Abstract

Cogeneration, also known as combined heat and power (CHP), offers significant cost, energy, and carbon saving potential by generating on-site electricity, but its performance relies heavily on its ability to recover otherwise wasted heat to meet a building's thermal demands. This thesis research analyzes the CHP impact on cost and carbon dioxide (CO_2) emission savings at an urban academic campus to ascertain the performance of the systems and to identify opportunities for improvement. The thesis describes Cooper Union's existing CHP plants (the 250-kW unit at the 41 Cooper Square building and the 150-kW unit at the Foundation Building). Currently, the institution's CHP systems run at less than their maximum electrical and heat recovery capacities and incur significant downtime. The thesis assesses 2015 and 2018 historical data for 41 Cooper Square and computes for both units' carbon breakeven points, which is defined as the heat recovery rate for a given electrical output at which the CHP emissions are equal to the emissions from buying electricity and natural gas to run boilers. Next, the thesis analyzes the potential emission savings from proposed retrofits. This thesis suggests future work, including determining the CHP impact on Cooper Union's ability to meet its Climate Action Plan 40% carbon reduction target by 2030 and avoiding Climate Mobilization Act penalties beginning in 2024 for exceeding CO_2 emission limits set forth by the city council. Actual maintenance and repair costs need to be factored into the economic analysis, especially in light of the recent 41 Cooper Square engine failure, to aid in the decision whether to make continued investments into the CHP plants or direct these investments to other cost and CO_2 saving measures. This study provides a methodology for determining cost and carbon emission savings to assist decision-makers in considering both the economic and environmental impacts of CHP.