Wastewater Treatment Plants with CHP: Resilient, Renewable, and Ready for Net Zero Energy

By Tom Bourgeois, Daniel Robb on behalf of the New York/New Jersey Combined Heat and Power Technical Assistance Partnership (NY/NJ CHP TAP). September 12, 2022

Wastewater Treatment Plants (WWTP's) have long been recognized as an attractive market for Combined Heat and Power (CHP). In our recent series of newsletters, the New York / New Jersey Combined Heat and Power Technical Assistance Center (NY/NJ CHP TAP) has addressed the theme of "resiliency" and CHP in the context of high-tech greenhouses[1], and in hospitals[2]. This newsletter builds upon prior work of the national network of DOE's CHP Technical Assistance Partnerships (CHP TAPs), discussing how CHP in WWTPs can contribute to site resiliency, to increased renewable energy production and to ultimately meeting net zero carbon goals.

A Sampling of US Department of Energy Resources

Characterization of CHP Opportunities at U.S. Wastewater Treatment Plants. April 2019 DOE/EE – 1969. Source: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/Characterization_CHP_Opportunities_US_Wastewater_Plants_April2019.pdf

Combined Heat and Power (CHP) Fact Sheet Series: Wastewater Treatment Plants. Source:

https://betterbuildingssolutioncenter.energy.gov/resources/combined-heat-and-power-chp-fact-sheet-series-wastewater-treatment-plants

Energy Data Management Manual for the Wastewater Treatment Sector. [DOE/EE-1700] By Paul Lemar. Oak Ridge National Laboratory Contract No. DE-AC05-00OR22725. December 18, 2017. Source: https://www.energy.gov/eere/slsc/downloads/energy-data-management-manual-wastewater-treatment-sector

Wastewater Infrastructure: State and Local Infrastructure. https://www.energy.gov/eere/slsc/wastewater-infrastructure

The Sustainable Wastewater Infrastructure of the Future (SWIFt) Initiative, the U.S. Department of Energy (DOE).

https://betterbuildingssolutioncenter.energy.gov/accelerators/wastewater-infrastructure

CHP In Net-Zero Energy Facilities : Policy Profile. By Clifford Haefke, Director. U.S. DOE Midwest CHP Technical Assistance Partnership (CHP TAP). Source: https://chptap.ornl.gov/profile/422/CHP_in_Net-Zero_Energy_Facilities.pdf

[1] CHP Adds Food to the Resiliency Menu
[2] NYU Langone Hospital

The Midwest CHP Technical Assistance Partnership (CHP TAP) describes several illustrative cases of Net-Zero CHP: Examples from the Wastewater and Healthcare Sectors. The author observe that, "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".[3]

With the passage of New York's Climate Law and Community Protection Act (CLCPA, or "Climate Act) forward looking investment planning focuses on recovering renewable methane and prioritizing renewable based generation options. Hybrid biogas / solar PV systems at wastewater treatment plants are emerging as the next level of environmentally superior, resilient, and economically advantageous energy investments. In our region, New Jersey, the Willingboro Municipal Utilities Authority (WMUA) recently was among the winners of the Project of the Year Award in the elite Environment + Energy Leader Awards program. In selecting this project, the judges stated, "the comprehensive nature of this upgrade (including biogas, CHP, microgrid and advanced meter infrastructure) provides a holistic solution improving the operation of the municipal water/wastewater system".[4] This innovative renewable CHP project and microgrid is projected to reduce energy costs and emissions, provide energy resilience to keep the plant operational during grid outages, and diversify the energy supply, while garnering over $7 million of savings over twenty years[5]

A wide range of state and federal support has emerged for appropriately designed, configured and site-suitable investment in renewable, resilient CHP at wastewater treatment plants. In response to Climate Act directives demand is strong for investments that prioritize efficiency and net zero operations. Financial support from federal and state sources is quite extensive. The Infrastructure Investment and Jobs Act provides an incremental $428 Million for New York State's Revolving Fund (SRF) Programs in 2022[6]. The Clean Water State Revolving Fund (CWSRF) is administered in New York by the New York State Environmental Facilities Corporation (EFC)[7]. The H.R.5376 - Inflation Reduction Act of 2022 (IRA)[8] extends timelines, increases amounts available and creates new programs providing assistance to qualifying renewable energy, CHP and microgrid systems.

For many larger wastewater treatment plants, there's a significant remaining opportunity for renewable based CHP in New York. With the surplus of resources available, this may be a time where opportunity and resources are potentially well synchronized!

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[3] *CHP in NetZero Energy Facilities*. Clifford Haefke, Director, Midwest CHP Technical Assistance Partnership (CHP TAP). March 2021. https://chptap.ornl.gov/profile/422/CHP_in_Net-Zero_Energy_Facilities.pdf

[4] 2022 E&E Leader Awards Book. Page 69. Source. https://gateway.on24.com/wcc/eh/3047076/lp/3875399/2022-ee-leader-awards-book

[5] Ibid., page 69.

[6] Source: NY State Infrastructure Funding Opportunities. Prepared by Kaitlin J. Penner, P.E. Deputy Director Division of Engineering and Program Management, Environmental Facilities Corp. Prepared for NYWEA 94th Annual Meeting, February 8,2022. Page 16.

[7] EFC is a public benefit corporation that provides financial assistance including low-cost capital and grants Sewer and wastewater treatment through Clean Water State Revolving Fund (CWSRF) and administers Drinking water projects through Drinking Water State Revolving Fund (DWSRF) and administers various NYS grant programs.

[8] H.R.5376 - Inflation Reduction Act of 2022 08/16/2022 Became Public Law No: 117-169. https://www.congress.gov/bill/117th-congress/house-bill/5376/text

A 2019 US DOE report stated that assessment of technical potential for ADG CHP should be limited to WWTPs with existing anaerobic digesters[9]. The report expands on these criteria stating that WWTPs processing at least 2 million gallons of wastewater per day (2 MGD) produce sufficient biogas to offer investment opportunities in renewable CHP systems. Using these criteria, the report found that New York ranked fifth among the 50 states in terms of sites with Technical Potential for CHP and identified 57 sites.[10]

As a follow-up to a stakeholder engagement conducted by the NY/NJ CHP TAP, in May 2022 we were provided a list of WWTPs with Anaerobic Digesters in NY[11] from the New York State Department of Environmental Conservation (NYSDEC). This database contains information on 136 existing WWTPs with anaerobic digesters in New York State, ranging from < 1 MGD to > 100 MGD.

We conducted an analysis of the NYSDEC data utilizing the methodology described in the 2019 US DOE report on Technical Potential. The results indicated that there are 49 WWTPs in NY meeting two threshold criteria for CHP technical potential: existing Anaerobic Digestors and capacity > 2 MGD. Of these 49 WWTPs , 16 of them treat between 2 and 5 MGD and considered somewhat less likely to show strong benefits, in terms of potential for CHP capacity. Further analysis was conducted on the 33 systems that treat > 5 MGD:

- 18 of these WWTPs currently using biogas to fuel CHP systems and direct drive pumps and blowers. These CHP systems have a total installed capacity of > 4 MW, but could be candidates for upgraded CHP systems depending on the age and performance of their current system(s).
- 4 WWTPs combust biogas in a boiler or flare. These facilities could make more efficient use of the produced biogas by installing a CHP system, and likely reduce their operating costs, by producing their own electricity.
- For 10 WWTPs we could not find any information indicating the biogas is put to beneficial use. This set of 10 represent the candidates for further evaluation, and thus may benefit from a TAP-led screening of their plant.

While utilizing a database different from that of the 2019 US DOE Study, *Characterization of CHP Opportunities at U.S. Wastewater Treatment Plants,* the conclusions arrived at are similar regarding the number of WWTPs with potential for CHP in New York state. While the NY/NJ TAP's analysis referred to above refined the technical potential for CHP at WWTPs, compared with the DOE study, by considering existing CHP systems, it confirmed that there is still significant potential (> 20 MW[12]) at existing facilities in NY.

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[9] *Characterization of CHP Opportunities at U.S. Wastewater Treatment Plants*. April 2019. Prepared for: U.S. Department of Energy (U.S. DOE) Office of Energy Efficiency and Renewable. Energy (EERE) Advanced Manufacturing Office (AMO). Prepared by: David Jones, Anne Hampson, and Nick Posawatz at ICF. DOE/EE – 1969. Page 9.

[10] Table 1. Municipal WWTP Technical Potential by State (DOE/ICF). Page 9. Characterization of CHP Opportunities at U.S. Wastewater Treatment Plants. April 2019. Prepared for: U.S. Department of Energy (U.S. DOE) Office of Energy Efficiency and Renewable. Energy (EERE) Advanced Manufacturing Office (AMO)

[11] Personal communication from James Tierney, Deputy Commissioner Office of Water Resources to Tom Bourgeois on May 24th, 2022, with attached worksheet titled *WWTPs with Anaerobic Digesters*

[12] Est. using Department of Environmental Conservation (DEC) provided methane production of 13,750 ft^3 / day of methane produced per MGD, estimated biogas energy content of 600 Btu/scf, CHP electrical efficiency of 25%.

Wastewater Treatment Plants offer a unique opportunity to integrate a CHP system as part of a comprehensive strategy to advance critically important societal, environmental, energy efficiency, infrastructure resiliency and greenhouse gas reduction goals. DOE's CHP TAPs promote and assist in transforming the market for CHP, waste heat to power, and district energy technologies/concepts throughout the United States. As leading experts in CHP (as well as microgrids, heat to power, and district energy) the CHP TAPs work with sites to screen for CHP opportunities as well as provide advanced services to maximize the economic impact and reduce the risk of CHP from initial screening to installation. For information and assistance, contact the CHP TAP in your area, found at this site, https://betterbuildingssolutioncenter.energy.gov/chp/chp-taps