WHITE PAPER

From Threat to Asset—How CHP Can Benefit Utilities

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Executive Summary

Combined heat and power (CHP) is an efficient approach to generating electric power and useful thermal energy from a single fuel source. CHP, along with other forms of distributed generation (DG), has seen a sharp increase in attention in recent years driven by DG technology cost reductions, increased supplies of low-cost natural gas, state and federal policymaker recognition, accelerated deployment of automated metering infrastructure, and concerns about grid reliability. These factors have caused increased deployment of DG technologies, which is causing a fundamental shift in how electricity is generated and delivered, leading utilities to face new opportunities and challenges as electricity and gas markets transform. Electric industry groups have identified DG as the largest disruptive threat to utilities' business model and financial health[1]; however this perspective has started to change, and industry studies have found that the majority of public and private power providers plan to take an offensive position by actively engaging with new stakeholders on DG.[2]

As electric utilities look to more efficient ways of generating power at reduced risk and cost, CHP has become an increasingly attractive option. Utilities are often more aware of where CHP systems would provide the most value for their customers and the grid, such as when businesses are changing hands, where future investments in transmission and distribution are planned, and other criteria that can enable success in the CHP market. CHP systems also provide a number of benefits that utilities are well-suited to appreciate, including: reducing locational grid congestion, improving reliability, and reducing overall system emissions, easing compliance with new environmental regulations.

Current CHP Market Status

CHP is an important electric generating resource in the United States; about 83 gigawatts (GW) of existing CHP generation capacity at over 4,300 facilities represents over 8 percent of total U.S. power generation capacity.[3] However, currently only around three percent of installed CHP capacity is owned by utilities.

Recent interest in CHP is driving increasing numbers of installations, with system announcements showing significant amounts of capacity poised to come online in 2014 to 2016. This new capacity includes several large systems over 300 MW, representing a resurgence of large system development that has been absent in recent years (see the figure below).

CHP systems provide an array of benefits for both the energy user and society at large:

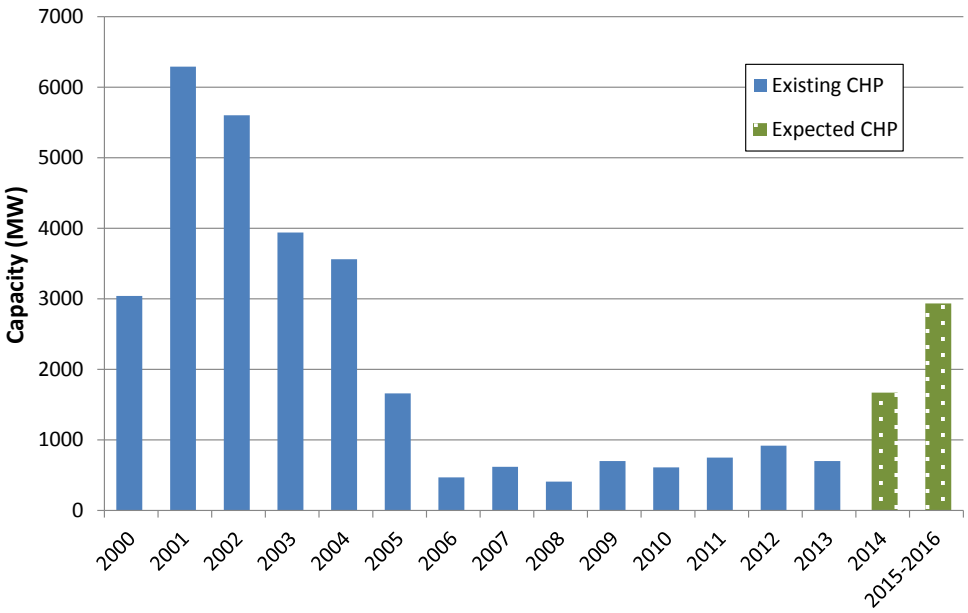
- Reduces air pollutant emissions
- Reduces energy costs for the user
- Enhances site energy reliability
- Reduces need for new T&D infrastructure
- Uses abundant clean domestic energy sources (e.g., natural gas and biomass)

[1] Edison Electric Institute

[2] GTM, The Grid Edge: Grid Modernization in the Age of Distributed Generation, https://www.greentechmedia.com/gridedge.

[3] *CHP Installation Database* developed by ICF International for Oak Ridge National Laboratory and the U.S. DOE; 2012. Available at http://www.eea-inc.com/chpdata/index.html.

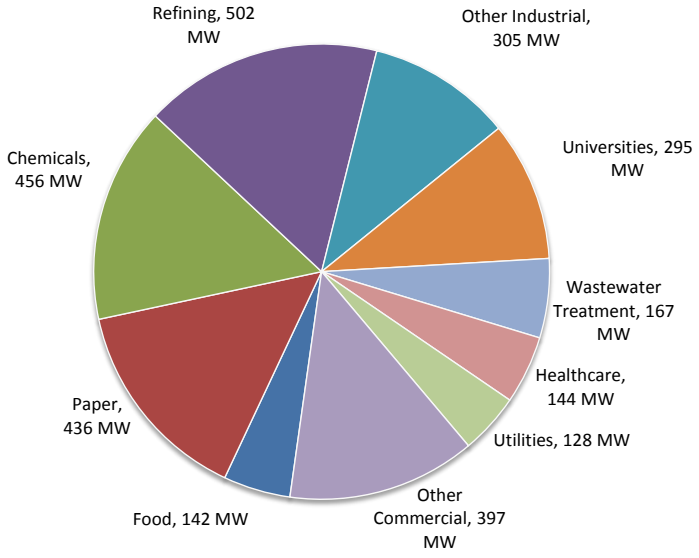
Figure 1. Annual Capacity Additions (MV)



Source: ICF CHP Installation Database and Internal Projections

Natural gas is by far the dominant fuel used for CHP, accounting for 70 percent of existing CHP capacity, however there is also strong growth in biomass and waste-fueled systems that take advantage of free or low cost fuel sources. Most existing CHP capacity (86 percent) is located at industrial manufacturing facilities; however, this trend has started to change over the past few years. From 2010 to 2013 industrial CHP installations made up 62 percent of new installed capacity, showing that there is noteworthy growth in the commercial and institutional CHP markets—rising from 14 percent of historic installed capacity to 38 percent of 2010-13 new installed capacity.

Figure 2. CHP Capacity Additions 2010—2013



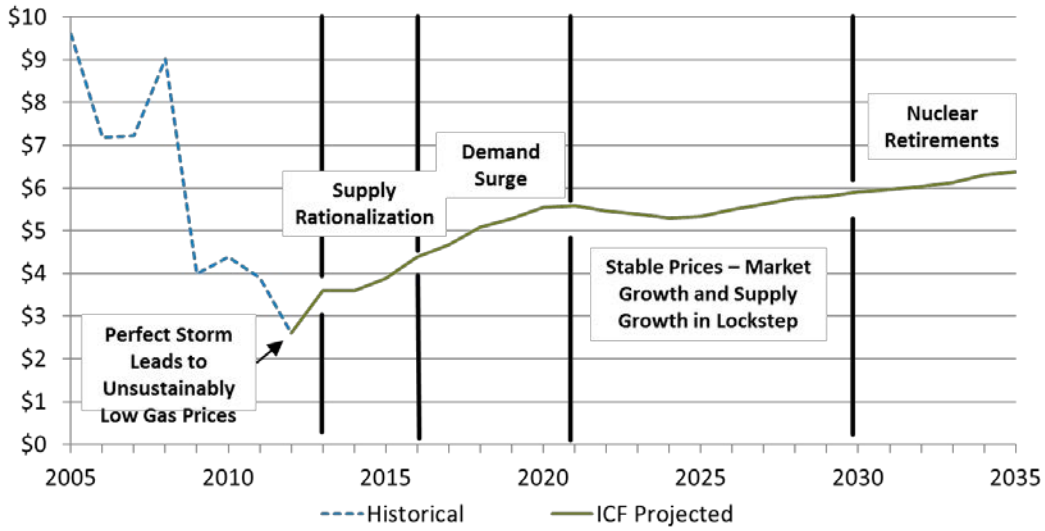
The majority of these CHP systems are owned by the manufacturing company, or by energy service companies, resulting in lost revenue and cost recovery concerns for utilities. The lack of utility involvement in CHP projects represents a lost opportunity; utilities can participate in CHP projects and find value in a range of forms.

Key Drivers

There are a number of diverse factors driving U.S. CHP development. Elements influencing CHP growth range from natural gas prices, to government initiatives, to storm events that have caused widespread grid disruptions.

- *Fuel Prices* –Inexpensive natural gas, a preferred fuel for CHP, has helped increase interest in CHP as a low-cost and low-emissions resource. Low gas prices have also led to resurgence in industrial growth that has created new opportunities for CHP.

Figure 3. Annual Average Henry Hub Price (2010$/MMBtu)



Source: ICF Internal Projections

- *Environmental Policies*—The higher efficiency of CHP facilities is a very cost-effective way to reduce emissions. New environmental regulations are increasingly recognizing CHP as a compliance option. An analysis of EPA's 111(d) proposed New Source Performance Standards (NSPS) to regulate CO_2 emissions from existing power plants, estimates that 3.5 GW of CHP could be built by 2030 in response to the regulation.[4] The EPA's Boiler Maximum Achievable Control Technology (MACT) regulations released in 2013 heavily impact coal and oil fired boilers at industrial and large commercial sites, causing many affected facilities to consider natural gas-fired CHP. The Department of Energy conducted an outreach program directed at nearly 700 affected facilities and identified almost 70 facilities interested in CHP as a compliance option, representing 1.26 GW of possible capacity additions.[5]

[4] Center for Clean Air Policy, Expanding the Solution Set: How Combined Heat and Power Can Support Compliance with 111(d) Standards for Existing Power Plants, http://ccap.org/assets/CCAP-Expanding-the-Solution-Set-How-Combined-Heat-and-Power-Can-Support-Compliance-with-111d-Standards-for-Existing-Power-Plants-May-2014.pdf.

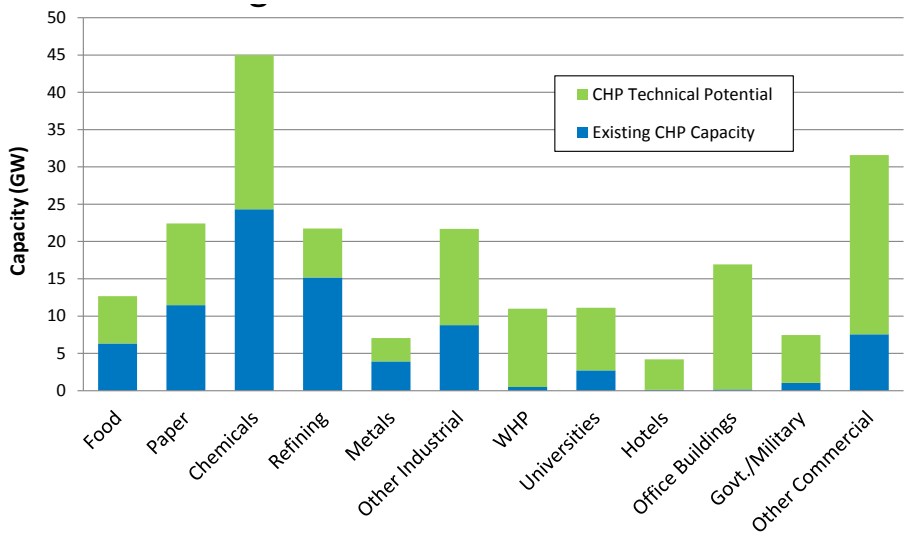
[5] U.S. DOE, Boiler MACT Technical Assistance, http://energy.gov/sites/prod/files/2014/05/f15/boiler_MACT_tech_factsheet_1.pdf.

- *Reliability & Resiliency*—CHP has been widely recognized due to its reliability and resiliency benefits, especially in areas hard hit by recent storm events that caused extensive grid disruptions for days or even weeks. Texas and Louisiana have instituted laws requiring critical government facilities to consider the value of implementing CHP.[6] After Hurricane Sandy, New York, New Jersey, and Connecticut have also implemented CHP incentive programs focused on improving state energy resiliency.
- *State and Federal Policy Support*—One of the most important steps ever taken by a President to promote CHP was President Obama's Executive Order (EO) 13624 released in 2012. This EO set a goal of deploying 40 GW of new, cost-effective CHP by 2020. State support has focused lately on laws seeking to tap the reliability and resiliency benefits of CHP, and as a way of meeting state energy efficiency targets.

CHP Potential

- Given the aforementioned drivers, the technical potential for additional CHP installations at existing industrial, commercial, and institutional facilities is large. ICF estimates that there is approximately 130 GW of technical potential[7] for CHP systems serving existing onsite electric loads at facilities conducive to CHP. Utilities could also take advantage of sizing CHP systems for industrial thermal loads leading to exports of electricity to the surrounding grid. This increases the technical potential by another 110 GW. With the additional export to the grid this represents a significant opportunity for utility and independent power producer (IPP) involvement in the CHP market.

Figure 4. Existing CHP vs. Technical Potential



Source: ICF Internal Projections

[6] ICF International, Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities, prepared for Oak Ridge National Laboratory, http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_critical_facilities.pdf.

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

How to Realize the Potential

Historically, electricity has been generated at central stations, with limited opportunities for economically feasible on-site customer generation of electricity. More recently, DG projects, like CHP, have become more prominent, driven by technology cost reductions[8], increased supplies of low-cost natural gas, and heightened awareness of energy costs by customers due in part to more widespread deployment of enhanced energy management tools.

Utilities need to explore new service opportunities within the constraints of current business models and regulatory conditions, while at the same time continuing to deliver electricity and gas to residential, commercial and industrial customers safely, reliably, and at competitive prices. Utilities need to seek opportunities for customer services that they can deliver which address these challenges while returning value to their customers and their investors.

Utility Opportunities in CHP

Market Overview & Limitations

Utilities have often struggled with how to find value in CHP. The ability for utilities to participate in and receive value from CHP projects is dependent on a state's regulatory framework. Fifteen states have fully restructured their electric utilities, and in these markets, distribution utilities are usually not allowed to generate power and the wholesale market for power is open to competition. As a result, utilities in these restructured states cannot own CHP systems or any other form of generation. However, utilities may still be able operate and maintain CHP systems, providing an alternative way to find value in CHP installations.

Most U.S. states still have traditional structured electricity markets and as a result the ability for utilities to find value from CHP differs from that in restructured markets. In this framework, vertically integrated utilities have control over both the generation and distribution of power. In these markets utilities may own CHP systems. Examples of how both electric and gas utilities have been able to benefit from CHP using different approaches are described below.

Potential for Utility Ownership of CHP

In April 2014, New York State issued a new proposal called Reforming the Energy Vision. The proposal calls for redesigning the regulatory framework that applies to the state's electric utilities, and focuses on increasing system reliability and promoting clean energy. The proposed reforms envision that customers will be able to generate their own electricity through CHP and other forms of clean energy, and that the distribution utility, which will become a Distributed System Platform Provider (DSPP), will function more like a traffic cop instead of a monopoly distributor of power, and will be compensated by the distributed resource providers that deliver electricity. Under the Reforming the Energy Vision, the New York Public Service Commission will consider the degree to which DSPPs should own, operate, and/or finance distributed energy resources.

Some utilities have embraced DG through investments in and financing of CHP systems. This is a way utilities can offer competitively priced clean-energy options that prevent customers from seeking these services elsewhere. Utilities' existing customer relationships as a trusted energy advisor and their low cost of capital makes them the ideal provider of capital and services that last over 20 years. Utilities could also potentially

[8] EPA Combined Heat and Power Partnership. "Catalog of CHP Technologies," An updated version will be released in 2014.

own CHP through siting new power plants in energy parks or industrial parks. In this model, the utility could own and operate the CHP system while enjoying the benefits of selling two products, both electricity and steam. These are not risky ventures and have been implemented across the country in different sizes and industries.

Alabama—is a vertically integrated market, and Alabama Power has successfully integrated both the costs associated with purchasing electricity through Power Purchase Agreements (PPAs) and company-owned CHP into its rate base.[9,10] Alabama Power, owned by Southern Company, has 2,000 MW of CHP in its service territory. Approximately, 1,500 MW is customer-owned CHP and more than 500 MW is company-owned CHP located at large industrial sites. This company-owned CHP generation has enabled Alabama Power to avoid departing load and provided them flexibility in building future capacity. Alabama Power continues to assess customers for CHP potential, seeking "win-win scenarios" that benefit the customer, the utility, and the utility's customers.

Oregon—a restructured market, has adopted provisions enabling utility ownership of CHP, although the requirements differ for electric utilities as compared to natural gas utilities. Electric utilities can request rate recovery for investment in CHP from the Public Utility Commission; to date none have done so. For natural gas utilities, the state PUC is still working on developing a process to implement Oregon Senate Bill 844.[11] This bill was passed in 2013 and allows natural gas utilities to participate in a voluntary GHG reduction program that would provide an incentive and allow recovery of investments in projects that reduce GHG emissions. CHP projects are one of the main areas that gas utilities are interested in pursuing once the PUC finalizes its rules. The PUC currently is considering incentive levels, oversight provisions, eligibility requirements and other logistics in docket AR 580.[12]

Texas—has a prime example of municipal utility ownership of CHP in Austin Energy. The municipal utility is interested in clean energy and wanted to test out building and owning a CHP system as a way to potentially open up additional opportunities with customers. In 2006, Austin Energy installed a 4.3 MW CHP system at Dell Children's Medical Center in Central Texas. The CHP installation is part of a district energy system and helped the Medical Center become the first LEED Platinum certified hospital in the world. Austin Energy was also able to receive a grant from DOE to help build this project.

Potential for Utility Operation and Maintenance of DG/CHP

In states where utilities are not allowed to own generation assets, an alternative opportunity is for utilities to enter into operation and maintenance contracts for CHP. Strategic locating of CHP by utilities can serve as a key way of addressing grid congestion or reliability issues. An example, of a utility that has found value in this option is Detroit Edison through their Mobile Distributed Generation (DG) program that was started in 2003 to address time and budget constraints associated with transmission and distribution (T&D) assets. Under DTE's Mobile DG program, DG, including CHP, was used as a temporary distribution solution (1 to 5 years). DTE partnered with customers on overloaded circuits through their premium power program. DTE ended up working with communities so that they would host CHP and other projects, and DTE could continue to provide operation and maintenance services.[13]

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[9] American Council for an Energy-Efficient Economy (ACEEE), July 2013. "How Electric Utilities Can Find Value in CHP," Web link.

[10] State and Local Energy Efficiency Action Network (SEE Action), March 2013. "Guide to the Successful Implementation of Combined Heat and Power Policies," Web link, pages 46-47.

[11] Oregon State Legislature, Senate Bill 844, https://olis.leg.state.or.us/liz/2013R1/Measures/Text/SB844/Enrolled.

[12] Oregon Public Utility Commission, Docket No. AR 580, http://apps.puc.state.or.us/edockets/docket.asp?DocketID=18862.

[13] Synapse, Review of Utility Owned DG Business Models for New York, http://www.synapse-energy.com/Downloads/SynapsePresentation.2010-04.0.DG-NY-Models.S0060.pdf

Utilities can also take advantage of their experience with electricity networks by helping to integrate DG. Infrastructure-support revenue, which utilities could collect from DG users, could help mitigate lost revenue from falling demand. The German utility RWE is pursuing a similar strategy after renewable energy and DG growth reduced its legacy power generation earnings. It now aims to help customers manage and integrate DG rather than invest in centralized generation.

CHP as a Solution for Grid Congestion or Reliability Issues

Connecticut has experienced significant grid congestion issues, especially in the southwest part of the state. In 2005, Connecticut passed "An Act Concerning Energy Independence," which established a number of CHP/DG incentives for both end-users and utilities. The program provided $450/kW in monetary grants for customer-side CHP and DG and provided an additional $50/kW to projects in southwestern Connecticut.[14] The program was widely subscribed and helped to address the grid congestion issues that were plaguing the state.

Utilities Including CHP in Ratepayer Funded Energy Efficiency Programs

Ratepayer funded utility energy efficiency programs can support CHP projects that have system-wide benefits and can provide both economic and environmental benefits to both the utility and its customers. An example of a successful ratepayer funded CHP program is the Energy Savers program run by Baltimore Gas & Electric. The program was prompted when the EmPOWER Maryland Energy Efficiency Act of 2008 set a goal of reducing overall per capita energy consumption and demand in the state by 15% by 2015. The program provides multiple incentives including upfront capital grants and a performance based incentive for the first 18 months of the project. To date the program has been very successful with the initial round of funding committed to CHP projects ranging from 75 kW to 2 MW, and new funding available for projects on a rolling submission basis.

Other states, including Illinois, are seeking to start similar ratepayer-funded CHP programs, through the Illinois Energy Now CHP Program, that would target public sector facilities in the main investor owned utility territories. These types of programs provide utilities with guaranteed rate recovery to support their involvement in enabling CHP.

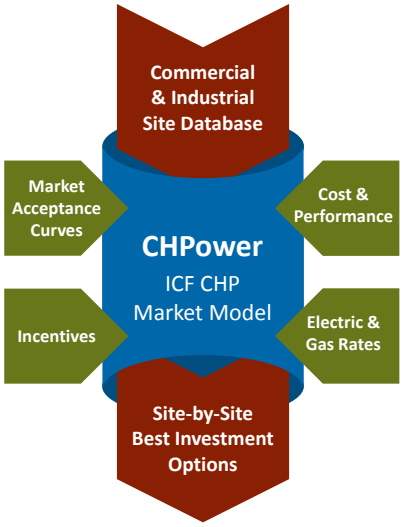
Next Steps

CHP is an efficient and clean approach to generating electric power and useful thermal energy from a single fuel source, and can provide a number of significant benefits to utilities utilizing different strategies. As demonstrated in areas hard hit by recent storm events, CHP is a proven solution to help resolve reliability and resiliency issues in a utility's territory. In addition, well-placed CHP can help address grid congestion issues, can be part of a utility's compliance strategy under new and upcoming EPA regulations, and provides an array of other benefits. However, a utility needs analytics and experience to identify likely CHP locations and realize and maximize these CHP benefits.

[14] Connecticut Department of Public Utility Control, Incentives for Customer-Side Distributed Resources, http://www.ct.gov/deep/lib/deep/p2/institution/cjacobspresentation10-12-2006.pdf.

ICF's Analysis Tools

- ICF's *CHP Installation Database*[15] is the most comprehensive source of CHP installations in the U.S., is updated on a continuous basis, and contains detailed information each CHP system's operating characteristics. The CHP database can show trends in U.S. CHP development on a geographic, size range, and application type basis.
- ICF's proprietary *CHPower* model identifies the most viable candidates for CHP projects. The *CHPower* model uses data from ICF's national database of CHP potential sites, which contains energy usage estimates used to calculate CHP potential. *CHPower's* accuracy in finding target CHP sites minimizes customer engagement costs and the time necessary to understand regional effects of CHP development on transmission and distribution infrastructure.



Conclusions

Many utilities have long struggled with how to benefit from CHP and DG market opportunities. In the past electric industry groups have identified DG as a threat[16]; however this mindset has begun to change, with a number of power providers now planning on, or actively engaging with stakeholders on DG.[17] As installations of new CHP are expected to rise in the next few years (close to 2 GW in 2014, and over 3 GW in 2015 and 2016), it is more important than ever for utilities to develop a well-thought out strategy for DG.

Utilities are in a unique position to gain advantage from CHP. Utilities are often more aware of where CHP systems would provide the most value for their customers and the grid. CHP systems also provide a number of benefits that utilities are well-suited to appreciate, including reducing locational grid congestion, improving reliability, and easing compliance with new environmental regulations. ICF encourages utilities to assess their options for realizing CHP opportunities. Once gaps are defined, utilities can then identify partners that can help them identify the best pathways to gain value from CHP.

ICF analysis tools can provide utilities with information on which sites have the most to gain, and therefore highest likelihood, of installing CHP. This will give utilities insight into its customer's perspective on energy supply options enabling the utility to make calculated strategic decisions on how to get involved in the CHP market or provide supporting services. ICF experts can provide the following types of support to utilities:

- Help utilities understand what levels of CHP penetration to expect in their service territories.
- Understand the impact of that level of CHP penetration on the utility operations, expenses, and rate structures.
- Develop scenarios for CHP adoption for inclusion in integrated resource plans
- Locational analysis for installation of CHP for grid benefits
- Evaluate potential business structures that would benefit both ratepayers and the utility's operating groups.

[15] Maintained for Oak Ridge National Laboratory.

[16] Edison Electric Institute

[17] GTM, The Grid Edge: Grid Modernization in the Age of Distributed Generation, https://www.greentechmedia.com/gridedge.

About the Authors

Anne Hampson has more than 10 years of experience in market and policy analysis in power generation and energy efficiency. She focuses primarily on distributed generation (DG) and combined heat and power (CHP), and she leads efforts in the development and management of databases on installed CHP capacity and operational reliability of DG equipment. Ms. Hampson also leads the development of estimates for the technical potential for CHP growth, and she has conducted analysis and research on market issues, regulatory policies, economic incentives, reliability issues, emissions issues, and performance characteristics of DG equipment.

Previously, Ms. Hampson worked at Pace Global Energy Services, where she focused on analysis of industrial energy systems while using real-time energy monitoring software.

Ms. Hampson has an MBA from George Washington University and a BS in Integrated Science and Technology from James Madison University.

Jessica Rackley has more than nine years of experience in energy and environmental policy analysis, specializing in air regulatory issues with an emphasis on greenhouse gas (GHG) legislation. She has worked on a range of issues, including financial and regulatory opportunities for renewable and energy efficiency projects, state and regional GHG programs, and national GHG legislation.

Ms. Rackley also has experience working on combined heat and power (CHP) policy issues such as development of output-based regulations to promote CHP, evaluation of financial incentives applicable to CHP, and numerous U.S. state and federal CHP policies.

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