



ABBY-NET E³-Systems Research Project Update 2019: Interactions of Renewable Energy Technologies with Traditional Fossil-Fueled Grids

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Project summary

The goal of increasing renewable energy necessitates the adoption of technologies that can balance supply and demand despite intermittent generation. These technologies can include ramping thermal generation, storage, or demand side management (DSM). Data centers are a perfect operational characteristics to compare renewable energies, storage, and DSM technologies. The project seeks to analyze energy use in data centers, firstly from the grid perspective: How do marginal changes in electricity use affect the grid at large? Data on the Alberta electricity merit order was used to determine how marginal changes would affect the grid. It was found that small changes in the supply/demand balance occurring at specific times can have major impacts on the price of electricity. A common metric for assessing GHG emissions, the marginal emissions factor, was found to fluctuate far more significantly and unexpectedly than previously suggested in the literature. As a result, using an average hourly emissions factor is recommended.

Progress to date

The project will consist of two papers for publication that will be combined to make up the bulk of a Master's thesis. The first paper focuses on marginal changes in the electricity grid and the second compares electricity options on the scale of a single data center operator. The first paper is currently being reviewed by colleagues and will be ready for submission near the end of August. The second paper is nearing completion of the analysis stage with a draft expected near the end of August.

Contribution to E3-system and Implications

The study explores a potential mechanism to assist in the energy transition to renewables in a fossil-fuel dominated grid. Furthermore, the economic case for locating data centers in Alberta could provide a new industry along with assisting in the energy transition. The study comes from the engineering perspective and focuses on the energy use (i.e. electricity) and the economic and environmental impacts (i.e. GHG emissions) associated.

Geographic location

Due to data availability on the electricity merit order, the first part of the project focuses on Alberta alone. The second part will include pricing data on Alberta, Ontario, Bavaria, and California.

Final Outcomes

The primary final outcome will be a Master's thesis, with the goal of two publications along the way.

