



Startup
Enerbrain
Turin, Italy

Hosts
EPRI
Duke Energy
SCE



Intelligent Energy Monitoring and Control for Commercial Space Conditioning

Technology Solution

Commercial buildings in the United States consumed 18 quadrillion Btu of primary energy in 2019. According to EPRI and other studies, up to 20% of peak load in commercial buildings can be temporarily curtailed for demand response without significantly impacting comfort, while Internet-of-Things (IoT) sensing and connectivity combined with control system replacements and upgrades can reduce overall building energy use by as much as 30%.

This pilot project was launched to test the IoT sensing and AI-based monitoring and control solution developed by Enerbrain for increasing the efficiency and demand responsiveness of heating, ventilation, and cooling (HVAC) systems in small to medium commercial buildings. Self-calibrating networked sensors provide building data to cloud resources hosting Enerbrain's proprietary reinforcement learning algorithm for optimizing indoor temperature control and building energy consumption. Plug-and-play operability and IoT-AI integration support fast and scalable deployment.

Project Overview

The project team included Enerbrain as the technology supplier, EPRI as the host of the demonstration at its headquarters in Charlotte, North Carolina, and Duke Energy and Southern California Edison (SCE) as utilities interested in exploring new demand-side management offerings for customers.

The objective was to demonstrate the capabilities of Enerbrain's IoT kit and AI algorithm for achieving energy and demand savings while maintaining the desired level of comfort (temperature and relative humidity) via remote control of standard HVAC units serving



Networked metering, sensing, and communications hardware deployed at EPRI's headquarters provided the data required for optimizing HVAC control to reduce energy consumption without impacting thermostat settings.

four electrical rooms at EPRI's headquarters. This pilot test environment is representative of small to medium commercial buildings that may not have a building automation or energy management system, whereas Enerbrain's current customer base includes larger buildings in European markets.

Key milestones for this pilot included the following:

- Installation of data loggers to monitor electricity consumption by the Daikin heat pump units and IoT sensors to monitor temperature, relative humidity, and CO₂ levels within individual rooms.
- Full data acquisition via Sigfox connectivity to cloud computing resources and data ingestion and training by Enerbrain's proprietary algorithm.

- Remote monitoring and control of HVAC energy consumption and ambient conditions within individual rooms via web interface.

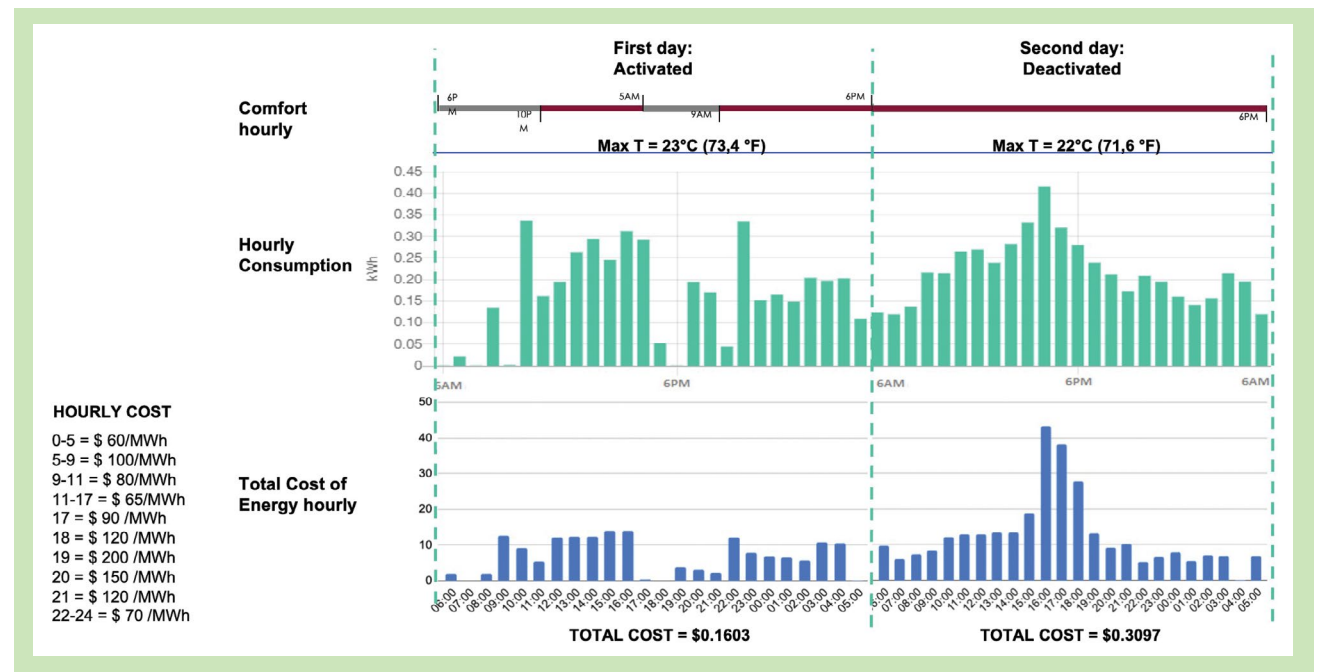
Enerbrain offers guaranteed energy savings, but this project was not designed to verify that. For the project to be considered successful, the project team set a minimum savings goal of 9%, calculated according to the “International Performance Measurement and Verification Protocol.” More broadly, the project was intended to evaluate the scalability of Enerbrain’s solution as a utility program offering.

Results & Learnings

This pilot project highlighted key advantages of Enerbrain’s IoT-AI system for commercial building energy monitoring and control and provided the company with deployment insights specific to U.S. markets and utility interests. The plug-and-play installation was completed fully remotely by Enerbrain in just a couple of days, supported by physical deployment of sensing, metering, and communications hardware by EPRI’s contractors.

The web-based interface allowed remote monitoring and management of the four HVAC systems with advanced calendar settings. Enerbrain’s solution delivered energy savings on HVAC consumption by maintaining the same comfort levels, as measured by indoor air temperature and relative humidity, while optimizing control of the existing Daikin units. Energy savings of more than 20% were recorded, but this was achieved in a testing environment in rooms with no occupants, no windows, and limited operating equipment.

The system also was tested for control based on load management objectives in order to assess the



Initial field testing of the Enerbrain solution’s load management capabilities in response to price signals demonstrated reduced hourly consumption (top left) and energy cost (bottom left) with minimal impacts on comfort.

potential for demand response. As shown in the figure above, applying Enerbrain’s algorithm to one Daikin unit based on an hourly cost profile resulted in reduced energy use, both across the day and during peak pricing periods. Using lower-cost energy to pre-cool the room helped cut energy costs by ~50% with a maximum 1°C change from the standard setpoint.

During the course of the project, several issues with potential to influence U.S. deployment of Enerbrain’s solution were identified. The technology appears suitable for applications without automation or energy management systems, but installations in buildings that have a centralized point of connection will require engagement of a local system integrator to implement the solution using a Modbus or BACnet protocol.

Also, Enerbrain’s system is currently not compatible with HVAC technologies offering variable air volume or variable air volume/temperature capabilities, a common feature in the U.S. market. This could be a future development opportunity for Enerbrain, along with building out its features as a demand response solution, as was tested in this project for the first time.

Implications & Next Steps

This pilot project highlighted the potential for beneficial application of Enerbrain’s solution in the U.S. commercial building marketplace and generated insights for tailored business planning and technology development around utility use cases.

While commercial customers are primarily motivated by energy and cost savings, utilities have particular interest in untapping the potential of demand-side management in buildings for managing peak loading, and this first test at EPRI's headquarters was very successful. Enerbrain plans to develop a full integration of demand-side management capabilities and tools—including for participation in demand response programs and flexibility markets—to allow both utilities and customers to capture value. Completing the UL certifications required for deployment of Enerbrain's hardware also is planned.

EPRI, Duke Energy, and SCE are interested in identifying larger case studies for experimenting with advanced technologies for improving building efficiency and demand responsiveness and for assessing the interest of customers in Enerbrain's HVAC solution or similar approaches.

Resources

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TESTIMONIAL: Enerbrain

Thanks to EPRI and utility sponsors, we were able to demonstrate that our technology can deliver substantial energy savings in U.S. markets and also to identify the developments needed to bring forward a full solution for load shifting and peak shaving by commercial buildings.

TESTIMONIAL: EPRI

Enerbrain's technology combined energy monitoring and control in one complete package, installation was fast and straightforward, and pilot results showed potential. Participating utilities like the promise of "guaranteed savings" and hope to verify that in a field demonstration.

TESTIMONIAL: Duke Energy

This pilot showed that Enerbrain's plug-and-play solution, using IoT sensor data for remote monitoring and control of HVAC systems, can be effective for commercial buildings that do not have energy management systems, opening the door for utilities to explore new program offerings and demand response opportunities.

Resources

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3002023025

March 2022

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