White Paper

Utility Owned CHP– A Least-Cost Baseload Resource

ICF and Sterling Energy Group

Shareables

- Utility-owned combined heat and power (CHP) installations are an untapped efficiency resource of over 150 GW that can improve grid reliability while reducing operational costs.
- With thermal energy sales credited to fuel costs, utility-owned CHP systems can have the lowest Levelized Cost of Energy (LCOE) among base load supply options.
- Utility ownership of CHP means no lost revenues or subsidies, while unloading the transmission and distribution (T&D) system, lowering emissions, and strengthening the competitiveness of large customers.

Executive Summary

The relationship between electric utilities and their customers is changing. As distributed energy resource deployments grow, utilities are making efforts to modernize the grid, and customers are becoming more engaged in energy-saving solutions. Utility-owned CHP installations represent a large untapped least-cost, base load resource that can provide benefits on both sides of the meter while diversifying generation, increasing efficiency, lowering emissions and water use, reducing T&D losses and strengthening customer competitiveness.

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Performance Benefits of CHP

- With thermal utilization, well applied CHP can be 50% more efficient than traditional power generation, leading to lower costs and reduced emissions
- CHP generates at the point of use, eliminating T&D losses, which average 7%, but often double during peak load hours
- CHP installations help increase the reliability and resiliency of power and steam supply for key utility customers, improving their competitiveness and supporting growth.

Economic Benefits of CHP

- Faster development, permitting, and commissioning of new utility generation in smaller MW increments helps match future load and supply
- Unloading the T&D system can help utilities avoid significant capital investment and high congestion costs
- CHP can help keep businesses competitive in their respective markets by improving reliability and lowering energy costs, supporting manufacturing expansion and job growth.

While many utilities understand and support CHP intellectually, they continue to consider CHP a *customer-owned* resource that competes with utility supply. Utilities have seldom explored CHP as a base load resource or included it as a supply option in their resource planning even though it is the most efficient method of generating baseload power. However, straightforward new business models are emerging with CHP as a key resource to help utilities transform towards a decentralized and highly resilient grid. Utility-owned CHP systems at customer sites can provide substantial benefits to utilities and the grid, and to a diverse array of customers with continuous thermal loads who are interested in reducing costs, expanding operations, and enhancing energy security.

While many facilities across the U.S. have already installed CHP on their own[1], there is still a large amount of technical potential for CHP remaining. According to a March 2016 Department of Energy report,[2] there is 151 GW of CHP technical potential for systems >5 MW at 4,000 industrial and commercial customer sites.

CHP Ownership Advantages for Utilities

By deploying CHP as a supply-side resource, utilities can realize significant benefits compared to investing in traditional central power stations.

- **Low Cost and High Capacity Factor –** CHP is the most efficient method of generating power, and well applied sites have been demonstrated to have the lowest LCOE among base load supply options when thermal credit is applied to fuel costs benefiting all customers. Base load CHP also has a higher annual capacity factor (95%) when compared to central station options such as natural gas combined cycle plants (averaging 40-80%) [3].
- **Less Risk –** The planning, permitting, and implementation process for CHP (2-3 years) is much shorter than that of a large capacity central station generator (6-10 years). Future utility loads are difficult to forecast – building smaller, high-efficiency CHP installations can reduce the risk involved with developing new power generation assets. With a utility-owned, rate-based CHP system, the utility does not lose power revenues from the CHP host site, who is secured with a long-term contract.
- **Locational Value –** Customer-sited CHP systems can provide locational value to utilities by relieving congestion, deferring the need for T&D investments and enhancing local reliability. CHP systems can also provide reactive power and other services to support grid operations.

[1] There is currently over 80 GW of CHP capacity from more than 4,300 installations according to the CHP Installation Database, https://doe.icfwebservices.com/chpdb/.

[2] "Combined Heat and Power Technical Potential in the United States". Prepared by ICF for the Dept. of Energy. March 2016. https://energy.gov/chp-potential

[3] The 2015 average capacity factor for combined cycle plants was 56% according to the Energy Information Administration.

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Duke Energy's CHP Ownership Plans

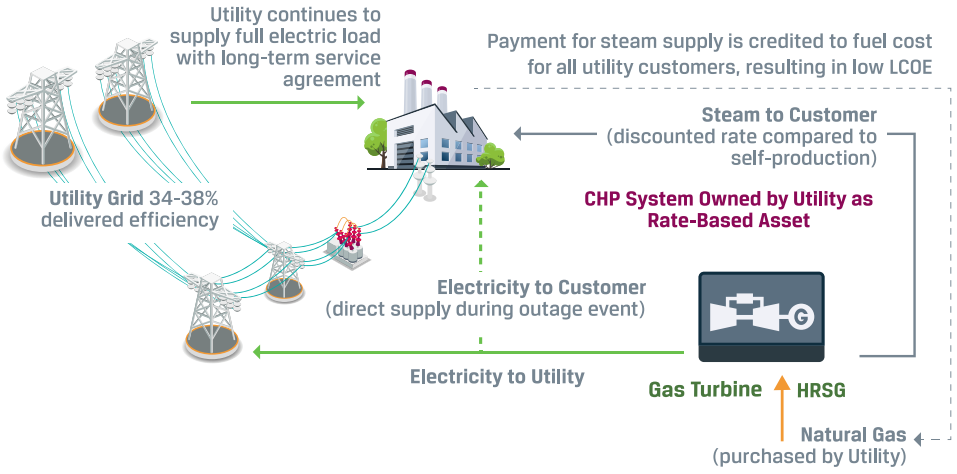
- Duke Energy has included base load CHP plants in their 2015 and 2016 integrated resource plans for the Carolinas and Indiana, demonstrating that distributed CHP is a least cost base load resource when compared to gas fired combined cycle and other central station technologies.
- The 16 MW CHP project is under development at Clemson University will be one of the first Duke Energy owned CHP plants which will provide for campus growth, added resiliency, increased efficiency and lower emissions for the campus and community.
- A similar 21 MW CHP project under development with Duke University will provide both steam and hot water for the campus, boosting efficiency to 80% HHV. The project will decrease CO2e emissions in North Carolina by a projected 100,000 tons/yr. The University is also procuring renewable biogas from NC swine industry projects doubling the emissions benefits. The University will own and retire the associated Renewable energy credits, while also helping catalyze the market for further methane reductions in the swine industry.
- Duke Energy is also working with select industrial manufacturing customers with suitable thermal loads to evaluate and pursue additional CHP opportunities that can be beneficial to the host, the utility, and all customers.

- **Increasing Value for Customers –** Being a CHP host can produce substantial operational and economic benefits for customers providing modern, highly efficient and reliable thermal (steam) energy systems without direct investment by customer. This can enable hosts to retire older boilers, reduce operating costs and still expand operations. The increased reliability and lower costs helps the host customer be more competitive in their market, protecting and even expanding production and local jobs.

Ownership Structure and Service Agreements

In many states, electric utilities can simply treat CHP investments as rate-based supply assets, the same as any other supply-side investment. With utility ownership of a CHP asset, the utility continues to serve the full customer electric load, without the loss of revenue that occurs when a customer invests in CHP. A long-term agreement is executed between the customer and utility, with guarantees for purchase of electricity service and steam or thermal energy from the utility. Thermal sales revenue is credited directly back to fuel costs, benefiting all customers by driving the net heat rate below central station generation. During utility outage events, the CHP system can provide resilience by continuing to serve the customer loads. This process is depicted in Exhibit 1.

EXHIBIT 1. UTILITY CHP OWNERSHIP BUSINESS MODEL



Benefits for Customers

Distributed energy resources are becoming economically competitive with traditional grid power and attractive to customers that are looking for more reliable, cleaner, and cost-effective sources of energy. Utility-owned CHP has several advantages compared to customer-owned CHP systems.

- **Lower Costs –** Utility-owned CHP equipment can provide lower-cost and more reliable thermal energy (steam, hot/chilled water) to customers, who may retire aging, high-maintenance equipment and apply the avoided costs into core business investments. Additionally, with the revenues from thermal sales being credited back to fuel costs for the entire rate base, electricity becomes less expensive for all customers.

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- **Low Risk –** Customers can receive the benefits of high-efficiency on-site power and thermal production without a large capital investment in a non-core asset. Long-term steam contracts with utility suppliers can also reduce risk by providing a hedge against future price volatility.
- **Resiliency –** CHP has the ability to 'island' in the case of a grid outage, increasing resilience and providing benefits for the surrounding community. CHP can be integrated with existing plant systems, as well as nearby loads and resources, to create a microgrid that directly serves critical loads during outage events.

Example – Eight Flags Energy and Rayonier Advanced Materials[4]

Chesapeake Utilities subsidiary Florida Public Utilities (FPU) recently constructed a 21.7 MW, 200,000 lb/hr CHP project on Amelia Island. The project, named Eight Flags Energy CHP, supplies reliable base load power to FPU electric customers along with steam and hot water to the adjacent Rayonier Advanced Materials softwood cellulous specialty mill. It is one of the first in a new generation of CHP projects being developed by utilities that can beneficially use the waste heat of the power production process as part of their base load electric supply portfolio.

Photo Courtesy of: Florida Public Utilities, Cottle Communications

The $40 million project operates at 78% HHV efficiency, and has achieved an operating availably of 98.5% since it was commissioned in July 2016. The project supplies approximately 50% of electric supply to FPU customers on Amelia Island and uses 5,000 Dth/day of natural gas supplied via the FPU gas distribution system.

[4] FPU/Eight Flags Project Overview August 2016 - https://youtu.be/1UaNWrRBMpo

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"We're continually looking for new ways to increase efficiencies, improve reliability, provide cost savings and add value to our customers and the communities we serve. That commitment has resulted in the development of this state-of-the-art CHP plant"

- Jeffry M. Householder, President of Florida Public Utilities Company.

The project was constructed in less than 12 months even though it is located on a challenging 1.5 acre site between the Rayonier mill and the Amelia River marsh only 8' above sea level. Amelia Island has been served by a single transmission line leaving it vulnerable to island-wide power outages. The CHP system was designed to withstand Category 4 winds and storm surge. Following a major storm, the CHP plant will be able to power an island-wide microgrid, supporting essential services and providing energy security for all customers.

Another important factor in planning the project was the collaboration with a key customer, Rayonier. The CHP system provides additional, competitively priced steam and hot water under a long term agreement permitting the mill to operate even when their boilers are down for maintenance. This expanded steam capacity was instrumental in the Rayonier site being approved for a $125 Million expansion scheduled to be operational in spring 2018. [5] The expansion will add 5 MW of electric load and substantial natural gas load to FPU.

Benefits for FPU and their Customers

- Reduction in power costs for all customers
- $28 million net present value for FPU
- Increased reliability by forming a regional generation microgrid on Amelia Island
- 78% overall efficiency leads to 80% lower NOx and 38% lower C02 emissions than current supply

Benefits for Rayonier and the Community

- Increased steam capacity and electric reliability at the Rayonier plant – several more production days per year
- Rayonier expansion at site due to increased operational efficiency with CHP - resulting in 50 additional jobs and $20 Million annually to the NE Florida economy
- Increased the local tax base by $800,000

A Winning Combination

Utility-owned CHP can be a key asset in the current evolution of the electric grid, providing significant benefits to utilities, customers, and surrounding communities. Utilities can create new rate-based generation assets with locational value and additional revenue streams, while customers and local communities benefit from resilient on-site power and lower energy costs. Substantial growth potential exists for CHP given the transition towards a more robust, distributed energy system, and opportunities for utility ownership are also expanding.

By screening utility customers to identify good CHP candidates, utilities can begin to synthesize overall system benefits and target potential locations for CHP implementation. For utilities seeking to provide cleaner, reliable, and cost-effective base load power to their customers, CHP installations can offer a mutually beneficial solution.

[5] "Joint Venture LIngoTech Florida Plans Manufacturing Center in Fernandina Beach, Florida," 12/09/2016. http://www.areadevelopment.com/newsItems/12-9-2016/lignotech-fernandina-beach-florida.shtml

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