MIDWEST CHP Technical Assistance Partnerships

POLICY PROFILE

CHP in Net-Zero Energy Facilities

What is Net-Zero Energy?

A net-zero energy facility features a combination of energy efficiency and on-site renewables, such that the facility's net annual energy consumption calculates to zero. Ideally, a net-zero energy facility is optimized to be as efficient as possible through the use of demand-side technologies. The facility aims to produce enough on-site renewable energy to meet its remaining energy demand over the course of a year. In some cases, the facility may also use renewable energy credits to help meet demand. In efforts to achieve net-zero energy use, it is important to reduce both thermal and electric energy consumption, as this makes it easier and less expensive to meet the facility's energy needs with renewable energy or with renewable energy credits. Combined heat and power (CHP) can be a valuable resource in net-zero energy facilities. CHP can serve as either a key demand-side technology application to lower thermal and electric energy demand and reduce costs—in the case of non-renewable (i.e., natural gas-fired CHP)—or as an on-site renewable generation technology, in the case of biomass or biogas-fueled CHP. By reducing demand and generating clean electricity, renewably-fueled CHP competes well economically against other low-carbon energy resources, such as electric heat pumps. Overall, net-zero energy facilities using CHP offer a range of benefits, including improved energy security, reduced environmental impacts, lower operating and maintenance costs, and improved resilience in the face of power outages and natural disasters.

Net-Zero Energy and CHP Potential

In 2018, the National Renewable Energy Laboratory (NREL) published a report on zero-energy districts, discussing the opportunities and challenges they present and strategies for achieving efficiencies at scale. Among other recommendations, NREL suggested that projects whose goals include net-zero energy and energy security include the integration of distributed energy and energy storage in energy planning.[1] NREL found that 64% of commercial buildings could achieve net-zero energy goals with the use of technologies such as CHP.[2] There remains significant untapped CHP potential across the United States. In 2016, the U.S. Department of Energy (DOE) estimated that there were 76 GW of on-site commercial CHP technical potential, spread out across more than 240,000 potential sites, and 73 GW of on-site industrial CHP technical potential, spread out across more than 51,000 sites.[3] With its ability to help commercial and industrial facilities reduce thermal and electric energy consumption, and generate electricity with renewable fuels, CHP has the potential to play a significant role in enabling the achievement of facilities' net-zero energy goals.

Net-Zero Energy Accounting

Many net-zero energy facilities are connected to the electric grid. During periods when on-site energy generation exceeds the facility's demand, the excess energy can be exported back to the utility grid or stored in on-site batteries. This excess

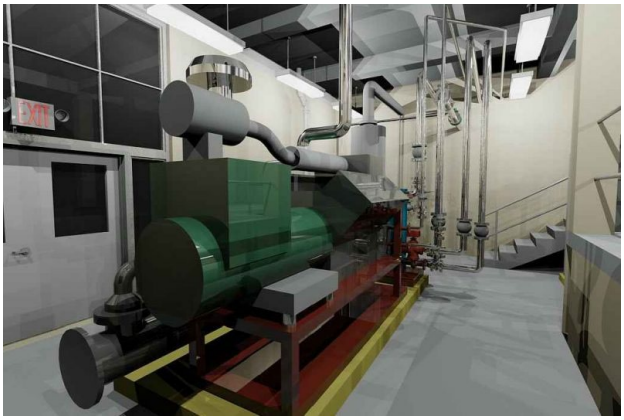
[1] Zaleski, Sarah, Shanti Pless, and Ben Polly. 2018. "Communities of the Future: Accelerating Zero Energy District Master Planning: Preprint." Golden, CO: National Renewable Energy Laboratory. NREL/CP-5500-71841. https://www.nrel.gov/docs/fy18osti/71841.pdf.

[2] Ibid.

[3] U.S. Department of Energy, Combined Heat and Power (CHP) Technical Potential in the United States (March 2016), p. 22, *available at* https://www.energy.gov/sites/prod/files/2016/04/f30/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf

energy production can offset periods of excess demand that may happen at different times throughout the year, resulting in an annual net energy consumption of zero. Excess power sales may also be a source of revenue for the facility, depending on local regulations. According to DOE's common definition of net-zero energy buildings, "source energy" is calculated from delivered energy and exported energy for each energy type using "source energy conversion factors," which are applied to convert energy delivered and exported on-site into the total equivalent source energy.[4] The goal is to credibly balance delivered energy with equivalent exported energy.

Net-Zero CHP: Examples from the Wastewater and Healthcare Sectors



At the Downers Grove Sanitary District, CHP units can produce up to 660 kW of electricity. Utilized alongside major energy efficiency improvements throughout the facility, the CHP system assists the sanitary district in its journey to net-zero energy status.

SOURCE: DOWNERS GROVE SANITARY DISTRICT

CHP systems are common in both the wastewater and healthcare sectors due in part to their need for reliable and resilient energy and their energy-intensive processes. In the wastewater treatment sector, many municipalities are looking for opportunities to reduce emissions and achieve net-zero. CHP, due to its energy efficient characteristics, can significantly help wastewater treatment facilities meet net-zero energy planning goals. By using biogas generated in the wastewater treatment process, these facilities can operate zero-emission CHP, providing both clean thermal and electric energy which enables a cost-effective path to net-zero energy consumption. Examples of wastewater treatment facilities using CHP to meet net-zero annual energy consumption include the Kishwaukee Water Reclamation District in DeKalb, Illinois, the Southwest Wastewater Treatment Plant in Springfield, Missouri, and the Downers Grove Sanitary District in Downers Grove, Illinois.

There is also a key opportunity for CHP to enable net-zero energy consumption in the healthcare industry. Emissions reduction in the healthcare sector is now seen as a public health priority especially in terms of racial and social equity.[5] Hospitals are one of the most intensive users of energy for reasons that include the use of energy-intensive equipment and the need to be well lit, well ventilated, and temperature controlled 24 hours per day. According to DOE, hospitals and nursing homes together represent 8,889 MW of CHP technical potential nationally, spread out over 17,307 potential sites.[6] Gundersen Health System in La Crosse, Wisconsin, which utilizes a biomass-fueled CHP steam turbine/generator set to produce up to 400 kW of electric power and provide approximately 80% of the facility's annual steam load, claimed the title of the nation's first net-zero energy health complex in 2015. In 2014, Kaiser Permanente became the first carbon-neutral health system in the Unites States, in part through the CO_2 emissions reduction provided by a 750 kW microturbine system at the Vacaville Medical Center.[7] The CHP system greatly reduces the number of carbon offset credits required by Kaiser, making it more financially feasible for the healthcare system to achieve carbon neutrality.

For More Information

U.S. DOE MIDWEST CHP TECHNICAL ASSISTANCE PARTNERSHIP (CHP TAP)
www.mwchptap.org

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[4] U.S. Department of Energy, A Common Definition for Zero Energy Buildings (September 2015), *available at* https://www.energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf

[5] Frumkin H. (2018). The U.S. Health Care Sector's Carbon Footprint: Stomping or Treading Lightly? American journal of public health, 108(S2), S56-S57. https://doi.org/10.2105/AJPH.2017.304160

[6] U.S. Department of Energy, Combined Heat and Power (CHP) Technical Potential in the United States (March 2016), p. 25, *available at* https://www.energy.gov/sites/prod/files/2016/04/f30/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf

[7] https://about.kaiserpermanente.org/community-health/news/first-carbon-neutral-health-system-in-us