ICF QUICK TAKE

Getting the Most Out of CHP Potential

By Rick Tidball and Anne Hampson

CHP Economics Driving Customer Demand

Combined heat and power (CHP) plays a significant role in U.S. electricity generation—larger than many observers realize, but not anywhere near its potential. In 2014, approximately 4,400 CHP installations in the United States accounted for 12 percent of electricity production and 8 percent of power generation capacity—83 gigawatts. CHP deployment is poised to grow further in the near-to-medium term, due to increasingly compelling economics. A 10 megawatt (MW) system appropriate for many industrial and large commercial applications can reduce site energy costs by 47 percent and achieve economic payback in 3.7 years, even without including (potentially significant) tax credits or incentives (Table 1)[1,2]. The current low-cost environment for natural gas, which fuels 70 percent of CHP installations, is expected to be sustained in the coming years. ICF's recent quarterly Natural Gas Strategic Forecast suggests that Henry Hub prices will rise to only $4.35/MMBtu (2014 dollars) in 2020 and remain below $5.50/MMBtu through 2030. Furthermore, there are parts of the United States (such as the Northeast and Midwest) that will continue to have lower gas prices than Henry Hub, due to shale gas production. In addition, the value of reduced emissions is expected to increase as new environmental regulations and policies are adopted, including state initiatives meant to enable greater deployment of distributed energy and the federal Clean Power Plan, which will put an implicit (or explicit) price on carbon.

The economics for CHP have become compelling enough to drive a significant and widespread rise in customer interest, although they vary across markets, depending on state incentives and retail energy rates based on central station generation. In turn, utilities are increasingly recognizing that the growth of CHP can represent a threat or an opportunity—and perhaps even some of both—and are trying to determine the right strategy to try to channel growth.

Table 1 – Economics of a Sample CHP System

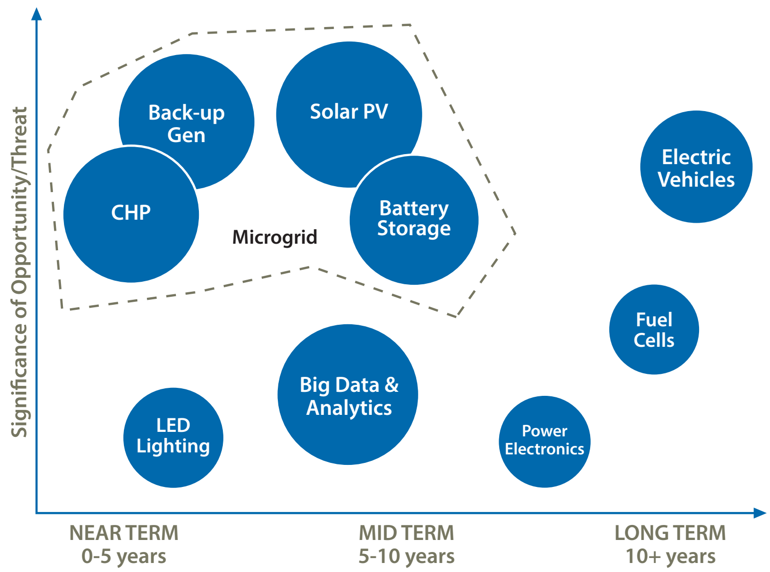
Description	Value
CHP System Size (MW)	10
Capacity Factor (%)	85%
Electricity Production (MWh/yr)	74,460
Useful Thermal Energy (MWh/yr)	106,371
Capital Cost ($/kW)	$2,000
Capital Cost ($)	$20 million
Energy Cost Savings ($/yr, %)	$5,468,555 (47%)
Payback (yrs)	3.7
Energy Savings (MMBtu/yr, %)	308,605 (25%)
CO2 Savings (short tons, %)	42,716 (44%)

[1] U.S. Department of Energy and U.S. Environmental Protection Agency, Combined Heat and Power – A Clean Energy Solution, data adapted from Table 1, P.8, 2015. http://energy.gov/sites/prod/files/2013/11/f4/chp_clean_energy_solution.pdf
[2] Economics based on $6.00 / MMBtu natural gas cost and 12¢ / kWh electricity cost.

The First Key Step: Know What's Growing in Your Own Back Yard

To assess this question, ICF's utility clients have first been seeking to understand two fundamental questions: which customers are "at risk" of migration to CHP, and what are the implications of that potential departing load?

Figure 1 – DER Development Potential Timing and Impact



Source: ICF International

These are neither small nor straightforward issues. The volume of potential lost load affects integrated resource planning and the overall need for central station generation, incremental transmission, and distribution system investment. The location of CHP adoption alters the placement and scale of new investment. As discussed in ICF's recent paper, "The Value in Distributed Energy: It's All About Location, Location, Location," distributed energy resources (DER) like CHP can deliver very different system value—or impose costs—based on their location, the topology of their distribution feeders, and the resources' characteristics such as dispatchability. As depicted in Figure 1, the significance of the class of DERs with microgrid applications, including CHP, is both high and near term.

SMUD CHP Potential Analysis

ICF conducted an evaluation of the technical and economic potential for CHP in Sacramento Municipal Utility District's (SMUD) service territory. The analysis used customer data to identify which customers would be most likely to benefit from installing CHP and how the market would respond to changes in:

- Electricity and natural gas prices
- CHP capital costs
- Ability of CHP to participate in capacity markets
- Customer acceptance of CHP

SMUD is using the results of the analysis to engage with their customers on CHP and inform their corporate strategy relative to distributed generation development.

Understanding the potential and pace of likely CHP penetration informs the strategic business options available to utilities to manage CHP growth productively. These options depend very much on state regulation, utility structure, and overall goals. In some states, utilities have the ability to explore owning and operating CHP systems on customer sites, while in others the greater value may lie in making use of, or adjusting, existing energy-efficiency programs. Some states have active DER grid integration initiatives, under which utilities may want to identify the best targets for pilot projects to demonstrate microgrid applications and new approaches to locational value-driven distribution planning. Other states may be ripe for utilities to work with regulators on new tariffs or programs to capture and deliver enhanced system value from managed CHP adoption.

ICF's CHPower Model

The CHPower model identifies the most viable candidates for CHP projects. The model is supported by the DOE/ICF CHP Installation Database, which contains information on more than 4,400 CHP installations in the United States with a collective capacity exceeding 82,700 MW.* The model is also supported by ICF's CHP Technical Potential Database—the only comprehensive data source for CHP technical potential available in the United States—which includes information on specific sites throughout the country that have concurrent electric and thermal loads conducive to CHP.

* Maintained by ICF International for U.S. DOE

To inform these strategic choices and help assess overall threats and opportunities, ICF has been working with utilities to implement that critical first step of understanding the CHP market potential in their own service territory, as described in the example above. In addition to knowing the total amount of "at-risk" load, cataloging the highest value potential sites also affects potential locational costs and benefits and allows utilities to target desired locations for programs or to offer a tariff structure designed to optimize adoption.

While uncertainties remain about the future direction of CHP adoption and DER-enabling regulatory mechanisms, there are clearly options for utilities to become more active in understanding and shaping the development of CHP. In so doing, utilities can minimize some of the costs and risks and develop opportunities to achieve greater value.

About the Authors

Rick Tidball has more than 25 years of experience related to research, development, and commercialization of advanced energy technologies. He has analyzed conventional and emerging technologies throughout the energy chain, with an emphasis on distributed generation (DG) technologies, including CHP.

Prior to joining ICF, Mr. Tidball held engineering and management positions with Energy and Environmental Analysis, Energy International, and Alzeta.

Mr. Tidball has a master's degree in Chemical Engineering from the University of Colorado and a bachelor's degree in Chemical Engineering from Stanford University.

Anne Hampson has more than 10 years of experience in market and policy analysis in power generation and energy efficiency. She focuses primarily on DG and 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.

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