QCoefficient
Turning Buildings into Batteries™

2020-2022 Demonstration Projects

QCoefficient's ("QCo") Foresight EMeister™ is a hosted software platform that i) reshapes large commercial building cooling load profiles to accommodate from the simplest to the most sophisticated electric rates and ii) automates large commercial building participation in electric utility operations and emerging Independent System Operator ("ISO") wholesale grid markets.

At the core, EMeister is a software-as-a-service platform that combines breakthroughs in building energy modeling ("BEM") and model predictive control ("MPC") to harness the thermal mass associated with the drywall, concrete, and furnishings in large commercial buildings as a grid-scale thermal energy storage medium. This QCo-enabled storage outperforms all other forms of energy storage – better efficiency, no capital expense, no space requirement, no equipment, and no permitting.

EMeister is the first scalable Grid-Interactive Efficient Buildings ("GEB") technology that reduces both energy use and expense, shrinks the carbon footprint, enhances grid resilience and provides grid-scale flexibility to accommodate PV and wind.

Following is a description of the two demonstrations that QCo is conducting in New York City during the 2021 and 2022 cooling seasons.

Multi-Objective optimization of portfolios of large commercial buildings to support the:

NY Climate Leadership and Community Protection Act ("CLCPA")
NYC Building Emissions Law ("LL97")
ConEd Non-Wires Program

The EMeister stand-alone building application described above has been developed, commercially proven, and successfully deployed in New York City and Chicago. Through intelligent coordination of a portfolio of buildings, larger objectives can be achieved that are simply not possible through single building optimization. To that end, QCo – and its RD&D partners at the University of Colorado Boulder ("UCB") and the Pennsylvania State University ("PSU") – have developed an equivalent building portfolio application, in effect, a portfolio version of EMeister. This provides the local scale, coordination, optimization, and reliability required for many important and $billion electric grid problems, including enabling large market penetration of photovoltaics and wind (CLCPA); reducing and shifting energy use to reduce carbon emissions (LL97); and unloading local distribution systems to postpone $billion capital investment (Non-Wires Program).

This application leverages large commercial buildings' untapped HVAC demand flexibility to enable significant participation in and contribution to a broader portfolio solution by collocated PV and smaller buildings.

This development and demonstration project is sponsored by the Solar Energy Technology Office of the U.S. Department of Energy. QCo's large commercial building customers have the opportunity to participate in a 2021 NYC demonstration – and so will immediately realize the benefits of expense, energy, and carbon savings as well as operational collaboration with PSU and UCB.

Multi-objective deep reinforcement learning for grid-interactive efficient buildings

This project is also rooted in a firm belief that MPC can unleash the large potential of GEB. That is, commercial buildings must become grid-interactive intelligent elements that can flexibly participate in grid-level operations to enhance resiliency of our national grid, while addressing the needs of occupants and economic objectives. This is particularly important in view of the ongoing transformation of the power grid – as in New York – to an active network with volatile distributed energy resources.

This project addresses the most important barrier to MPC scalability – the time, expense, and specialized expertise to develop a building energy model. MPC algorithms – like QCo's EMeister – rely on a building energy model that requires expert QCo engineering and expense for model development and tuning. This makes economic sense for large commercial buildings in large, grid-congested cities; but not for the many smaller buildings or less expensive markets.

Therefore, the industry needs a better approach to intelligent building control and operation that achieves both algorithmic scalability and deployment repeatability to unlock the potential our entire building stock offers. This project does so by leveraging the emerging deep reinforcement learning (RL) paradigm to develop scalable multi-objective RL algorithms that simultaneously address both building-centric and grid-serving objectives. The RL-based approach learns the optimal controller directly from data and interaction with the building, thus avoiding costly building-by-building customization required by standard MPC approach.

The National Renewable Energy Laboratory (NREL) and the University of Colorado Boulder (UCB) will develop and test these algorithms in simulation and compare to the EMeister MPC performance in QCo's New York City customer buildings. In the Summer 2022, QCo will conduct field demonstration at those same customer sites.

This RD&D project is sponsored by the Building Technology Office of the U.S. Department of Energy. QCo's large commercial building customers have the opportunity to participate – and so will immediately realize the benefits of expense, energy, and carbon savings as well as operational collaboration with NREL and UCB.

Additional demonstration features

- QCo's carbon emissions analysis of the New York electric system; and QCo's proposed marginal CO_2 emission rate protocol for NYC commercial buildings.
- Optimized operation under no/partial occupancy while meeting ventilation objectives and constraints. To master precooling and subcooling strategies of large commercial buildings over the last ten years, QCo and its research partners necessarily had to master MPC and building energy modeling for the widely varying occupancy and ventilation states of such buildings.
- Application of QCo's MPC-based chiller sequencing and staging RD&D.
- Cyber-security and privacy that meets increasingly stringent ISO and utility standards.
- Participant confidence that their building information (and even the fact of their participation) kept private.