Energy Portfolio Standards and the Promotion of Combined Heat and Power

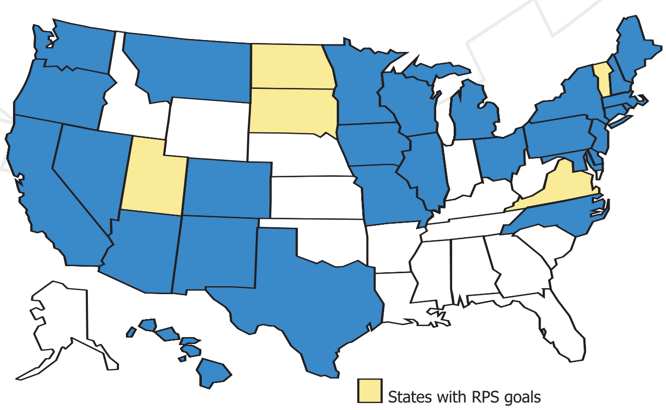
Energy Portfolio Standards

Energy portfolio standards (EPS) are becoming a widely applied method of encouraging the development of renewable and efficient energy resources. The most commonly implemented portfolio standards are renewable portfolio standards (RPS), although there is increasing discussion about Energy Efficiency Resource Standards (EERS). An RPS requires electric utilities and other retail electric providers to supply a specified minimum amount of customer load with electricity from eligible renewable energy sources. This amount usually begins as a small percentage of the total electricity load that increases gradually over time (e.g., 5 percent by 2010, increasing 1 percent per year to 15 percent by 2020). Through August 2008, EPS requirements or goals have been established in 33 states plus the District of Columbia (see Figure 1).[1] Most EPSs have been established within the last five years, with 10 states enacting RPS policies in 2004 and 2005 alone.[2]

The type of resources that are eligible under an RPS or EPS varies by state. Most states include renewable resources such as solar, wind, small hydropower and ocean/tidal/thermal systems, biomass, and landfill gas. Some states also include advanced technologies, such as fuel cells, that possess beneficial energy and environmental attributes. In addition, states are increasingly recognizing the energy, environmental, and economic benefits of energy efficiency and combined heat and power (CHP), and are including these technologies in expanded or alternative EPS policies. For example, some states, like Connecticut, are promoting a variety of energy efficient technologies in their EPS policies through a system of different technology classes or tiers; each tier requires a specific percentage or amount (in megawatts) of energy production to come from specified renewable or efficient technologies. Connecticut and Pennsylvania have both included energy efficiency and CHP in a separate tier in their EPSs.

Thirteen states—Colorado, Connecticut, Hawaii, Massachusetts, Michigan, Nevada, North Carolina, North Dakota, Ohio, Pennsylvania, South Dakota, Utah, and Washington—include CHP and/or waste heat recovery as an eligible resource and Arizona explicitly includes renewable fueled CHP systems. CHP, also known as cogeneration, is

Figure 1 - States With RPS Requirements



Source: Database of State Incentives for Renewable Energy (DSIRE) last accessed March 2009, www.dsireusa.org.

the simultaneous production of electricity and heat from a single fuel source such as natural gas or biomass/biogas. CHP systems offer considerable environmental benefits when compared to traditionally purchased electricity and onsite-generated thermal energy.

Combined Heat and Power (CHP)

By capturing and utilizing heat that is normally wasted, CHP systems typically achieve total system efficiencies of 60 to 80 percent—compared to less than 50 percent for equivalent separate heat and power systems. With this increased efficiency, a CHP system uses 35 percent less fuel to achieve the same energy output as separate heat and power systems.

Because CHP is a form of distributed generation (DG) in which less fuel is combusted, it offers a number of environmental and economic benefits:

- Reduced emissions of all air pollutants
  - Fewer greenhouse gas emissions, such as carbon dioxide (CO_2)
  - Fewer criteria air pollutants, including nitrogen oxides (NO_X) and sulfur dioxide (SO_2)
- Reduced grid congestion and avoided distribution losses
- Increased reliability and power quality
- Lower operating costs

For more specific information about how CHP works and what its benefits are, see the addendum at the end of this paper or visit EPA's CHP Partnership website at www.epa.gov/chp.

RPS Design and Implementation

States have recognized the increasing need to encourage efficient and nonpolluting sources of energy. RPSs are the favored approach for most states because they can stimulate market and technology development using a cost-effective, market-based approach that is also administratively efficient.

Most RPS requirements work through the application of a trading program either in the state or on a regional basis. Qualifying renewable resources receive a certain number of certificates per year, usually based upon their generation (e.g., 1 megawatt-hour [MWh] = 1 certificate). These certificates are most often referred to as renewable energy certificates (RECs). Renewable energy generators can then sell RECs to electricity suppliers, such as large utilities, that must also fulfill the RPS. RECs not only generate revenue for renewable generators, but they are also the measure of compliance for the RPS policy. REC trading programs provide flexibility and reduce administrative program costs in several ways:

- Not every electricity supplier needs to develop and operate renewable generation assets to comply.
- Independent renewable developers have access to the market.
- Renewable energy can be supplied from the most advantageous sites to electricity suppliers throughout a state or a region.

RPSs often contain an alternative compliance mechanism under which an electric supplier or distributor can pay a fee to the state if they are unable to procure a sufficient supply of RECs. The Alternative Compliance Payment (ACP) is often set at a high level to encourage the development of renewable projects. Payments to an ACP fund are usually used by the state to promote the development of renewable projects. For example, in Massachusetts, the ACP goes to the Massachusetts Technology Collaborative. This organization then uses the money to fund clean energy and green buildings and infrastructure programs. The clean energy program's goal is to support community and utility projects that use wind, solar, and bioenergy and to educate citizens about green electricity markets. The green buildings and infrastructure program provides funding to renewable energy technologies in all types of buildings. In Connecticut, the ACP goes to the Connecticut Clean Energy Fund to promote Class I and Class II resources (new renewable generation) and to the conservation and load management program to support Class III resources (energy efficiency and CHP).

Elements of a Successful RPS Policy

There are several key components to the design and implementation of an RPS, discussed below.

Eligibility

The definition of which technologies are eligible for inclusion is quite varied. Table 1 summarizes the technology eligibility for state RPS programs as of August 2008. While states identify renewable technologies differently, most tend to include, at a minimum, solar, wind, biomass, and landfill gas/biogas. Some programs only allow combustion technologies that use biomass or other renewable fuels; others allow the use of any fuel as long as it is in an approved technology. In the case of CHP, inclusion may require meeting a minimum efficiency percentage (e.g., 50 percent total efficiency in Connecticut) or designation as a "qualifying facility" under the Public Utilities Regulatory Policy Act. These efficiency minimums also usually require some threshold of

Table 1 - Eligible Technologies Under State RPS Requirements

	Biofuels	Biomass	CHP/Waste Heat	Energy Efficiency	Fuel Cells‡	Geothermal	Hydro	Landfill Gas	Municipal Waste	Ocean Thermal	Photovoltaics	Solar Thermal Electric	Tidal	Waste Tire	Wave	Wind
AZ	●	●	●*			●	●	●			●	●				●
CA	●	●				●	●	●	●	●	●	●	●		●	●
CO	●	●	●			●	●	●			●					●
CT	●	●	●	●	●		●	●	●	●	●	●	●		●	●
DE	●	●				●	●	●		●	●	●	●		●	●
DC	●	●				●	●	●	●	●	●	●	●		●	●
HI	●	●	●	●		●	●	●	●	●	●	●	●		●	●
IA	●	●					●	●	●		●					●
IL	●	●		●			●	●			●	●				●
MA	●	●	●			●	●	●	●	●	●	●	●		●	●
MD	●	●				●	●	●	●	●	●	●	●		●	●
ME	●	●			●	●	●	●			●	●	●		●	●
MI	●	●	●	●		●	●	●	●		●	●	●		●	●
MN	●	●			●**		●	●	●		●	●				●
MO	●	●				●	●	●	●		●	●				●
MT	●	●				●	●	●			●	●				●
NC	●	●	●	●		●	●	●			●	●	●		●	●
ND*	●	●	●			●	●	●			●	●				●
NH	●	●			●	●	●	●	●	●	●	●	●		●	●
NJ	●	●			●	●	●	●	●		●	●	●		●	●
NM	●	●				●	●	●			●	●				●
NV	●	●	●	●		●	●	●	●		●	●		●		●
NY	●	●			●		●	●		●	●		●		●	●
OH	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
OR	●	●			●	●	●	●		●	●	●	●	●	●	●
PA	●	●	●	●	●	●	●	●	●		●	●				●
RI	●	●				●	●	●		●	●		●	●	●	●
SD*	●	●	●			●	●	●	●	●	●	●	●		●	●
TX	●	●				●	●	●		●	●	●	●		●	●
UT*	●	●	●			●	●	●		●	●	●	●		●	●
VA*	●	●				●	●	●		●	●	●	●		●	●
VT*	●	●					●	●	●		●	●				●
WA	●	●	●	●		●	●	●		●	●	●	●		●	●
WI	●	●				●	●	●			●	●	●		●	●

*States with RPS goals not mandatory requirements.
*Renewable CHP systems are eligible; fossil-fueled CHP systems are not eligible.

‡Includes only those states that allow fuel cells using nonrenewable energy sources of hydrogen. Some states allow only renewable fuel cells (Arizona, California, Colorado, Delaware, Massachusetts, Maryland, Missouri, New Mexico, New York, Rhode Island, South Dakota, Utah, Wisconsin) as eligible technologies.

Source: Database of State Incentives for Renewable Energy (DSIRE), accessed March 2009.

recovered electric and/or thermal energy, such as Connecticut's 20 percent minimum thermal threshold. The RPS eligibility requirements might also set emission limits for emitting technologies. For example, through 2005, California sources were required to produce zero emissions or meet the 2007 state emission limits for DG to qualify as eligible. In Connecticut, specific emission limits apply to biomass facilities.

CHP systems that are fueled with a qualifying renewable resource, such as biomass, are eligible under RPSs. In this context, typically only the electric output of the CHP system is eligible. States can also include the thermal output for these systems in their RPS to fully value the benefits of CHP. There are numerous states that credit thermal output in their environmental regulations. For example, California, Maine, Rhode Island, and Texas include thermal output in their Small DG Rule.[3] So do EPA's Combustion Turbine New Source Performance Standards.[4] To account for the thermal output of CHP units, these states convert the measured steam output (British thermal unit, or Btu) to an equivalent electrical output (MWh). This is done through a unit conversion factor (1 MWh = 3.413 MMBtu). By adding the thermal and electric output together, states are recognizing the full environmental and emissions benefits of CHP. RPS language can be modified to state that CHP output will be calculated as the electric output plus the thermal output in MW, based on the conversion of 1 MWh = 3.413 MMBtu of heat output.

RPSs often include several tiers or classes of generators in order to differentiate between different technologies and allow different targets to be set for different classes. Often, Tier I includes primarily zero-emitting renewables, while other tiers include biomass or other emitting renewable technologies or advanced low-emitting non-renewables. Some states, such as Connecticut and Pennsylvania, can utilize a separate tier for energy efficiency and CHP, ensuring these resources do not compete with renewable energy technologies. Different generation targets are then set for each tier according to state goals, resources, and interests. RECs for different tiers typically garner different prices, with the zeroemitting renewables typically having the highest prices (see Table 2). For example in New Jersey, the price for a solar REC for the 2007-2008 calendar years was $265.

Consistency among state portfolio standards in a region provides large benefits to the electric market. Considering state and regional resource availability is central to the success of a portfolio standard.

Size of Requirement

The basis of the renewable requirement can vary but is typically a percentage of annual generation or sales of electricity. The size of the requirement is also quite varied. Requirements normally start from a small percentage and then grow by some increment each year to achieve a plateau level by a specific target year, subject to review. Table 3 shows the range of target values in states with an RPS.

The size of both the initial and target values also depends on which technologies and vintages are allowed in the program. For example, Maine's first RPS required 30 percent clean energy, but it included many existing biomass facilities, which already comprised more than 30 percent of the state's generation. It is also important for states to conduct renewable energy, energy efficiency, and CHP potential studies as a portfolio standard is created. These studies ensure that the standard can be met without placing too much strain on the affected utilities.

Alternative Compliance Payment

Many RPS programs include an Alternative Compliance Payment (ACP) provision. The ACP sets a limit on the price of RECs in case renewable generation does not keep up with the requirements. If the regulated entities cannot purchase RECs at a price below the ACP, they are allowed to pay the state the ACP price as an alternative. The state then uses the ACP funds to promote renewable projects. The ACP price usually escalates over time. This structure prevents the REC price from being too high while at the same time provides funding for renewable development when supply is scarce.

Vintage

Because the goal of an RPS is to encourage new sources of renewable or efficient generation, many RPS requirements state that eligible resources are those constructed after a certain date, such as after or shortly before the rule is promulgated. Some states credit incremental generation added after the required vintage date; CHP systems in Connecticut and biomass facilities in Massachusetts are allowed such flexibility. In a few cases, existing facilities are allowed full credit under the RPS (e.g., renewable facilities under Maine's first RPS). As previously noted, the decision on vintage also affects the appropriate size of the target.

Point of Origin

RPS programs are typically state programs that allow only the use of RECs generated in that state. However, some programs do allow trading of RECs from other states with harmonious RPS programs that are in the same or an adjacent power pool. The Northeast includes multiple states in this category. However, some mechanism must still ensure that RECs from other states meet appropriate

Table 2 - REC Prices in 2008/2009
(1 REC = 1 MW)

Connecticut	
CLASS I*	
2009	$26.00
CLASS II	
2009	$1.03
CLASS III‡	
2008	$27.00
Maine‡	
2008	$0.25
Massachusetts*	
2009	$31.50
Texas*	
H2 2008	$1.40
H1 2009	$1.75
Delaware‡	
2008 "Existing"	$0.65
2008 "New"	$13.75
Rhode Island ‡	
2008 "New"	$48.00
New Jersey*	
SOLAR‡	
2007/2008	$265.00
CLASS I*	
2009	$20.00
CLASS II*	
2009	$1.05
Maryland‡	
TIER I	
2006	$0.60
2007	$0.95
2008	$1.10
TIER II	
2006	$0.40
2007	$0.55
2008	$0.60
DC‡	
TIER I	
2007	$0.65
2008	$1.15
TIER II	
2007	$0.75
Pennsylvania‡	
TIER I	
2007/2008	$8.50

‡ Evolution Markets. July 2008 Monthly Market Update (2008) www.evomarkets.com.

* 2009 REC prices from Argus Air Daily. March 10, 2009, Volume 16, 46.

Table 3 - State Portfolio Targets

State	Target (% of electric sales)	Specific Provisions (% of electric sales)
AZ	15% by 2025	4.5% from DG by 2012
CA	20% by 2010	
CO	IOUs 20% by 2020; electric cooperatives and municipal utilities 10% by 2020	IOUs: 0.4% solar by 2020
CT	27% by 2020	4% Energy Efficiency and CHP by 2010
DC	20% by 2020	0.4% solar by 2022
DE	20% by 2019	2.005% solar by 2019
HI	20% by 2020	
IA	105 MW by 2025	
IL	25% by 2025	18.75% wind by 2013
MA	Class I: 4% by 2009 (+1%/year after); Class II: 3.6% renewable, 3.5% waste energy by 2009; APS: 5% by 2020 increasing by 0.25% each year after.	Class II: 3.6% renewable, 3.5% waste energy by 2009
MD	20% by 2022	2% solar by 2022
ME	30% by 2000; 10% new by 2017	
MI	10% by 2015	
MN	Xcel Energy (utility) 30% by 2020; other utilities 25% by 2025	Xcel Energy: 25% wind
MO	15% by 2021	0.3% solar retail sales by 2021
MT	15% by 2015	
ND☆	10% by 2015	
NH	23.8% by 2025 (16.3% new)	0.3% solar by 2025
NJ	22.5% by 2021	2.12% from solar by 2021
NM	IOUs: 20% by 2020; rural electric cooperatives 10% by 2020	Wind: 4%; solar: 4%; biomass and geothermal: 2%; distributed renewables: 3% by 2020 (IOU only)
NV	20% by 2015	1% solar by 2015
NY	24% by 2013	0.154% customer-sited by 2013
OH	25% by 2025 (12.5% renewable energy)	1% solar by 2025
OR	Large utilities (>3% state's total electricity sales) 25% by 2025	Smaller utilities 5-10% by 2025 (depending on size)
PA	18% by May 31, 2021 (8% renewable energy)	0.5% solar by 2025
RI	16% by 2020	
SD☆	10% by 2015	
TX	5,880 MW by 2015	At least 500 MW from renewables other than wind
UT☆	20% by 2025	
VA☆	12% of 2007 sales by 2022	
VT☆	20% by 2017; Total incremental energy growth between 2005-2012 to be met with new renewables (10% cap)	
WA	15% by 2020	
WI	10% by December, 31 2015	

☆States with RPS goals, not mandatory requirements.

Source: Database of State Incentives for Renewable Energy (DSIRE), accessed March 2009.

eligibility criteria. If both states are in the same power pool with a consistent attribute tracking system, ensuring eligibility across state lines is easier. For example, states in the New England Power Pool (NEPOOL) can rely on the power pool's Generation Information System (GIS) to track and compare RECs.

Monitoring

In most cases, the formation of a REC is based on the amount of electricity generated. Therefore, a program must have a system of tracking the generation to ensure that it comes from a qualifying resource. Many states already have such tracking systems to meet emissions disclosure requirements. NEPOOL's GIS tracks generation and even classifies RECs according to their eligibility to meet different state RPS requirements. The PJM Generation Attributes Tracking System (GATS) can be used to track generation attributes in the Mid-Atlantic region and can form the basis for awarding RECs, as it is in Pennsylvania. In California and other western states, the Western Renewable Energy Generation Information System (WREGIS) was created to issue, register, and track RECs; the system helps monitor and track renewable energy generation for both regulatory compliance and voluntary market programs. The WREGIS covers the Western Electricity Coordinating Council (WECC) service area, which extends from Canada to New Mexico and includes 14 western states, 2 Canadian provinces, and part of Baja California.

The Midwest Renewable Energy Tracking System (M-RETS) tracks renewable energy generation in the form of RECs for participating states (currently Illinois, Iowa, Minnesota, Montana, North Dakota, South Dakota, Wisconsin, and the Canadian province of Manitoba.) and assists in verifying compliance with individual state RPS requirements or goals. M-RETS production data is provided by the Midwest Independent Transmission System Operator (MISO).

In Texas, the Electric Reliability Council of Texas (ERCOT) allocates RECs to renewable generators each year for every MWh metered on the grid. ERCOT then uses a pro-rata basis to determine renewable requirements for each retail electricity provider (REP). The requirements are based on total electricity sales for a given year, not on generation. REPs are required to retire RECs; they do not have to buy the associated generation.

Trading

In most RPS states, affected entities must meet the RPS through the surrender and retirement of RECs. The affected entity can generate, purchase, or trade the RECs. States typically utilize a regional tracking system that allows renewable generators located anywhere within the region to participate in the market. RECs are the currency used to represent renewable generation that is creditable against the RPS requirements for a seller or generator of electricity. The affected entity can create the RECs itself or purchase them from another eligible generator.

Trading RECs increases flexibility and reduces the cost of compliance. This method provides a market that encourages the development of eligible resources by many independent developers by providing an important income stream for project developers. This income can be an important component of the pro-forma financial package needed to attract capital to finance a new project.

Trading allows the flexibility to develop renewable resources wherever the available resource is most favorable, either within the state or between states, allowing the development of the most cost-effective resources. However, accepting out-of-state RECs might reduce the amount of in-state environmental improvement and economic development resulting from the RPS. This tradeoff must be evaluated against cost and resource availability to determine the appropriate structure for any given state.

One state that deviates from the common RPS compliance options is New York. New York's RPS works though a method called a central procurement model. Under this model, electric utilities collect a surcharge on electricity sold to consumers. These funds are turned over to the New York State Energy Research and Development Authority (NYSERDA), which purchases RECs on behalf of all the regulated entities.

State Examples of EPS That Include CHP

The inherent flexibility in RPS design allows states to identify and promote specific resources or technologies that support their environmental, energy, and economic development goals. CHP is one of the technologies that supports each of these goals. Table 1 summarizes the characteristics of current state portfolio standards, including the thirteen states that include CHP.[5] Of these states, eight include clean fossil-fueled CHP, five include waste heat CHP, and one includes renewably fueled CHP.[6] State EPS programs that include CHP are summarized below.

Connecticut

The Connecticut RPS was originally promulgated in 1998 and was revised in 2005 and 2007. In 2005, Connecticut added a third tier to the RPS resource requirements, establishing a new RPS Class III that must be fulfilled with CHP, demand response, and electricity savings from conservation and load management (C&LM) programs.[7] In 2007, the Class III standard was expanded to include systems that recover waste heat.[8] The RPS standard requires electric suppliers and distribution companies to obtain 1 percent of their generation from Class III resources beginning in 2007, increasing by 1 percent per year until leveling out at 4 percent in 2010 and thereafter. The total RPS requirement is 10 percent in 2008 and will rise to 27 percent in 2020 (including Class I, Class II, and Class III resources).

The Connecticut Department of Public Utility Control (DPUC) released its final decision regarding the implementation of a Class III standard on June 28, 2006, in Docket No. 05-07-19.[9] The final decision outlines requirements for accreditation of savings from C&LM projects; CHP efficiency and metering standards; environmental attribute management; qualifying demand response activities; and certificate creation, allocation, and incorporation with the NEPOOL GIS. The DPUC reopened the docket on August 1, 2007, to clarify the eligibility of waste heat recovery systems added to the Class III standard by the legislature in 2007, and to consider the allocation of Class III credits to eligible technologies. The decision is still being considered as of March 2009.[10]

Eligible CHP systems must be developed on or after January 1, 2006. Eligible systems that recover waste heat or pressure from commercial and industrial processes must be installed on or after April 1, 2007. Existing units that have been modified on or after January 1, 2006, may earn certificates only for the incremental output gains. A CHP system must meet a total efficiency level of at least 50 percent. The sum of all useful electrical energy output must comprise at least 20 percent of the technology's total usable energy output. The sum of all thermal energy products must also constitute at least 20 percent of the technology's usable energy output. Annual fuel-conversion efficiency and percentages of production will be assessed quarterly for the first year after initial certification. After this first year, the CHP system must demonstrate compliance with the efficiency requirements each quarter to qualify for RECs.

Pursuant to the 2007 legislation, customers that install Class III resources on or after January 1, 2008, are entitled to Class III credits equal to at least one cent per kilowatt-hour (kWh). The revenue from these credits must be divided between the customer and the state C&LM Fund in different ways depending on when the Class III resources are installed, whether the owner is residential or nonresidential, and whether the resources received state support.[11] Energy savings from demand response activities are eligible for Class III certificates; however, the demand response projects must be registered and participate in the region's wholesale electricity market administered by ISO New England, Inc. (ISO-NE).

Hawaii

Hawaii has had a mandatory RPS since 2004,[12] which was amended in 2006.[13] The RPS requires 10 percent renewable energy and renewable electrical energy to be generated in 2010, 15 percent in 2015, and 20 percent in 2020. Existing renewables may be counted in the total. Renewable electrical energy includes electrical energy savings “brought about by the use of energy efficiency technologies,” including the “use of rejected heat from co-generation and combined heat and power systems excluding fossil-fueled qualifying facilities that sell electricity to electric utility companies and central power projects.”[14]

The Hawaii Public Utility Commission (PUC) has the authority to review the RPS every five years and potentially extend requirements past 2020. The PUC may also establish standards for each utility that prescribe what portion of the RPS shall be met by specific types of renewable energy sources, provided that at least 50 percent of the RPS is met by renewable energy sources.

In Hawaii, an electric utility company must fulfill the RPS requirement. However, electric utilities and electric affiliates are allowed to combine their renewable portfolios to meet the requirements. Thus, Hawaii’s program does not include a REC trading program as such. The utilities must document their generation directly to show compliance.

Massachusetts

Massachusetts passed an RPS in 1997, although the state Department of Energy Resources (DOER) did not issue final regulations for the standard until 2002. The original RPS began at one percent for 2003, rising by 0.5 percent each year until reaching 4 percent in 2009.[15]

In July 2008, the Green Communities Act doubled the rate of increase in the RPS from 0.5 percent per year to 1 percent per year, with no cap. As a result, the RPS will incrementally increase from 4 percent in 2009 to 15 percent in 2020, 25 percent in 2030, and so forth. Beginning Janary 1, 2009 only "Class I" renewables can be used to meet the standards just described. The legislation further established three separate standards beginning on January 1, 2009: one for “Class I” renewables (mentioned above), one for “Class II” renewables (3.6% renewable, 3.5% waste energy by 2009), and an alternative energy portfolio standard (APS) that includes CHP (the APS sets a target of 5% of sales by 12/31/2020, and an additional 0.25% of sales each year thereafter, with no stated explanation date).[16]

On March 12, 2009, the DOER filed its proposed final regulations for RPS Class I, Class II, and APS. The RPS requires Class I renewables to account for a minimum of 4% of energy, including on-site generation, rising to 15% by 2020 with a continuing increase of 1% per year thereafter. Class II renewable generation minimum percentage is 3.6%, and the Class II waste energy minimum is 3.5%. The APS requires 1% minimum by 2009, rising to 5% by 2020, with a 0.25% increase each year thereafter.[17]

Class I renewables must come from a source that began commercial operation after December 31, 1997, or represent the net increase from incremental new generating capacity added to an existing facility after that date, or receives a statement of qualification with a vintage waiver prior to January 1, 2009. The following energy sources are included in Class I: solar photovoltaic or solar thermal electric; wind; ocean thermal, wave, or tidal; fuel cells utilizing either an eligible biomass fuel, landfill methane gas, or hydrogen that meets certain conditions; landfill gas; certain small hydroelectric; low emission advanced biomass including biogas and liquid biofuel; marine or hydrokinetic; and geothermal. Class II renewable sources include systems that began commercial operation before December 31, 1997, and generate electricity using any of the resources included in Class I, in addition to certain waste-to-energy systems.

The legislation defines an alternative energy source as one which generates electricity using any of the following: gasification with carbon capture and sequestration; CHP; flywheel energy storage; substitution of any portion of a fossil fuel source with an alternative, paper-derived fuel source for the production of heat or power; energy efficient steam technology; or any other alternative energy technology approved by DOER. However, the following technologies cannot be considered alternative energy supplies: coal, except when used in gasification; petroleum coke, except when used in gasification; oil; natural gas, except when used in gasification or CHP; and nuclear power. Under Massachusetts' proposed APS regulations, CHP must have begun operation on or after January 1, 2008. Existing units can receive credit for their added incremental useful thermal energy or useful electrical energy. Only those additions made on or after January 1, 2008 qualify.

APS Alternative Energy Attributes are equal to the result, if positive, of the following calculation: take the sum of (1) the electrical energy generated divided by the overall efficiency of electrical energy delivered to the end-use from the electrical grid (which efficiency is equal for this purpose to 0.33); and (2) the Useful Thermal Energy divided by the overall efficiency of thermal energy delivered to the end-use from a standalone heating unit (which efficiency is equal for this purpose to 0.80); and subtract from this sum the total of all fuel and any other energy consumed by the CHP unit in that quarter expressed in MWh and calculated using the energy content of the fuel based on its higher heating value.

The Green Communities Act established additional energy goals, including meeting at least 20 percent of the state’s electric load through new renewable and alternative energy generation by 2020. The Act also sets a goal of meeting at least 25 percent of electric load with demand-side resources including energy efficiency, load management, demand response, and distributed generation by 2020. CHP systems with an annual efficiency of 60 percent or greater may count toward meeting this second target, with the goal of achieving 80 percent efficiency for CHP systems by 2020.[18]

The Massachusetts Department of Energy Resources (DOER) filed its proposed final regulations for RPS Class I, Class II, and APS with the legislature on March 12, 2009. The regulations will go into effect upon publication in the Massachusetts Register.

More information can be found here, http://www.mass.gov/?pageID=eoeeamodulechunk&L=5&L0=Home&L1=Grants+%26+Technical+Assistance&L2=Guidance+%26+Technical+Assistance&L3=Agencies+and+Divisions&L4=Department+of+Energy+Resources+(DOER)&sid=Eoeea&b=terminalcontent&f=doer_rps_emergency-regs&csid=Eoeea

North Carolina

In August 2007, North Carolina enacted a Renewable Energy and Energy Efficiency Portfolio Standard (REPS) requiring all investor-owned utilities to supply 12.5 percent of 2020 retail electricity sales from eligible energy resources by 2021. Municipal utilities and electric cooperatives must meet a target of 10 percent eligible energy resources by 2018. Up to 25 percent of the requirements may be met through energy efficiency measures, including CHP. After 2018, up to 40 percent of the standard may be met through energy efficiency and CHP.[19]

Under the REPS, there is no minimum efficiency requirement for CHP. Energy from CHP is included to the extent that the system "uses waste heat to produce electricity or useful, measurable thermal or mechanical energy for the retail customer's use and results in less energy used to perform the same function or provide the same level of service at the retail customer's facility."[20] Thermal energy that is not used to generate electric power and is measured accurately in British thermal units (Btu) shall earn equivalent RECs based on the end-use energy value of electricity of 3,412 Btu per kWh. Renewable energy and CHP must have been installed after January 1, 2007, to be considered eligible.

Utilities may meet their obligations through actual generation of electricity with eligible fuels and technologies, through the purchase of bundled renewable energy, by procuring unbundled RECs (each equivalent to 1 MWh) from in-state or out-of-state renewable energy facilities, or through the implementation of energy efficiency measures.[21]

The North Carolina Utilities Commission (NCUC) is responsible for administering the RPS and may adjust or modify the RPS schedule if it deems such modifications to be in the public interest. The NCUC issued final RPS regulations under Order, Docket No. E-100, Sub 113, on February 28, 2009. This Order can be found here, http://ncuc.commerce.state.nc.us/cgi-bin/webview/senddoc.pgm?dispfmt=&itype=Q&authorization=&parm2=SAAAAA06080B&parm3=000127195

Ohio

Ohio enacted its alternative energy portfolio standard (AEPS) in May 2008. Under the standard, utilities must provide 25 percent of their retail electricity supply from alternative energy resources by 2025. Of this 25 percent, half may be generated from advanced energy resources and at least half must be generated from renewable energy resources, including 0.5 percent from solar energy resources. Although there are no annual benchmarks for the overall alternative energy standard, the standard sets specific annual benchmarks for renewable and solar energy resources beginning in 2009 and increasing incrementally to 12.5 percent and 0.5 percent in 2025.[23]

The standard applies to all retail electricity providers except municipal utilities and electric cooperatives. In order to qualify under the standard, all alternative energy and renewable energy facilities must have a placed-in-service date on or after January 1, 1998. At least 50 percent of the renewable energy requirement must be met by in-state facilities. Utilities may meet the standard through the purchase of qualified renewable energy credits (RECs).

Eligible renewable resources are defined to include the following technologies: solar photovoltaics (PV), solar thermal, wind, geothermal, biomass, biologically derived methane gas, landfill gas, certain non-treated waste biomass products, fuel cells that generate electricity, and qualified hydroelectric facilities.

The standard defines advanced energy resources as any process or technology that increases the generation output of an electric generating facility without additional carbon dioxide emissions. The definition explicitly includes clean coal; generation III advanced nuclear power; combined heat and power (CHP); fuel cells that generate electricity; certain solid waste conversion technologies; and demand side management or efficiency improvements. The Public Utilities Commission of Ohio (PUCO) may classify any new technology as an alternative energy or renewable energy resource.[24]

The standard does not set a minimum efficiency requirement for CHP, but defines its eligibility as "any distributed generation system consisting of customer cogeneration of electricity and thermal output simultaneously, primarily to meet the energy needs of the customer's facilities."[25] Alternative energy resources also can include new or existing mercantile customer-sited advanced energy resources or renewable energy resources that the customer commits for integration into a utility's demand-response, energy efficiency, or peak demand reduction programs.

PUCO will review compliance with the renewable and solar energy standards and must submit compliance reports to the Ohio General Assembly on an annual basis. The law contains *force majeure* clauses for cost limitations and allowances for non-compliance for reasons beyond a utility's control. Any compliance payments that the PUCO imposes will be deposited into the Ohio Advanced Energy Fund.[26]

Pennsylvania

Pennsylvania's Alternative Energy Portfolio Standard (AEPS) was enacted in 2004 and amended in 2007.[27] Pennsylvania has a tiered structure to its RPS, similar to Connecticut. Both new and existing renewables are eligible as Tier I resources. Tier II resources include demand-side management and distributed generation systems, including CHP. In 2007/2008, 1.5 percent of electricity sold must come from Tier I sources with 4.2 percent from Tier II. The Tier I standard increases to 2 percent in 2008/2009 and 0.5 percent each year thereafter, to reach 8 percent of electricity from Tier I sources by 2020/2021. The Tier II standard increases 2 percent every five years to reach 6.2 percent in 2010/2011 and 8.2 percent in 2015/2016. An additional jump to 10 percent in Tier II resources by 2020/2021 is included as part of the standard, with 0.5% solar by 2021.

Utilities comply with the RPS by obtaining the required number of RECs (each equivalent to one MWh of generation), which are tracked using the PJM power pool's GATS. AEPS amendments in 2007 clarified that RECs are the property of the renewable energy generator. The AEPS contains a *force majeure* clause under which the Pennsylvania Public Utilities Commission (PUC) can make a determination as to whether there are sufficient alternative energy resources in the market for utilities to meet their targets. If the PUC determines that utilities are unable to comply with the standard despite good faith efforts, the PUC may alter the obligation for a given year. It may then require higher obligations in subsequent years to compensate for shortfalls.[28]

Washington

In 2006, Washington State passed a Renewable Energy Standard (RES) by ballot initiative I-937.[29] The initiative requires electric utilities that serve more than 25,000 customers in the state to generate 15 percent of their electric load from new renewables by the year 2020. Additionally, electric utilities must identify and undertake all cost-effective energy conservation. As of 2007, 17 of Washington's 62 utilities will be regulated under the RES, covering more than 80 percent of the population.[30] The RES starts at 3 percent of a utility's load for 2012 to 2015, rising to 9 percent for 2016 to 2019, and 15 percent from 2020 forward.

Renewably fueled DG with a capacity of not more than 5 MW is eligible under the renewable portion of the RES. DG may also be counted as double the facility's electrical output if the utility owns the facility, has contracted for the DG and associated RECs, or has contracted to purchase only the related RECs. Additionally, electricity from a generation facility powered by a renewable resource (other than fresh water) must begin operation after March 31, 1999 to qualify.

CHP systems owned and used by a retail electric customer to meet its own needs may be counted toward the conservation provision in the initiative, but only the first 12 months of CHP operation can be used to meet the end-use conservation targets. By January 1, 2010, and every two years thereafter, each affected utility is required to identify its "achievable cost-effective conservation potential through 2019." Each utility must then issue an acquisition target to be met during the next two years. Utilities may count high-efficiency CHP units with a useful thermal output of at least 33 percent of the total energy output towards meeting their conservation targets. The amount of energy conservation eligible towards meeting the target will be determined based on an analysis of the reduction in electricity consumption from the CHP system compared to a best-commercially available technology combined-cycle natural gas-fired combustion turbine. Additionally, only the output used by the customer to meet its own needs will count towards the target.[31]

The Washington Department of Community, Trade and Economic Development (CTED) Energy Policy Division issued final rules, with 194-37 WAC on March 18, 2008. The final rules can be accessed at: http://cted.wa.gov/site/1001/default.aspx.

Waste Heat CHP—Colorado, Nevada, North Dakota

Colorado, Nevada, and North Dakota all include recycled energy or energy recovery processes as eligible technologies within their RPS. CHP is included under each of these definitions, but the most common type of CHP, which recovers otherwise lost energy from a process whose primary purpose is electricity generation, is excluded in each case.

In Colorado, the RPS was originally passed by ballot initiative (Amendment 37) in November 2004, and was then increased and extended by the state legislature in March 2007 as HB 1281.[33] The expanded RPS requires utilities to meet a target of 20 percent of electric sales from renewable and recycled energy resources by 2020 and each year thereafter. Eligible CHP units must be smaller than 15 MW and convert otherwise wasted heat from exhaust stacks or pipes to electricity.

In Nevada, the RPS was initiated in 1997 and was expanded to include energy savings from efficiency measures in 2005. The RPS requirement is 9 percent for 2007 and 2008, increasing 3 percent every two years to reach 20 percent in 2015 and thereafter. CHP systems are eligible under the RPS as a qualified energy recovery process. Eligible CHP units must be 15 MW or less, and only “the heat from exhaust stacks or pipes used for engines or manufacturing or industrial processes” used to generate electricity is considered to be an eligible CHP process.[34]

North Dakota’s legislature passed a voluntary RPS, HB 1506, in March 2007 that establishes an objective that 10 percent of all retail electricity sold in the state be obtained from renewable and recycled energy by 2015. CHP systems are eligible under the recycled energy definition by “producing electricity from currently unused waste heat resulting from combustion, or other processes, into electricity.”[35] Each retail provider or generation supplier must conduct an economic evaluation of new renewable and recycled energy and consider the RPS objective and economic evaluation to determine the electricity alternatives that best meet its resource or customer needs.

Additional Resources

A number of additional resources are available for developing RPS policies.

- EPA’s *Clean Energy-Environment Guide to Action* outlines 16 policies and programs states are successfully implementing to increase clean energy. Chapter 5 discusses RPS. http://www.epa.gov/cleanenergy/energy-programs/state-and-local/state-best-practices.html
- EPA’s Fact Sheet, *Renewable Portfolio Standards: An Effective Policy to Support Clean Energy Supply* describes the benefits of RPS for states and how RPS encourage CHP projects. www.epa.gov/chp/documents/rps_fs.pdf
- The Database of State Incentives for Renewable Energy (DSIRE) is a comprehensive and continually updated source of information on state, local, utility, and selected federal incentives that promote renewable energy. www.dsireusa.org
- *Evaluating Experiences With Renewable Portfolio Standards in the United States* (2004) provides a comprehensive analysis of U.S. experience with RPS, including lessons learned. http://eetd.lbl.gov/EA/EMP/reports/54439.pdf
- *Projecting the Impact of RPS on Renewable Energy and Solar Installations* (2005) is a PowerPoint presentation that estimates and summarizes the potential impacts of existing state RPS on renewable energy capacity and supply. www.newrules.org/de/solarestimates0105.ppt

Endnotes

1 Vermont’s RPS is voluntary, but if the utilities have not met their goal by 2012, then the RPS will become mandatory in 2013. EERE State Activities and Partnerships, www.eere.energy.gov/states/maps/renewable_portfolio_states.cfm.

2 Rabe, B. *Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standards* (2006), Pew Center on Global Climate Change, http://www.pewclimate.org/global-warming-indepth/all_reports/race_to_the_top/

3 www.arb.ca.gov/energy/dg/dg.htm.
www.eea-inc.com/rrdb/DGRegProject/Documents/MEDGRuleChapter148.pdf.
http://www.tceq.state.tx.us/assets/public/permitting/air/Guidance/NewSourceReview/segu_final.pdf
www.dem.ri.gov/pubs/regs/regs/air/air43_07.pdf

4 www.epa.gov/ttn/atw/combust/turbine/turbnsps.html.

5 As of 2007, Maine is not included among the states with current RPS that include CHP. In Maine’s original RPS, requiring 30 percent eligible technologies by 2000, CHP was considered an eligible resource. In 2007, Maine enacted a new RPS of 10 percent renewable by 2017 and declared eligible technologies to include only new renewable energy systems placed into service after September 1, 2005. CHP is not eligible under the current standard. www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=ME01R&state=ME&CurrentPageID=1&RE=1&EE=1.

6 In Arizona, only renewably fueled CHP systems are eligible within the state’s RPS; fossil-fueled CHP systems are not eligible.

7 Connecticut Public Act No. 05-1, “An Act Concerning Energy Independence,” www.cga.ct.gov/2005/ACT/PA/2005PA-00001-R00HB-07501SS1-PA.htm.

8 Connecticut Public Act No. 07-242 §40-44, “An Act Concerning Electricity and Energy Efficiency,” www.cga.ct.gov/2007/ACT/PA/2007PA-00242-R00HB-07432-PA.htm.

9 Docket No. 05-07-19: DPUC Proceeding to Develop a New Distributed Resources Portfolio Standard (Class III) - Decision, June 28, 2006, www.dpuc.state.ct.us/FINALDEC.NSF/2b40c6ef76b67c438525644800692943/cad07929137a20278525719c006ec899/$FILE/050719-062806.doc.

10 Docket No. 05-07-19: DPUC Proceeding to Develop a New Distributed Resources Portfolio Standard (Class III) - Reopening, August 1, 2007, www.dpuc.state.ct.us/FINALDEC.NSF/2b40c6ef76b67c438525644800692943/6a82a9c57e998dd28525732f004aee23/$FILE/050719-080107.doc.

11 DSIRE, Connecticut Renewables Portfolio Standard, www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CT04R&state=CT&CurrentPageID=1&RE=1&EE=1.

12 A Bill for an Act Relating to Renewable Energy, SB 2474, June 2, 2004, www.capitol.hawaii.gov/session2004/bills/SB2474_HD1_.htm.

13 A Bill for an Act Relating to Energy, SB 3185, June 2, 2006, www.capitol.hawaii.gov/session2006/bills/SB3185_cd1_.htm.

14 A Bill for an Act Relating to Energy, SB 3185, June 2, 2006, www.capitol.hawaii.gov/session2006/bills/SB3185_cd1_.htm.

15 Commonwealth of Massachusetts, Renewable Energy Portfolio Standard Annual RPS Compliance Report for 2003, February 15, 2005, www.mass.gov/doer/rps/rps-annual-05.pdf.

16 Massachusetts SB 2768, “An Act Relative to Green Communities,” http://www.mass.gov/legis/bills/senate/185/st02pdf/st02768.pdf.

17 Massachusetts Department of Energy Resources, Proposed Final Regulations for RPS, http://www.mass.gov/?pageID=eoeeamodulechunk&L=5&L0=Home&L1=Grants+%26+Technical+Assistance&L2=Guidance+%26+Technical+Assistance&L3=Agencies+and+Divisions&L4=Department+of+Energy+Resources+(DOER)&sid=Eoeea&b=terminalcontent&f=doer_rps_emergency-regs&csid=Eoeea

18 Massachusetts SB 2786, “An Act Relative to Green Communities,” http://www.mass.gov/legis/bills/senate/185/st02pdf/st02768.pdf.

19 Session Law 2007-397/SB 3, August 20, 2007, www.ncleg.net/Sessions/2007/Bills/Senate/PDF/S3v6.pdf.

20 Session Law 2007-397/SB 3, August 20, 2007, www.ncleg.net/Sessions/2007/Bills/Senate/PDF/S3v6.pdf.

21 North Carolina Utilities Commission, Renewable Energy and Energy Efficiency Portfolio Standard (REPS), www.ncuc.commerce.state.nc.us/reps/reps.htm.

22 North Carolina Utilities Commission, Orders and Filings in Docket No. E-100, Sub 113, http://ncuc.commerce.state.nc.us/cgi-bin/fldrdocs.ndm/INPUT?compdesc=Generic%20Proceeding&numret=001&comptype=E&docknumb=100&suffix1=&subNumb=113&suffix2=&parm1=000127195.

23 Ohio SB 221, An act to revise state energy policy, May 1, 2008, www.legislature.state.oh.us/bills.cfm?ID=127_SB_221.

24 DSIRE, Ohio Alternative Energy Resource Standard, www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=OH14R&state=OH&CurrentPageID=1&RE=1&EE=1.

[25] Ohio SB 221, An act to revise state energy policy, May 1, 2008, www.legislature.state.oh.us/bills.cfm?ID=127_SB_221.

[26] DSIRE, Ohio Alternative Energy Resource Standard, www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=OH14R&state=OH&CurrentPageID=1&RE=1&EE=1.

[27] Pennsylvania Public Utility Commission, Alternative Energy Portfolio Standards, www.puc.state.pa.us/electric/electric_alt_energy.aspx.

[28] HB 1203, July 17, 2007, www.legis.state.pa.us/CFDOCS/Legis/PN/Public/btCheck.cfm?txtType=HTM&sessYr=2007&sessInd=0&billBody=H&billTyp=B&billNbr=1203&pn=2343

[29] Chapter 19.285 RCW: Energy independence act, November 7, 2006, http://apps.leg.wa.gov/RCW/default.aspx?cite=19.285.

[30] DSIRE, Washington Renewable Energy Standard, www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=WA15R&state=WA&CurrentPageID=1&RE=1&EE=1.

[31] Department of Community, Trade and Economic Development, WSR 07-20-126 Proposed Rules, December 27, 2007, www.cted.wa.gov/DesktopModules/CTEDPublications/CTEDPublicationsView.aspx?tabID=0&ItemID=5375&MId=863&wversion=Staging.

[32] Department of Community, Trade and Economic Development, I-937 Rulemaking, www.cted.wa.gov/site/1001/default.aspx.

[33] HB 07-1281 Concerning Increased Renewable Energy Standards, March 27, 2007, www.leg.state.co.us/clics/clics2007a/csl.nsf/fsbillcont3/C9B0B62160D242CA87257251007C4F7A?open&file=1281_enr.pdf.

[34] Nevada Revised Statues Annotated, www.dsireusa.org/documents/Incentives/NV01R.htm.

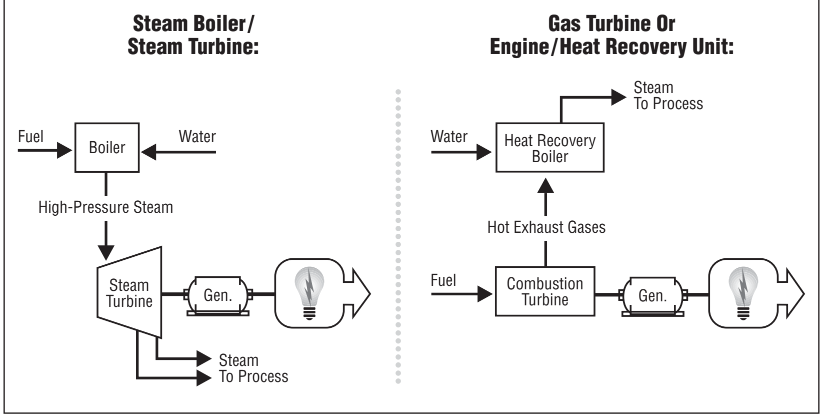
[35] HB 1506, An Act to establish a state renewable and recycled energy objective, March 23, 2007, www.legis.nd.gov/assembly/60-2007/bill-text/HBIO0500.pdf.

Addendum—Information about Combined Heat and Power (CHP)

CHP is the sequential generation of power (electricity or shaft power) and thermal energy from a common fuel combustion source. CHP captures waste heat that is ordinarily discarded from conventional power generation; typically, two-thirds of the input energy is discarded to the environment as waste heat (up exhaust stacks and through cooling towers). This captured energy is used to provide process heat, space cooling or heating for commercial buildings or industrial facilities, and cooling or heating for district energy systems. CHP facilities typically have efficiencies of 60 to 80 percent and use numerous types of technologies, including turbines, reciprocating engines, and fuel cells, as well as various fuels, including natural gas, biomass, coal, and biogas. More information about these technologies and their applications can be found in the EPA CHP Partnership's *Catalog of CHP Technologies* (www.epa.gov/chp/basic/catalog.html). Figure 2 shows two common configurations for CHP systems.

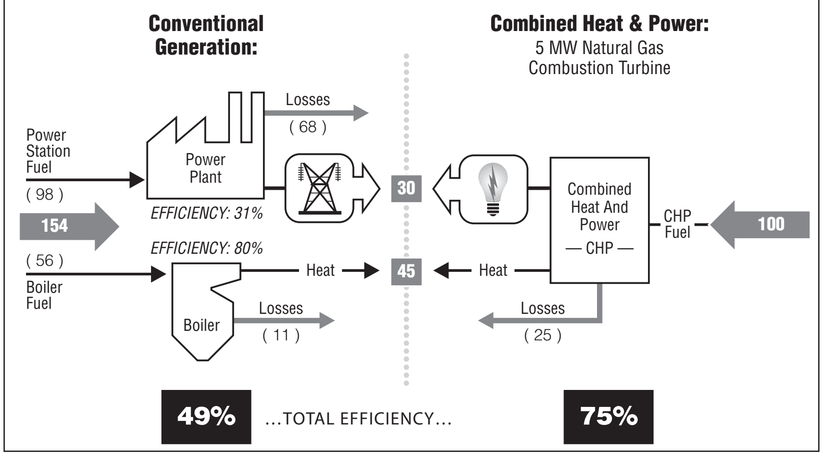
CHP's applicability to many technologies and fuels means that it can be applied in many different end uses and can use many fuels. It is a well-known and well-demonstrated technology. The United States has approximately 85 gigawatts (GW) of CHP capacity in place as of 2007, yet the potential for substantial expansion is great.[33] In 2000, the U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) set a goal to double the capacity of U.S. CHP installations by 2010.

Figure 2 - Two Typical CHP Configurations



Source: U.S. EPA *Output-Based Regulations: A Handbook for Air Regulators* (2004), www.epa.gov/chp/documents/obr_final_9105.pdf.

Figure 3 - Efficiency Benefits of CHP



Source: U.S. EPA *Output-Based Regulations: A Handbook for Air Regulators* (2004), www.epa.gov/chp/documents/obr_final_9105.pdf.

[33] U.S. DOE CHP database, maintained by Energy and Environmental Analysis, www.eea-inc.com/chpdata/index.html.

By providing electrical and thermal energy from a common fuel input, CHP significantly reduces the associated fuel use and emissions. Figure 3 illustrates the higher efficiency of a CHP facility compared to a conventional system providing the same service. In this case, both systems provide 30 units of electric energy and 45 units of thermal energy to the facility.

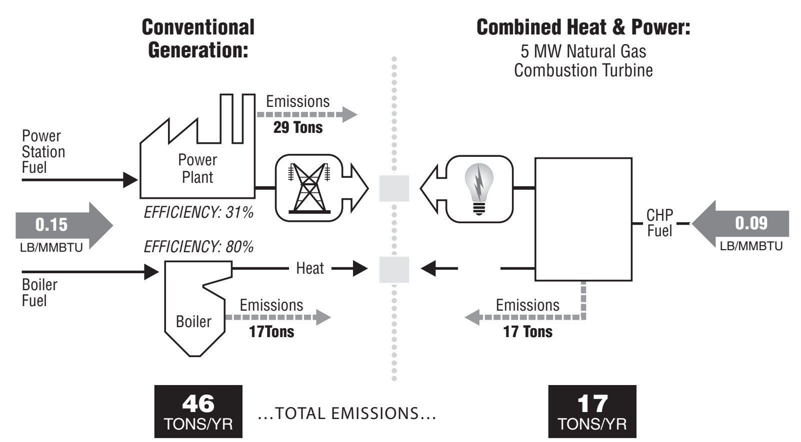
In the conventional system, the electricity required by the facility is purchased from the central grid. Power plants on average are about 31-percent efficient, considering both generating plant losses and the transmission and distribution losses. Thermal energy required by the facility is provided by an onsite boiler, averaging 80 percent efficiency. Combined, the two systems use 154 units of fuel to meet the combined electricity and steam demand. The combined efficiency to provide the thermal and electric service is 49 percent.

In the CHP system, an onsite system provides the same combined thermal and electric service. Electricity is generated in a combustion turbine, and the waste heat is captured for process use. The CHP system satisfies the same energy demand using only 100 units of fuel. This system is 75 percent efficient.

Due to its higher efficiency compared to conventional central-station generating systems, CHP produces lower emissions of traditional air pollutants and carbon dioxide, the leading greenhouse gas associated with global climate change, than conventional generating systems.

Figure 4 shows the NO_x emissions benefits of the CHP system. The CHP system has much lower emissions because it uses 35 percent less fuel, even if the combustion process has the same input-based emission rates as the conventional equipment. In this example, as is often the case, the new CHP system displaces higher-emitting generators on the electric grid, and the emissions rate for the new system is lower than the conventional alternative, further reducing emissions. In the case shown, the CHP system emits less than half as much NO_x as the conventional system due to a combination of greater efficiency and lower emissions rate.

Figure 4 - Nitrogen Oxide Emissions Benefits of CHP



Source: U.S. EPA *Output-Based Regulations: A Handbook for Air Regulators* (2004), www.epa.gov/chp/documents/obr_final_9105.pdf.

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