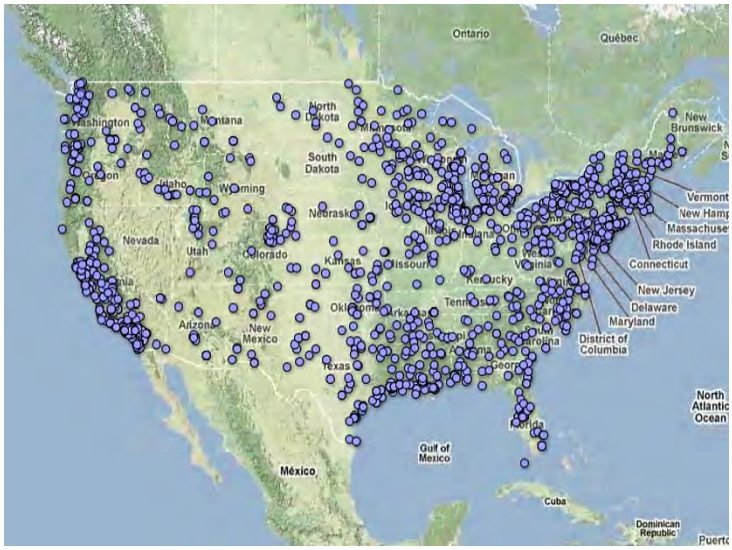
Executive Summary

Combined heat and power (CHP) can be an efficient and clean[1] method of generating electric power and useful thermal energy from a single fuel source at the point of use. Instead of purchasing electricity from the local utility and burning fuel in an on-site furnace or boiler to produce needed thermal energy,[2] an industrial or commercial user can use CHP to provide both energy services in one energy-efficient step. Consequently, CHP can provide significant energy efficiency and environmental advantages over separate heat and power. As with all power generation, CHP deployment has unique cost, operational, and other characteristics, but it is a proven and effective available clean energy option that can help the United States enhance energy efficiency, reduce greenhouse gas (GHG) emissions, promote economic growth, and maintain a robust energy infrastructure.

Currently, 82 gigawatts (GW) of CHP capacity are in use at more than 4,100 sites in the United States. Although 87% of CHP is in manufacturing plants around the country, a growing number of facilities from other sectors are considering its use.[3] Estimates indicate the technical potential[4] for additional CHP at existing industrial and commercial/institutional facilities is more than 130 GW.[5] A 2009 study by McKinsey and Company estimated that 50 GW of CHP in industrial and large commercial/institutional applications could be deployable at reasonable returns with then-current equipment and energy prices.[6] Today's economic and technical potential likely exceeds these estimates given the improving outlook in natural gas supply and prices. The importance of CHP to the United States was highlighted in President Obama's Executive Order of August 30, 2012, which calls for deployment of 40 GW of new, cost-effective CHP by 2020.[7]



Source: CHP Installation Database, ICF International
www.eea-inc.com/chpdata/index.html

Figure ES.1. Locations of existing CHP capacity

[1] State policymakers, project developers, advocates, utilities, and others have various definitions of "clean" energy. This guide does not attempt to create one definition, but rather recognizes that the primary audiences for the guide are state regulators and that they define it as they see fit.

[2] In some cases, there are opportunities to purchase thermal energy from a district energy system or steam loop.

[3] U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA). *Combined Heat and Power: A Clean Energy Solution*. August 2012. www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_clean_energy_solution.pdf.

[4] The technical market potential is an estimation of market size constrained only by technological limits—the ability of CHP technologies to fit existing customer energy needs. The technical potential includes sites that have the energy consumption characteristics that could apply CHP. The technical market potential does not consider screening for other factors such as ability to retrofit, owner interest in applying CHP, capital availability, fuel availability, and variation of energy consumption within customer application/size classes. All of these factors affect the feasibility, cost, and ultimate acceptance of CHP at a site and are critical in the actual economic implementation of CHP.

[5] Based on ICF International internal estimates as detailed in "Effect of a 30 Percent Investment Tax Credit on the Economic Market Potential for Combined Heat and Power," report prepared for WADE and USCHPA, October 2010. These estimates are on the same order as recent estimates developed by McKinsey and Company (see below).

[6] McKinsey Global Energy and Materials. (2009). *Unlocking Energy Efficiency in the U.S. Economy*. www.mckinsey.com/Client_Service/Electric_Power_and_Natural_Gas/Latest_thinking/Unlocking_energy_efficiency_in_the_US_economy.

[7] The White House. August 30, 2012. Executive Order–Accelerating Investment in Industrial Energy Efficiency. www.whitehouse.gov/the-press-office/2012/08/30/executive-order-accelerating-investment-industrial-energy-efficiency.

This guide provides state utility regulators and other state policymakers with actionable information to assist them in implementing key state policies that impact CHP. It discusses five policy categories and highlights successful state CHP policy implementation approaches within each category:

- Design of standby rates
- Interconnection standards for CHP with no electricity export
- Excess power sales
- Clean energy portfolio standards (CEPS)
- Emerging market opportunities—CHP in critical infrastructure and utility participation in CHP markets.

In addition, several related policy areas are discussed in the appendices:

- CHP in community planning: CHP zones
- Capacity and ancillary service markets: how CHP can participate
- Revision of utility distribution franchise regulations to allow non-utility CHP to serve neighboring load

A brief introduction to these five policy categories and the key policy implementation features follows.

Design of Standby Rates[8]

A primary motivation for industrial and commercial customers to install CHP systems is to meet electricity and thermal energy needs at a lower cost. Utility tariffs for "standby rates" or "partial requirements service"—the set of retail electric products for customers with on-site, non-emergency generation—can reduce these cost savings. The tariffs are meant to recover the utility costs of providing backup power, which would otherwise be passed on to non-CHP customers. In some cases, standby rates can pose a barrier to adoption of CHP systems when they are not designed to closely preserve the nexus between charges and cost of service. Standby rates that incorporate the following features encourage customer-generators to use electric service most efficiently and minimize costs they impose on the electric system:

- Offer daily or monthly as-used demand charges for backup power and shared transmission and distribution (T&D) facilities
- Reflect load diversity of CHP customers in charges for shared delivery facilities
- Provide an opportunity to purchase economic replacement power
- Allow customer-generators the option to buy all of their backup power at market prices
- Allow the customer to provide the utility with a load reduction plan
- Offer a self-supply option for reserves.

Interconnection Standards for CHP with No Electricity Export

Technical requirements governing how on-site generators connect to the grid serve an important function, ensuring that the safety and reliability of the electric grid is protected; however, non-standardized interconnect requirements and uncertainty in the timing and cost of the application process have long been a barrier to more widespread adoption of customer-sited generation.[9] Forty-three states and the District of Columbia have adopted some form of interconnection standards or guidelines. Streamlined application timelines and procedures, simplified contracts, and appropriate cost-based application fees are necessary to ensure that CHP projects are

[8] Distributed generation (DG) customers in some utility territory have the option to receive a high load factor gas rate. Justification for providing this rate to DG customers has been that DG customers may provide benefits to all electric customers by reducing constraints on the electric grid or may be the result of a natural gas cost of service. Gas rates are not covered in this document.

[9] IEEE Standard 1547.6 recommends against interconnection unless the generation is a de minimis amount of the customer's load, or a reverse power relay or other protection is in place.

implemented.[10] For states that do not have standard interconnection rules for distributed generation (DG) that does not export electricity, effective standardized interconnection rules should have the following characteristics:

- Interconnection fees commensurate with system size and complexity
- Streamlined procedures with simple decision-tree screens
- Uniform technical interconnection requirements
- Standardized, simplified interconnection agreements
- Dispute resolution procedures
- The ability for larger (20 megawatt [MW] and larger) CHP systems to qualify under the standards
- The ability for on-site generators to interconnect to both radial and network grids, assuming careful operational planning and system protection review.[11]

Excess Power Sales

In industrial applications with very large thermal needs, such as in the chemical, paper, refining, food processing, and metals manufacturing, sizing the CHP system to the thermal load can result in more power generation capacity than can be used on-site.[12] Excess power sales may provide a revenue stream for a CHP project, helping the project move forward. Additional CHP may help achieve state energy goals. While this guide does not explore the merits or problems with the development of markets that facilitate excess power sales, it does identify how policies can be successfully implemented to facilitate this aspect of CHP if such markets exist. Three types of programs can provide for excess power sales:

- **Programs based on state implementation of the federal Public Utility Regulatory Policies Act (PURPA).**[13] States have significant flexibility in administering PURPA, although amendments made in 2005 and Federal Energy Regulatory Commission (FERC) decisions have limited the applicability of PURPA in some regions, particularly for facilities larger than 20 MW.[14] However, FERC recently ruled that California's "multi-tiered" avoided cost rate structure for a feed-in tariff (FIT) for CHP systems of up to 20 MW is consistent with PURPA.[15] Specifically, FERC affirmed that state procurement obligations can be considered when calculating avoided cost, for example, requirements that utilities buy particular sources of energy with certain characteristics (e.g., renewable energy) to meet procurement obligations. Successful implementation approaches include:
    - Technical criteria for CHP eligibility (e.g., system size and efficiency)
    - Use of standard contracts and pricing
    - Inclusion of locational adders for avoided T&D investments.
- **FIT and variations.** Although FITs are often focused on renewable resources, these tariffs can be used to acquire CHP as well. FIT prices must be set high enough to attract the types and amounts of generation desired, while protecting consumers from paying more than needed to achieve generation targets. Typically, program administrators set a fixed price varying by technology per unit delivered during a

[10] "Database of State Incentives for Renewables & Efficiency." Accessed October 2012. www.dsireusa.org.

[11] Personal communication between ICF and Bill Ash, IEEE standards liaison, January 2013. IEEE Std 1547.6 is a finalized standard as of September 2011; however, the website hasn't been updated yet to reflect this final standard. http://grouper.ieee.org/groups/scc21/1547.6/1547.6_index.html.

[12] CHP systems that are sized to meet the facility's thermal needs operate at the highest efficiencies.

[13] Congress passed PURPA in 1978, codified at 16 U.S.C. § 824a-3.

[14] The Energy Policy Act of 2005 limited PURPA's scope through an amendment (210(m)) that allows utilities to file a request to FERC for relief from the mandatory purchase obligation (beyond existing contracts), at least for large projects, if they can show that competitive markets provide sufficient access for power sales from qualifying facilities. FERC found that six Regional Transmission Organizations and the Electric Reliability Council of Texas met this requirement. In their applications to FERC, utilities located in those designated regions can rely on a rebuttable presumption that qualifying facilities greater than 20 MW have nondiscriminatory access to wholesale markets.

[15] 133 FERC ¶ 61,059, Oct. 21, 2010. See the discussion in this guide on California's AB 1613 program.

specified number of years, or a premium payment on top of the energy market price. Such pricing relies on the estimated cost of eligible generation plus a reasonable return to investors. California offers standard program protocols and contract terms, while using competitive procurement to acquire least-cost eligible resources based on the generators' actual costs. FIT prices can be based on the value the generator provides to the electrical system or to society (e.g., the FIT program offered by the Sacramento Municipal Utility District). Successful implementation approaches include:

  - Technical criteria for CHP eligibility (e.g., system size and efficiency)
  - Use of standard contracts
  - Pricing based on avoided cost rates for specified technologies (i.e., renewables).

- **Competitive Procurement Processes.** In addition to FIT variations that employ market mechanisms, governments and load-serving entities that have established CHP targets or programs, such as California and Ontario, Canada, have used competitive procurement processes to acquire larger CHP projects. In restructured states, CHP projects also may bid into energy markets as well as any capacity and ancillary service markets if they can meet established protocols. Successful implementation approaches include:
  - Establishment of standard offer programs for small CHP
  - Competitive procurements for large CHP.

Clean Energy Portfolio Standards[16]

Many states have developed clean energy portfolio standards (CEPS) to increase the adoption of renewable energy generation, energy efficiency, and other clean energy technologies. Portfolio standards require utilities and retail energy suppliers (mostly electricity and sometimes gas) to procure a certain minimum quantity of eligible energy (typically from renewable sources and other specified supply-side resources) or achieve a minimum amount of energy efficiency savings (typically from demand-side measures). CHP systems offer on-site electricity generation, thermal energy production, and overall energy savings through increased efficiency compared to a baseline of centralized electric generation and on-site thermal production. State policymakers, including legislators and utility regulators, may determine that CHP can help states meet their CEPS while providing numerous benefits. Currently 23 states explicitly include CHP and/or waste heat recovery as an eligible CEPS resource.[17] State regulators should consider the following key elements in the incorporation of CHP in CEPS:

- CHP eligibility definitions
- Minimum efficiency requirements or performance-based metrics.

Emerging Market Opportunity—CHP in Critical Infrastructure

CHP offers the opportunity to improve critical infrastructure resiliency, mitigating the impacts of an emergency by keeping critical facilities running without any interruption in service. If the electricity grid is impaired, a properly configured CHP system can continue to operate, ensuring an uninterrupted supply of power and heat to the host facility. Following disruptions in 2001; the Northeast blackout in 2003; and natural disasters such as Hurricane Katrina in 2005, Hurricane Ike in 2008, and Superstorm Sandy in 2012; disaster preparedness planners have become increasingly aware of the need to protect critical infrastructure facilities and to better prepare for energy emergencies. Experience with Superstorm Sandy emphasizes the need to have qualified personnel on site to ensure safe start up once distributed generators have been brought down (e.g., by flooding). Resilient critical infrastructures enable a faster response to disasters, mitigating the extent of damage and impact on communities, and speed the recovery of critical functions. To ensure continued progress towards addressing grid and critical infrastructure resiliency through technologies such as CHP, improved coordination between government

[16] Clean energy portfolio standards can have a variety of names, such as renewable portfolio standards, alternative energy portfolio standards, energy efficiency resource standards, advanced energy portfolio standards, energy efficiency performance standards, and renewable energy standards.

[17] Based on ICF International Research and the Database of State Incentives for Renewable Energy (www.dsireusa.org).

emergency planners and the electricity sector must occur. State policymakers can facilitate that coordination and help reduce barriers to CHP so that these systems can be more easily installed in critical infrastructure applications.

Emerging Market Opportunity—Utility Participation in CHP Markets

A final, potentially significant policy option for increasing installed CHP capacity is to allow incumbent utilities to participate in CHP markets, either by owning CHP facilities directly, or by providing packages of services to customers who own their own CHP. This would be a policy that allows, but does not require, utility participation in CHP markets—a critical distinction. Key features of such a policy would include the following:

- Market rules to ensure non-discriminatory access by third parties wishing to enter the CHP market in the utility's service territory and compete with it
- Financial controls to prevent the utility from shifting costs from its CHP products and services to the revenue requirements of non-CHP customers.

Achieving the benefits provided by additional use of CHP is furthered by the successful implementation of the state policies discussed in this guide. Experience shows that successful implementation approaches often have three main features:

- They achieve the intent of state policy (a policy may be established but not successfully executed).
- They send clear market signals.
- Where applicable, they adhere to the principle of ratepayer benefits or neutrality.

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