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Integration of Thermal Energy Storage and Electric Heating with Combined Heat and Power Plants

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Abstract : Combined heat and power (CHP) plants are an efficient technology for meeting the heating and electric needs of large campus energy systems, but have come under greater scrutiny as the world pushes for emissions reductions and lower consumption of fossil fuels. The electrification of heating and cooling systems offers a great deal of potential for carbon savings, but these systems can be costly endeavors due to increased electric consumption and peak demand. Thermal energy storage (TES) has been shown to be an effective means of improving the viability of electrified systems, by shifting heating and cooling load to off-peak hours and reducing peak demand charges. In this study, we analyze the integration of an electrified heating and cooling system with thermal energy storage into a campus CHP plant, to investigate the potential of leveraging existing infrastructure and technologies with the climate goals of the 21st century. A TRNSYS model was built to simulate a ground source heat pump (GSHP) system with TES using measured campus heating and cooling loads. The GSHP with TES system is modeled to follow the parameters of industry standards and sized to provide an optimal balance of capital and operating costs. Using known CHP production information, costs and emissions were investigated for a unique large energy user rate structure that operates a CHP plant. The results highlight the cost and emissions benefits of a targeted integration of heat pump technology within the framework of existing CHP systems, along with the performance impacts and value of TES capability within the combined system.

Keywords : thermal energy storage, combined heat and power, heat pumps, electrification
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