DECARBONIZATION OF GRID-FRIENDLY ELECTRICIFIED DISTRICT HEATING AND COOLING WITH THERMAL STORAGE

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ABSTRACT

This project, supported by the Global Climate and Energy Project and the Bill & Melinda Gates Foundation at Stanford University, explores grid-friendly electrified district heating and cooling with thermal storage for the campus

INTRODUCTION

Driven by the need to curb global emissions, the penetration of renewables at large is challenging for power grid operators both at the transmission and distribution levels and requires a paradigm shift in overall system operation. Electric loads that can offer energy use could potentially play a role in the overarching control infrastructure of the power grid. Distressed energy historically played a small, but important role at a local level.

Electricity Billing Structure

As a Direct Access customer, Stanford pays a Locational Marginal Price for electricity usage, and a demand charge that represents the capacity that the utility must provide to meet the highest demand over the payment period. Billing is based on aggregate consumption.

Meeting Campus Energy Requirements

Heat maps for the energy consumption of the campus buildings. There are three main consumption streams. The electric load shown here corresponds to the non-dispatchable campus load. Power consumption is occupancy-driven, heating and cooling loads are seasonal.

Base case Optimal Operations Schedule

Picks for key operating variables. Optimal loads listed under a demand charge system have a typical load profile. The system is dispatched with both linear and linearized multi-variable controllers: a) CTU; b) local controller; c) non-dispatchable load. Assumptions: climate and occupancy data.

Modeling framework and main results

- We formulate the problem of generating optimal schedules for the CEP as a linear program with 2326 variables and 1770 constraints to generate the hourly schedule for the next day.

Optimizing grid-friendly electrified district heating and cooling with thermal storage

Developing a grid-friendly electrified district heating and cooling operation within the campus.

DESIRED OUTCOMES

- A demand side management strategy that intersects with the primary objective of achieving a carbon neutral university
- Explores the paradigm shift for grid operations and control
- Helps our community navigate the energy transition

RESOURCES

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