel use at the ethanol plant and fuel use at the central station power generation plant—can be reduced by more than 12 percent using natural gas and by 10 percent using coal. Because CHP reduces energy and operating costs, a plant that chooses to use CHP can help ensure its position as a low-cost supplier in this growing market.

Adkins Energy CHP System, Lena, Illinois

When farmer-led cooperatives in northeastern Illinois built a 43 mgy ethanol plant in 2002, they selected CHP to meet their energy demands. The 5 MW CHP system produces nearly all the electricity and approximately one-third of the steam needed for their ethanol production, while saving the plant more than $900,000 per year in operating costs.

With an operating efficiency of 70 percent, the CHP system requires approximately 15 percent less fuel than typical onsite thermal generation and purchased electricity. Based on this comparison, the CHP system reduces CO_2 emissions by an estimated 8,700 tons per year. This reduction is equivalent to removing the annual emissions from 1,448 cars or planting 1,798 acres of forest.

Dry Mill Ethanol (continued)

Partnerships between electric utilities and new biofuel production facilities have emerged and help to facilitate deployment of CHP systems at dry mill ethanol facilities. These partnerships can take various forms, including joint ownership of generating and heat recovery assets and joint purchase of fuel. The article "Utility-Ethanol Partnerships: Emerging Trend in District Energy/CHP," which EPA wrote for *District Energy* magazine, provides more information about these types of partnerships. The article can be accessed on the CHP Web site at <www.epa.gov/chp/documents/district_energy_article.pdf>.

For more information on the benefits and opportunities for CHP at dry mill ethanol facilities, and to access Partnership-produced studies and fact sheets, please visit the CHP Web site at <www.epa.gov/chp/markets/ethanol.html>.

Casinos and Hotels

CHP can help ensure comfort for guests while reducing operating costs and controlling rising energy costs. In addition, CHP can help minimize a casino's or hotel's environmental footprint and help meet corporate greenhouse gas reduction goals. Based on a CHP Partnership analysis, hotels and casino/hotel resorts with 100 to 300 rooms can utilize CHP systems to provide hot water to customers, space heating, and laundry needs; those with 300 to 500 rooms can utilize larger CHP systems to supply the facility's air-conditioning needs; and those with more than 500 rooms can support CHP systems of 1 to 10 MW to supply all of the facility's heating and cooling needs, in addition to a large portion of the electricity loads.

There are nearly 48,000 hotels in the United States, and about 10,000 of these have the energy characteristics suitable for current CHP technology. More than 500 large hotels (i.e., those with more than 500 rooms) and casinos in the United States have energy characteristics suitable for current CHP technology, and approximately 170 of these sites are likely to meet a simple payback on their investment within five years. Approximately 110 hotels in 21 states currently use CHP with a capacity of more than 71 MW. Today, there are also five casino resorts that utilize CHP, but with the growth and expansion of casinos in Las Vegas and along the Gulf Coast, much potential exists.

For more information on the benefits and opportunities for CHP at casinos and hotels, and to access Partnership-produced studies and fact sheets, please visit the CHP Web site at <www.epa.gov/chp/markets/casinos.html>.

Seneca Niagara Falls Casino, New York

Having experienced the 2003 Northeast blackout, the Seneca Niagara Falls Casino, operated by the Seneca Gaming Corporation in Niagara Falls, New York, installed and began operating a new CHP system in December 2005 with the help of CHP Partner, DCO Energy. The system was designed to operate in the event of a utility outage, providing back-up power to allow the Seneca Casino to remain operational in the event of a catastrophic failure of the electric grid. The CHP plant utilizes three 2 MW natural gas-fueled reciprocating engine/generator sets to generate approximately 6 MW of power. During peak load, the CHP system meets approximately 73 percent of the casino's electricity needs.

The CHP system was sized to meet the thermal load of the facility, providing space heating and cooling, as well as domestic hot water for the casino. During the summer months, the system is expected to meet 100 percent of the casino's thermal needs. The CHP system is expected to pay for itself within four years.

Strategic Markets for CHP

Wastewater Treatment Facilities

Rising energy costs and heightened awareness of climate change and its impacts have resulted in increased interest in biogas as a net zero greenhouse gas fuel. Wastewater treatment facilities (WWTF) with anaerobic digesters represent an excellent opportunity for municipalities to take advantage of this "free" fuel. CHP at WWTFs can increase the reliability of critical WWTF infrastructure and can lower energy and operating costs for taxpayers. Based on an analysis completed by the CHP Partnership, the biogas generated from each 4.5 million gallons per day (MGD) of influent flow generates approximately 100 kilowatts (kW) of electricity and 12.5 million British thermal units (MMBtu) of thermal energy in a CHP system. The thermal energy produced is typically used to meet digester heat loads and for space heating. Because biogas produced by WWTFs is considered renewable by most state renewable portfolio standards and third-party green power certification programs, the environmental attributes of electricity generated by CHP systems at WWTFs can be sold as renewable energy certificates (RECs). On a national scale, if all WWTFs that operate anaerobic digesters and have influent flow rates greater than 5 MGD were to install CHP, approximately 340 MW of clean electricity could be generated, offsetting 2.3 million metric tons of carbon dioxide (CO_2) emissions annually. These emission reductions are equivalent to removing approximately 421,000 cars from the road annually.

Palmdale Water Reclamation Plant, Palmdale, California

In 2004, the Los Angeles County Sanitation District (LACSD) began operating a 250 kW fuel cell CHP system at the Palmdale Water Reclamation Plant. The fuel cell was manufactured by FuelCell Energy, a CHP Partnership Partner. With the CHP system, 70 to 80 percent of the digester gas produced by the facility's anaerobic digesters is utilized in the fuel cell. The system produces 225 kW for use on site, while waste heat from the fuel cell exhaust is used to maintain proper temperature for digester operation.

LACSD chose to use biogas coupled with CHP to conserve fossil fuel, reduce air emissions, and save money. The CHP system reduces annual CO_2 and nitrogen oxide emissions by 778 tons and 0.58 tons, respectively, and saves LACSD approximately $227,000 per year in energy costs.

For more information on the benefits and opportunities for CHP at WWTFs, and to access studies and fact sheets developed by the Partnership, please visit the CHP Web site at <www.epa.gov/chp/markets/wastewater.html>.

Emerging Market Opportunities

The CHP Partnership has identified several emerging market opportunities for CHP and is working to promote CHP in these areas:

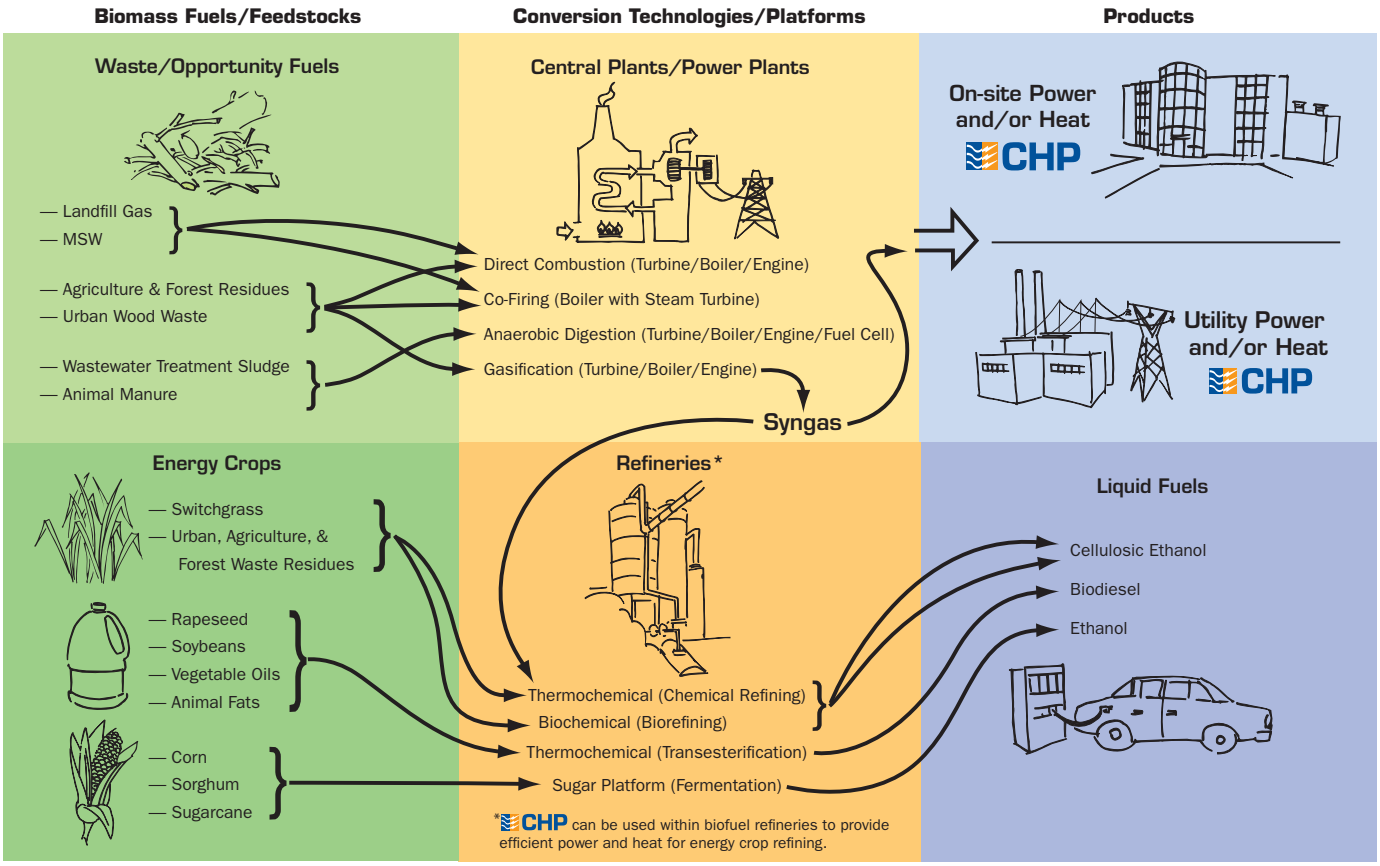
- **Data centers** are facilities used to house computer systems and associated components, such as telecommunications and storage systems. They have very large coincident thermal (cooling) and electricity loads that make them good candidates for CHP systems. CHP applied in data centers can provide cost savings to the facility operator in the form of lower energy and operating costs; increased reliability and decreased risk from power outages; and increased ability to meet facility expansion timelines by avoiding the need for utility infrastructure upgrades. Today there are 16 commercial data centers in operation using CHP, representing a total capacity of 16.2 MW.
- **Municipalities** are using CHP to reduce their operating costs, provide a hedge against volatile energy costs, increase their energy efficiency, reduce emissions of greenhouse gases and other pollutants from the combustion of fossil fuel, and meet clean energy goals. Local governments can use CHP in a variety of areas, including wastewater treatment facilities, landfills, government buildings, district energy systems, K-12 schools and community colleges, and hospitals and health centers. Today, more than 800 municipal governments currently use CHP, generating more than 6,300 MW of electricity.
- **Utilities** are showing increasing interest in CHP. This is occurring as states continue to enact policies that promote CHP, including decoupling utility profits from sales volume and some renewable portfolio standards (RPS) (see Policy Highlight, page 13). In addition, utilities appear to be showing greater interest in CHP as a way to efficiently add incremental increases in electric capacity to meet growing demand. In some instances, utilities are partnering with a thermal host, such as an ethanol plant, that uses the thermal energy while using the electricity to meet grid demand. Utilities are also starting to provide incentives for CHP in their territories to enhance reliability and peak load capacity.

Over the coming year, the CHP Partnership will continue to investigate the opportunities for CHP and work with its Partners to increase awareness and market penetration of CHP in these promising sectors.

Biomass as an Energy Resource

Using biomass and biogas for energy is becoming increasingly attractive in the United States due to high fossil fuel prices, a desire to reduce the environmental impact of energy use, and concerns about national security. Numerous opportunities exist to use CHP when converting biomass to biopower, thermal energy, or biofuels. Figure 9 shows some of the many feedstocks and processes that can utilize CHP. These opportunities range from burning wood waste to produce onsite power and heat to corn ethanol processing facilities using CHP to supply the electricity and steam required to run the plant.

Figure 9: Biomass to Bioenergy



Biomass CHP

To be used in CHP applications, biomass feedstocks must be collected, stored, and transported, and then converted into energy that can be used to generate electricity and/or heat. Commercial, proven, and cost-effective technologies for converting biomass feedstocks are currently available in the United States in the form of direct-fired boiler systems: fixed bed boilers, fluidized bed boilers, and co-firing applications. Direct-fired boilers have been used for decades by pulp and paper mills and other industrial users to convert woody biomass to energy.

In 2001, Weyerhaeuser Company installed an 88-megawatt (MW) CHP system fueled almost entirely by biomass at its bleached pulp mill in Hawesville, Kentucky. Pulp and paper biomass represents 96 percent of the fuel used in the CHP system, and natural gas accounts for the remaining four percent. EPA presented the system with a 2005 ENERGY STAR® CHP Award.

An emerging class of biomass conversion technologies is also becoming available that converts woody biomass feedstocks into useable fuel through gasification processes. These technologies—called fixed bed gasifiers and fluidized bed gasifiers—are being commercialized and currently are producing syngas for power and heat on a limited basis.

Biomass as an Energy Resource

In almost all cases, biomass resources are used most efficiently and economically to produce electricity and/or heat when converted and employed as fuel in a CHP system. Biomass CHP can be fueled with:

- Biomass fuels (e.g., wood waste, agricultural residues) that are combusted in a boiler or gasified
- Biogas (e.g., landfill gas, digester gas, syngas) that is captured and combusted much like natural gas

Keys to Success

In some locations, opportunities for a successful biomass CHP project are enhanced by the availability of:

- **A local fuel source**. Biomass is most economical as a fuel source when the CHP system is located at or close to the biomass fuel stock.
- **An appropriate end user**. Biomass CHP can be a strong technical and economic fit for industrial and institutional applications, such as wood product processors, industrial and manufacturing facilities, schools, college campuses, hospitals, local government facilities, and utility power plants.
- **Renewable portfolio standards**. As of May 2008, 30 states and the District of Columbia had renewable portfolio standards, and in each of these states, biomass CHP represents a permissible renewable energy resource. In some states, renewable energy credits can be generated by using biomass to power a CHP system, providing projects with an additional revenue stream.
- **Grants, loans, or tax credits**. Biomass CHP projects often qualify for additional federal, state, and local incentives that traditional CHP systems are ineligible to receive.

Biomass CHP for Utilities

The CHP Partnership has encountered recent interest in biomass CHP from rural and municipal cooperative utilities. Installing a large-scale biomass CHP system can diversify the utility's portfolio, stabilize fuel costs, and lead to additional revenue from steam sales.

With a biomass CHP system, a utility can offer a manufacturing or processing facility (e.g., an ethanol or biodiesel production plant) reliable power and steam at a cost below typical onsite generation. Simultaneously, steam sales can have a significant positive effect on reducing the net operating costs of generating power for the utility. In one prefeasibility study, the CHP Partnership determined that with 200,000 lb/hr steam export capabilities at a 60-MW biomass CHP plant, power could be produced for less than 3.5 cents per kilowatt-hour.

For More Information

In 2007, the CHP Partnership released a comprehensive Biomass CHP Catalog of Technologies, which contains detailed information about biomass resources, feedstock preparation, and performance characteristics of various biomass conversion and CHP technologies. The catalog can be found on the CHP Web site at <www.epa.gov/chp/basic/renewable.html>.

The CHP Partnership now consists of 245 Partners, including energy users, energy service companies, CHP project developers and consultants, and equipment manufacturers, as well as federal, state, and local government agencies. Through 2007, Partners have installed more than 335 projects representing 4,450 MW of capacity. All of these projects can be considered success stories, including the following two examples from 2007.

Austin Energy Begins Operation of Mueller Energy Center CHP Project

In February 2007, Austin Energy began operation of its newest CHP project—the Mueller Energy Center—representing the efforts of four CHP Partners: Austin Energy, Burns & McDonnell, TAS, and Solar Turbines. The natural gas-fired system is designed to produce up to 4.3 MW of electricity for the nearby Dell Children's Medical Center of Central Texas (DCMCCT) and the local utility grid. Although the DCMCCT is connected to the grid for backup power supply, the energy center provides 100 percent of its electricity needs, making it one of the first hospitals in Texas capable of full operation in the event of a power outage.

Heat recovered from the combustion turbine exhaust is used to produce steam that satisfies 100 percent of the medical center's demand for building heat and domestic hot water. Additional steam is delivered to an absorption chiller, which produces chilled water for the medical center and other customers on a district cooling system. A chilled-water tank stores up to 8,000 ton-hours of chilled water for space cooling during peak demand periods.

Burns & McDonnell provided the design, construction, and turnkey installation of the packaged hybrid CHP energy plant. The $18 million facility incorporates a Mercury 50 recuperated natural gas combustion turbine from Solar Turbines capable of generating power at a simple heat rate efficiency of 38 percent and having guaranteed nitrogen oxide emissions of 5 parts per million without a catalyst. TAS provided the packaged electrical centrifugal chilled-water plant.

The project was designed to conform to the output-based emissions formula developed by the Texas Commission on Environmental Quality (TCEQ). The CHP system has an operating efficiency of 56 percent, requiring approximately 20 percent less fuel than typical onsite thermal generation and purchased electricity. Based on this comparison, the CHP system will effectively reduce carbon dioxide emissions by an estimated 10,900 tons per year. This reduction is equivalent to removing the emissions from 1,926 cars or planting 2,250 acres of forest. System records show that nitrogen oxide and sulfur dioxide levels are also tracking significantly below TCEQ requirements. In addition to the efficiency and carbon emission benefits associated with the CHP project, the CHP system is expected to save $275,000 annually in energy costs.

Photo courtesy of Austin Energy

Austin Energy's Mueller Energy Center

The energy plant is also an integral component of the DCMCCT's application to become the first hospital in the world certified by the U.S. Green Building Council as LEED Platinum. Other "green" features of the facility include natural lighting, external egress stairways, low-flow plumbing fixtures, high-efficiency and cut-off lighting fixtures, lighting control and heat recovery systems, use of numerous recycled building materials, and a three-acre outdoor natural "healing garden."

EPA recognized the pollution reduction and energy efficiency qualities of the Mueller Energy Center project by presenting Austin Energy with a 2006 CHP Certificate of Recognition.

For more information on the CHP plant or other energy-saving measures in place at this facility, contact Cliff Braddock, Director of Energy Business Development, Austin Energy, at <cliff.braddock@austinenergy.com>.

Photo courtesy of Capstone Turbine

Masonic Homes, Elizabethtown, PA

Masonic Homes Upgrades Turbines to Further Boost Efficiency and Cut Emissions

In 2002, officials at Masonic Homes in Elizabethtown, Pennsylvania, weary of the complex's 90-year-old, inefficient coal-fired steam system—and the high emissions associated with burning coal—knew it was time to move to a next-generation technology for their heating and electric needs, namely CHP.

Masonic Homes is a sprawling, continuing care retirement community, children's home, and community-service organization that opened in 1910. Today, the 1,400-acre complex serves 1,737 residents cared for by 1,300 staff. For decades, the complex's old coal plant burned in excess of 5,000 tons of coal each year to produce heat for laundry and space heating.

Eager for a change, Masonic Homes conducted an extensive research and installed five Capstone Turbine C60 (60 kW) low-emission turbines in 2002 that produced a combined 300 kW of electricity. The turbines are designed specifically for CHP applications. For five years, the natural gas turbines supplied base-load hot water needs while simultaneously creating electric power for the complex. The reliable, clean-burning turbines substantially lowered emissions and improved energy efficiency.

In the meantime, Capstone's product development team worked to enhance the turbine and developed an integrated heat-recovery module (known as the C65 ICHP), which generates 65 kW of electricity and 408,000 Btus per hour.

Masonic officials, delighted with the performance of the original natural gas C60s, agreed in late 2007 to upgrade the CHP turbines to C65s. Working with local Capstone distributor and CHP Partner, E-Finity Distributed Generation, the retrofit increased the onsite power plant's thermal and electrical energy efficiency virtually overnight. The turbine upgrades took place in December 2007, and required less than 48 hours to complete.

In addition to the five C65 turbines, E-Finity and Capstone installed integrated heat recovery modules on each turbine, as well as a service network that allows real-time remote monitoring, alarming, and troubleshooting of the power plant via the Internet.

The original Capstone installation placed third-party heat exchangers beside each turbine. After the upgrade, the heat-recovery modules are now situated on top of each turbine, which means the entire system takes up much less space.

The new system produces 325 kW, which is 25 kW more than the original Capstone installation. Masonic Homes has seen a 47 percent increase in net heat recovery and an overall system efficiency of approximately 83 percent.

Photo courtesy of Capstone Turbine.

Microturbine Installation at Masonic Homes.

New State Energy Portfolio Standards Include CHP

Energy portfolio standards (EPS) are becoming a widely applied method of encouraging renewable and efficient energy resource development. As of May 2008, eight states—Colorado, Connecticut, Hawaii, Nevada, North Carolina, North Dakota, Pennsylvania, and Washington—include CHP and/or waste heat recovery as an eligible resource, and Arizona explicitly includes renewably fueled CHP systems. An increasing number of states are recognizing the energy, environmental, and economic benefits of energy efficiency and CHP and are including these technologies in expanded or alternative EPS policies. North Carolina and Washington recently enacted EPS policies that include CHP, as summarized below. More information about EPS policies and the promotion of CHP can be found on the CHP Web site at <www.epa.gov/chp/state-policy/renewable.html>.

North Carolina Renewable Energy and Energy Efficiency Portfolio Standard

North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard (REPS), enacted in February 2008, requires investor-owned utilities in the state to supply 12.5 percent of retail electricity sales from eligible resources by 2021, and municipal utilities and electric cooperatives to meet a target of 10 percent renewables by 2018. Up to 25 percent of these requirements may be met through energy efficiency technologies, including CHP systems powered by nonrenewable fuels. After 2018, up to 40 percent of the standard may be met through energy efficiency.

Other eligible energy resources include solar-electric (photovoltaics), solar thermal, wind, hydropower up to 10 megawatts (MW), ocean current or wave energy, biomass that uses Best Available Control Technology (BACT) for air emissions, landfill gas, waste heat from renewables, and hydrogen derived from renewables.

The overall target for renewable energy includes technology-specific targets of 0.2 percent solar by 2018, 0.2 percent energy recovery from swine waste by 2018, and 900,000 megawatt-hours (MWh) of electricity derived from poultry waste by 2014. The North Carolina Utilities Commission (NCUC) has required that each electric power supplier submit its first annual REPS compliance plan by September 1, 2008. Beginning in 2009, each power supplier will be required to file a compliance report detailing the actions it has taken to fulfill the requirements of the REPS.

The compliance schedule for investor-owned utilities is shown below. Each year's percentage requirement refers to the previous year's electricity sales (e.g., the 2021 goal is 12.5 percent of 2020 retail sales).

- 2010: 0.02 percent from solar
- 2012: 3 percent (including 0.07 percent from solar; 0.07 percent from swine waste; 170,000 MWh from poultry waste)
- 2013: 3 percent (including 0.07 percent from solar; 0.07 percent from swine waste; 700,000 MWh from poultry waste)
- 2014: 3 percent (including 0.07 percent from solar; 0.07 percent from swine waste; 900,000 MWh from poultry waste)
- 2015: 6 percent (including 0.14 percent from solar; 0.14 percent from swine waste; 900,000 MWh from poultry waste)
- 2018: 10 percent (including 0.20 percent from solar; 0.20 percent from swine waste; 900,000 MWh from poultry waste)
- 2021: 12.5 percent (including 0.20 percent from solar; 0.20 percent from swine waste; 900,000 MWh from poultry waste)

Unlike investor-owned utilities, cooperatives and municipal utilities are permitted to use demand-side management, in addition to energy efficiency, to satisfy up to 25 percent of the standard, and they may also use large hydropower to meet up to 30 percent of the standard. Cooperatives and municipal utilities must also meet the solar, swine waste, and poultry waste goals, but these utilities only must meet an overall target of 10 percent by 2018.

To demonstrate compliance with REPS, utilities must procure renewable energy credits (RECs) earned after January 1, 2008. Under NCUC rules, a REC is equivalent to 1 MWh of renewable energy generation, but the law explicitly states that RECs do not include credit for emission reductions from oxides of sulfur and nitrogen, mercury, or carbon dioxide. Excess RECs may be applied to the next year's compliance target, and utilities can use unbundled RECs from out-of-state renewable energy facilities to meet up to 25 percent of the portfolio standard. The law defines qualifying out-of-state facilities as (1) hydroelectric power facilities with a generation capacity up to 10 MW, or (2) renewable energy facilities placed into service on or after January 1, 2007. Suppliers with fewer than 150,000 customers are not limited in the amount of out-of-state renewable energy RECs they can procure to meet the standard.

Under the NCUC's final rules, there are no specified penalties or alternative payments for noncompliance. To view the text of the North Carolina REPS, please see <www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_62/GS_62-133.8.html>.

Policy Highlights

Washington Renewable Energy Standard

Washington's Renewable Energy Standard (RES) requires utilities with more than 25,000 customers to obtain 15 percent of their electricity from new renewable resources and to undertake all cost-effective energy conservation by 2020.[1] High-efficiency cogeneration owned and used by a retail electric customer to meet its own needs may be counted toward conservation targets. The RES passed by a ballot initiative in 2006 (the second state after Colorado to do so).

A utility subject to the RES must use eligible renewable resources or acquire equivalent renewable energy credits, or a combination of both, to meet the following annual targets:

- At least 3 percent of its load by January 1, 2012, and each year thereafter through December 31, 2015
- At least 9 percent of its load by January 1, 2016, and each year thereafter through December 31, 2019
- At least 15 percent of its load by January 1, 2020, and each year thereafter

"Renewable resources" include electricity produced from water; wind; solar energy; geothermal energy; landfill gas; wave, ocean, or tidal power; biogas from sewage treatment facilities; biodiesel fuel; and biomass energy based on animal waste or solid organic fuels from wood, forest, or field residues, or dedicated energy crops.

Utilities subject to the standard must also pursue all available conservation that is cost-effective, reliable, and feasible. Specifically, by January 1, 2010, utilities must (1) identify achievable cost-effective conservation potential through 2019, with reviews and updates every two years for the subsequent 10 years; and (2) establish and meet biennial targets for conservation.

Distributed generation using an eligible renewable resource may be counted as double the facility's electrical output if the utility owns the facility, has contracted for the distributed generation and the associated RECs, or has contracted to purchase only the associated RECs.

Utilities that fail to meet the energy conservation or renewable energy targets will be subject to a $50/MWh administrative penalty (adjusted annually for inflation). The funds will be deposited in a special account for the purchase of RECs or for energy conservation projects at public facilities, local government facilities, community colleges, or state universities.

To view the text of the Washington RES, please see <http://apps.leg.wa.gov/RCW/default.aspx?cite=19.285>.

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1 "Cost effective" means that a project or resource is forecast to (1) to be reliable and available within the time it is needed, and (2) to meet or reduce the electric power demand of the intended consumers at an estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative project or resource, or any combination thereof.

Oregon Proposes Interconnection Rule and Adopts Net Metering Standard Favorable to CHP

The Oregon Public Utility Commission (PUC) adopted net metering standards and formally opened a rulemaking docket for a small generator interconnection rule in July 2007, after a nearly year-long stakeholder process. Oregon's proposed interconnection rule is considered a national model for interconnection rule best practices. Oregon started with the Mid-Atlantic Distributed Resources Initiative (MADRI) model rule and made several improvements, including:

- Adding a "field certification" concept
- Allowing non-inverter-based Tier 2 fast tracking up to 2 MW
- Increasing the Tier 1 review to 25 kW

The net metering rule allows nonresidential investor owned utility (IOU) customers with systems up to 2 MW to interconnect. Eligible electric generating resources include solar power, wind power, hydropower, fuel cells, or biomass. The proposed interconnection rule allows small generator facilities[2] with systems up to 10 MW to interconnect, and does not specify specific eligible resources.

The PUC's net metering rules include three levels of interconnection and require the use of a standard application, a standard agreement, and reasonable procedural timelines for utilities and applicants. The proposed small generator interconnection rule includes four tiers of interconnection as outlined below.

- **Tier 1 interconnection review** applies to certified, inverter-based systems up to 25 kW in capacity that comply with IEEE standards and UL 1741 and that are not interconnected to a transmission line. A system is considered "certified" if a manufacturer has submitted it to a nationally recognized testing lab and it has been tested and listed by the lab. Systems must pass specific technical screens.
- **Tier 2 interconnection review** applies to certified systems up to 2 MW that comply with IEEE standards and UL 1741 but do not qualify for Tier 1 review. Systems must pass specific technical screens. The small generator must be interconnected to either a radial distribution circuit or a spot network distribution circuit limited to serving one customer, and must not be interconnected to a transmission line.
- **Tier 3 interconnection review** applies to systems that do not qualify for Tier 1 or Tier 2 review and have a capacity less than 10 MW. Systems must pass specific technical screens, and the small generator must not be connected to a transmission line or export power beyond the point of interconnection.
- **Tier 4 interconnection review** applies to systems that do not qualify for or failed to meet the Tier 1, Tier 2, or Tier 3 interconnection review requirements and have a capacity less than 10 MW. A feasibility study, system impact study, or a facilities study may be required under Tier 4 review.

Oregon's proposed small generator interconnection rule is scheduled to go before the PUC in the first half of 2008.

Oregon's new net metering and proposed interconnection standards will facilitate the development of clean distributed generation in the state and will help the state meet two of its energy and environmental goals created in 2007. On August 7, 2007, Oregon's governor signed landmark climate change legislation (HB 3543) that articulates Oregon's policy to halt increases in greenhouse gas emissions by 2010, and then reduce emissions below 1990 levels by 10 percent by 2020 and by 75 percent by 2050. Oregon also passed a renewable portfolio standard in June 2007, which requires utilities to supply 5 to 25 percent (depending on utility size) of the state's electricity from renewable energy resources. (CHP is not an eligible renewable resource).

As of April 2008, 31 states had adopted standard interconnection rules for distributed generation, and 11 additional states were in the process of developing rules. For more information on interconnection standards, how they support the development of clean distributed generation, and which states have interconnection standards favorable to CHP, please visit the CHP Web site at <www.epa.gov/chp/state-policy/interconnection.html>.

[2] "Small generator facility" means a facility for the production of electrical energy that has a nameplate capacity of 10 MW or less and can operate in parallel with a public utility's transmission or distribution system. A small generator facility does not include interconnection equipment, interconnection facilities, or system upgrades.

Policy Highlights

Energy Independence and Security Act of 2007

On December 19, 2007, President Bush signed the Energy Independence and Security Act of 2007 (EISA) into law. The Act creates several new programs and amends existing programs, listed below, that are applicable to CHP and renewable energy from biomass:

- Recoverable Waste Energy Inventory Program
- Waste Energy Recovery Incentive Grant Program
- Revised renewable fuel standard (RFS2)
- Grants for the production of advanced biofuels
- Clean Energy Application Centers
- Energy-Intensive Industries Program
- Energy Efficiency and Conservation Block Grant Program
- Renewable energy construction grants
- Express loans for renewable energy

Of note is the development of the Recoverable Waste Energy Inventory Program, established under Section 451 of EISA. The program will include an ongoing survey (the "Registry of Recoverable Waste Energy Sources") of all major industrial and large commercial combustion sources and sites in the United States. The program will also include a review of the quantity and quality of waste energy produced at each source.

EPA will calculate the total quantities of potentially recoverable waste energy from sources at the sites, nationally and by state. The Agency will also make public the total quantities of waste energy produced at the source, as well as information on the criteria pollutant and greenhouse gas emissions savings that might be achieved with recovery of the waste energy from all sources and sites listed on the Registry.

For each site listed in the Registry, at the request of the owner or operator of the site, EPA will offer, in cooperation with the U.S. Department of Energy (DOE) Clean Energy Application Centers, suggestions for optimum means of recovery of value from the waste energy streams in the form of electricity, useful thermal energy, or other energy-related products. To be included in the Registry, a project at the site must be economically feasible (i.e., it must offer a payback of invested costs not later than five years after the date of first full project operation, including incentives offered under Section 451 of EISA). Projects proposed for inclusion in the Registry cannot be developed or used for the primary purpose of making sales of excess electric power.

DOE will provide technical support for waste energy recovery to owners or operators of combustion sources, and will offer partial funding (in an amount equal to not more than one-half of total costs) for feasibility studies to confirm whether or not investment in recovery of waste energy or CHP at a source would offer a payback period of five years or less.

For fiscal years 2008 through 2012, $1 million per year is authorized for EPA to create and maintain the Registry and for services authorized under the program; $2 million is authorized for each year for DOE to assist site or source owners and operators in determining the feasibility of projects; and $5 million is authorized to provide funding for state energy office functions.

To view a summary of provisions in the EISA affecting CHP, please see "Energy Independence and Security Act of 2007: Key Provisions Affecting Combined Heat and Power," listed under "Clean Energy Policy Resource Documents" on the CHP Web site at <www.epa.gov/chp/publications/index.html>.

CHP Partnership Tools and Resources

EPA's CHP Partnership provides information, tools, and technical assistance to energy users who are considering implementing CHP projects.

Basic CHP Information

CHP Catalog of Technologies

A comprehensive guide to CHP technology,with descriptions of how prime mover and heat recovery technologies function, plus cost and performance characteristics.
<www.epa.gov/chp/documents/catalog_of_%20chp_tech_entire.pdf>

Quantifying the Reliability Benefits of CHP— New in 2007!

How to estimate the value of CHP as emergency or primary power that can function without the grid. How various design approaches impact project economics.
<www.epa.gov/chp/documents/calculating_reliability_benefits.pdf>

Methods of Calculating Efficiency

How and when to use the two most common methods for calculating CHP system efficiency: total system efficiency and effective electric efficiency.
<www.epa.gov/chp/basic/methods.html>

Biomass CHP Tools and Resources

Biomass CHP Catalog of Technologies— New in 2007!

A detailed technology characterization of biomass CHP systems. Includes technical and economic information about biomass resources, biomass preparation, energy conversion technologies, power production systems, and complete integrated systems.
<www.epa.gov/chp/documents/biomass_chp_catalog.pdf>

Opportunities and Resources for Biomass CHP Fact Sheet— New in 2007!

The benefits of biomass CHP, key considerations for successful projects, and the wide variety of biomass tools and resources that the CHP Partnership offers.
<www.epa.gov/chp/documents/biomass_fs.pdf>

Biomass to Biopower Diagram— New in 2007!

Graphical representation of how biomass is converted to biopower and of the industries that can capitalize on biomass and biogas opportunity fuels.
<www.epa.gov/chp/documents/biomass_map.pdf>

Project Development Resources

Qualification

Is My Facility a Good Candidate for CHP?

An online tool that can be used to screen a business for CHP suitability.
<www.epa.gov/chp/project-development/qualifier_form.html>

Feasibility

Level 2 Feasibility Study Overview and Checklist

An introduction to the elements of a Level 2 feasibility study, which is an engineering study using verified data to determine optimal system design and pricing. Includes a checklist for energy users who are considering implementing CHP at their facilities.
<www.epa.gov/chp/documents/level_2_studies_september9.pdf>

Procurement

Procurement Guide: Selecting a Contractor/Project Developer

Guidance for owners attempting to determine the roles they might take in the development process and the right contractor or project developer to get their CHP projects successfully developed, financed, and built.
<www.epa.gov/chp/documents/pguide_select_contractor.pdf>.

Procurement Guide: CHP Financing

Financing methods for CHP and advantages and disadvantages of each.
<www.epa.gov/chp/documents/pguide_financing_options.pdf>

Procurement Guide: CHP Siting and Permitting Requirements

Various siting and permitting issues related to CHP installations.
<www.epa.gov/chp/documents/pguide_permit_reqs.pdf>

Funding Resources

Funding Database

Financial and other incentives that might be applicable to a particular CHP or biomass project, organized by project type, state, and incentive type, updated monthly.
<www.epa.gov/chp/funding/index.html>

CHP Partnership Tools and Resources

Strategic Markets

Dry Mill Ethanol

The Impact of CHP on Energy Use and Carbon Emissions in the Dry Mill Ethanol Process—New in 2007!

Energy requirements at state-of-the-art, conventionally powered and CHP-powered ethanol production facilities. Energy savings and greenhouse gas emissions reductions resulting from CHP fueled by natural gas, coal, and biomass.
<www.epa.gov/chp/documents/ethanol_energy_balance.pdf>

Integration of Volatile Organic Compound (VOC) Destruction and CHP in the Ethanol Industry

Preliminary evaluation of the ability of CHP systems to serve as VOC oxidizers for ethanol facilities.
<www.epa.gov/chp/documents/voc_destruction_white_paper.pdf>

CHP for Ethanol Facilities Fact Sheet

The technical, economic, and environmental benefits of using CHP to provide electricity and steam for a dry mill ethanol production facility.
<www.epa.gov/chp/documents/ethanol_fs.pdf>

Hotels and Casinos

CHP in Hotels and Casinos—Market Analysis Report

Technical and economic potential for CHP in the hospitality industry.
<www.epa.gov/chp/documents/hotel_casino_analysis.pdf>

CHP in Hotels and Casinos—Market Analysis Report Addendum

Updated statistics on the potential for CHP in the hospitality industry.
<www.epa.gov/chp/documents/hotel_casino_addendum.pdf>

CHP for Mid-Size to Large Hotels Fact Sheet

The economic and environmental benefits of using CHP to provide electricity and heat for mid-size to large hotels (i.e., those with more than 100 rooms).
<www.epa.gov/chp/documents/hotel_fs.pdf>

CHP for Resort Hotels and Casinos Fact Sheet

The reliability and economic and environmental benefits CHP systems can provide to large resort casinos.
<www.epa.gov/chp/documents/casino_fs.pdf>

Municipal Wastewater Treatment Facilities

Opportunities for and Benefits of CHP at Wastewater Treatment Facilities— New in 2007!

Technical and economic benefits of CHP for wastewater treatment facilities and the potential for fuel savings and greenhouse gas reductions at wastewater treatment facilities. Engineering rules-of-thumb for considering a CHP system at a municipal wastewater treatment facility.
<www.epa.gov/chp/documents/wwtf_opportunities.pdf>

Energy Savings and Energy Reliability for Wastewater Treatment Facilities Fact Sheet— New in 2007!

Technical and economic benefits of using biogas-fueled CHP from an anaerobic digester at a wastewater treatment facility. Engineering rules-of-thumb for considering potential electricity and thermal outputs.
<www.epa.gov/chp/documents/wastewater_fs.pdf>

Additional Resources

Efficient Energy for Local Governments Fact Sheet—New in 2007!

Potential opportunities for installing CHP in municipalities, with case study examples and assistance that the Partnership offers to local governments.
<www.epa.gov/chp/documents/municipalities_fs.pdf>

The Role of Distributed Generation (DG) CHP Systems in Data Centers

How DG resources, such as fuel cells, reciprocating engines, and gas, can offer powerful energy efficiency savings in data centers, particularly when configured in CHP mode.
<www.epa.gov/chp/documents/datactr_whitepaper.pdf>

State Policy Resources

Output-Based Environmental Regulations Fact Sheet

How output-based regulations can encourage CHP projects, and a listing of which states have them in place.
<www.epa.gov/chp/documents/output_based_regs_fs.pdf>

Interconnection Standards Fact Sheet

How and why states implement standard interconnection rules to encourage DG technologies.
<www.epa.gov/chp/documents/interconnection_fs.pdf>

Utility Rates Fact Sheet

Rate design options that allow utility cost recovery and the expansion of clean DG.
<www.epa.gov/chp/documents/utility_rates_fs.pdf>

CHP Partnership Tools and Resources

State Clean Energy Funds Fact Sheet

Why states would implement clean energy funds, what fund options exist, and which states have clean energy funds.
<www.epa.gov/chp/documents/clean_energy_funds.pdf>

Renewable Portfolio Standards (RPS) Fact Sheet

The benefits of RPS for states, how RPS encourage CHP projects, and examples of state RPS requirements.
<www.epa.gov/chp/documents/rps_fs.pdf>

Energy Portfolio Standards (EPS) and the Promotion of CHP

The elements of successful EPS and RPS policies and how these policies can promote DG, energy efficiency, and CHP. Examples of state EPS programs that include CHP and an overview of the benefits and characteristics of CHP.
<www.epa.gov /chp/documents/eps_and_promotion.pdf>

Public Recognition

ENERGY STAR® CHP Award

Awarded to leaders who increase the nation's electric generation efficiency by developing highly efficient CHP projects. CHP systems can qualify for the ENERGY STAR CHP Award if they demonstrate considerable fuel and emission savings over comparable, state-of-the-art, separate heat and power generation. (See the article on page 20 for more information about the ENERGY STAR CHP Award.)
<www.epa.gov/chp/public-recognition/awards.html>

GHG Reduction Report

A frameable, color certificate that shows the estimated carbon reductions associated with each CHP Partners' projects, as reported annually to the CHP Partnership.

CHP Partners List

All companies and institutions that are CHP Partners, including profiles of each Partner organization, links to CHP-specific Web pages, and contact information.
<www.epa.gov/chp/partnership/partners.html>

Technical Assistance for Candidate Sites

With basic preliminary information about the candidate sites' electric and thermal needs, the Partnership can help:

- Identify opportunities for cost-effective CHP.
- Assess goals, drivers, and potential barriers for a project.
- Direct energy users to existing tools and resources.
- Determine next steps for project technical assistance.

The CHP Partnership can supply the following technical assistance to Partners free of charge:

Spark Spread Screening for Candidate Sites

Based on minimal site information, the CHP Partnership can provide your organization with a preliminary spark spread screening of CHP economic viability for single or multiple end-use sites. These screenings show the difference between the cost to purchase power for your site or to produce power on site.

Level 1 Feasibility Study

If a site is determined to have a good economic and technical potential for CHP, the CHP Partnership can conduct a Level 1 feasibility analysis to help a candidate site determine how compelling the opportunity is. The Partnership will evaluate several CHP technologies or system options and develop budgetary pricing and economic analyses for each option to determine a simple payback timeframe.

Third-Party Review of Feasibility/Design Studies

The CHP Partnership can provide third-party review of CHP system feasibility and/or design studies. A review will include an evaluation of critical assumptions, approaches to CHP equipment selection and sizing, and project economics.

Technology/Vendor List

The CHP Partnership can provide a list of technology suppliers and project developers with relevant expertise in the CHP technology you are considering. The list is not intended as a vendor recommendation, but rather for identifying suppliers and vendors with experience in similar installations.

Incentive/Policy Analysis

The CHP Partnership team can provide a review of specific national, state, and local incentives and policies that could impact the economic viability of a prospective CHP installation at a specific location.

Energy and Emission Savings Calculations

The CHP Partnership team has developed an online tool that your business can use to quantify the energy and emissions (CO_2, SO_2, NO_X) savings from using CHP technology. The Partnership team is available to help a candidate or operating site run the tool and will send a letter to the site owner outlining the results, upon request.
<www.epa.gov/chp/basic/calculator.html>

ENERGY STAR® CHP Awards

EPA awards the ENERGY STAR® CHP Award to leaders who increase the nation's electric generation efficiency through the development of highly efficient CHP projects. The ENERGY STAR CHP Award recognizes projects that reduce emissions and use at least five percent less fuel than state-of-the-art separate heat and power generation. For more information about the ENERGY STAR CHP Award, including information on how to apply, visit the Partnership Web site: <www.epa.gov/chp/public-recognition/index.html>.

The Application Process

Applying for the ENERGY STAR CHP Award is fairly simple, and the CHP Partnership can help facilitate the process as needed. To determine if your project qualifies, please complete the electronic application at <www.epa.gov/chp/public-recognition/awards.html> and send it to the CHP Partnership at <chp@epa.gov>. EPA accepts and processes applications continuously and presents awards at key events, such as our CHP Partners meeting and at other industry events.

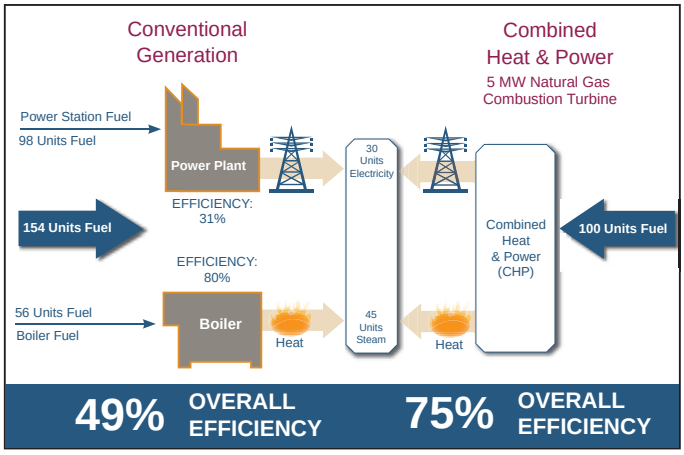
To qualify for an ENERGY STAR CHP Award, a project must:

- Use at least five percent less fuel than comparable state-of-the-art separate heat and power generation systems.
- Be in commercial operation.
- Have a minimum of 12 months and 5,000 hours of measured operating data. Because awards recognize contemporary performance, the operating period covered by the submitted data must begin within 14 months prior to the date of application.
- Be operating within the emission limits stipulated in their permits.

How Fuel Efficiency Is Compared

To qualify for an ENERGY STAR CHP Award, a CHP project must use at least five percent less fuel than the state-of-the-art separate heat and power system against which it is compared. This comparison is performed against separate heat and power generation (e.g., an onsite boiler and grid electricity) that uses comparable fuel, the same power-to-heat ratio, and incorporates transmission and distribution (T&D) losses.

For example, a natural gas-fueled CHP system would be compared to a natural gas combined cycle electric-only plant and a natural gas-fueled boiler; adjustments are made for T&D losses if the CHP project sells power to the grid.



Congratulations to Our 2006 and 2007 ENERGY STAR CHP Award Winners!

Adkins Energy LLC CHP System (2007)
5 MW, 70% system efficiency, CO_2 emissions reductions of 8,700 tons/year

Macon Energy Center CHP Project (2007)
10 MW, 66% system efficiency, CO_2 emissions reductions of 28,200 tons/year

Arizona State University CHP System (2007)
8.8 MW, 79% system efficiency, CO_2 emissions reductions of 16,000 tons/year

Princeton University Energy Plant (2007)
15 MW, 75% system efficiency, CO_2 emissions reductions of 27,900 tons/year

University of New Mexico CHP Project (2007)
6 MW, 64% system efficiency, CO_2 emissions reductions of 8,200 tons/year

Kent State University Cogeneration Plant (2007)
13 MW, 71% system efficiency, CO_2 emissions reductions of 13,000 tons/year

ExxonMobil Baytown CHP Project (2006)
171 MW, 73% system efficiency, CO_2 emissions reductions of 619,000 tons/year

New Partners

2006 and 2007 New Partners

We extend a warm welcome to the following 60 organizations that joined the Partnership in 2006 and 2007. To learn more about these and all our Partners, visit the Our Partners page of our Web site at <www.epa.gov/chp/partnership/partners.html>.

Antares Group, Inc.

Atlantice Ethanol, Inc.

Axiom Engineers

BAR Capital Group

Biotech Energy Company, LLC

Bioverda U.S. Holdings, LLC

Black & Veatch

Bonhag Associates, PLLC

Carbon Solutions Group

Carlson Small Power Consultants

Caterpillar Financial Services Corporation

Cumberland Financial Services Corporation

DE Solutions, Inc.

Dominion Federal Corporation

DSM Engineering Associates, PC

E-Finity Distributed Generation, LLC

E-Power

Elliott Energy Systems, Inc.

Energy Recovery International

Envio Energi, LLC

Ferrellgas

Fuss & O'Neill, Inc.

GE Energy

Genzyme Corporation

Great River Energy

Green Power Management, LLC

Greenline Industries, LLC

GT Environmental Finance, LLC

GTL Resources

Hammel, Green and Abrahamson, Inc.

Hannon Armstrong

HBH Gas Systems

Innovative Energy, Inc.

Innovative Engineering

Johnson Controls

KEMA

Kinergetics, LLC

Marketable Ventures

NewMech Facility Solutions, Inc.

Northeast Energy Systems

Novozymes North America, Inc.

OPRA Turbines

PCI Management & Consulting Company

Primenergy, LLC

Recycled Energy Development

Renewable Agricultural Energy, Inc.

Richard Reed Heating and Air Conditioning, Inc.

Self-Gen, Inc.

Siemens Industrial Turbomachinery

Southern California Gas Company

Technical Support, Inc.

TEDOM s.r.o

Thermal Energy Corporation

TVC Systems

U.S. Power Production, LLC

Vermont Department of Public Service

Western Energy Systems

Wilson TurboPower, Inc.

Wisconsin Power Control, LLC

WM Group Engineers

CHP

EPA COMBINED HEAT AND POWER PARTNERSHIP

www.epa.gov/chp

EPA

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