Autonomous Energy Management Software System for Small Commercial Buildings in Support of Decarbonization

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RD&D Challenge

Over 85% of commercial buildings, most of them small and medium size (SMB), lack proper control infrastructure, leading to operational deficiencies and excess energy consumption.

SMBs use packaged rooftop units (RTUs) controlled by thermostats for heating, ventilation, and air-conditioning (HVAC). Currently, in many SMBs:

- Set points, setbacks, schedules, and optimal start are not properly configured or enforced.
- Economizer controls do not work as intended.
- There is limited interaction with grid; buildings with multiple RTUs have no ability to coordinate RTU operation.
- Electrification of buildings by replacing fossil-fuel fired heating equipment with RTU-HPs (heat pumps) and decarbonization of electricity generation will significantly disrupt the supply-demand imbalance.

Other major end-uses, interior and exterior lighting, and exhaust fans, are not controlled in an automated way.

Energy Efficiency Features

- Managing set points and dead bands
- Managing setbacks
- Managing schedules
- Optimal start
- Remote management

Grid Service Features

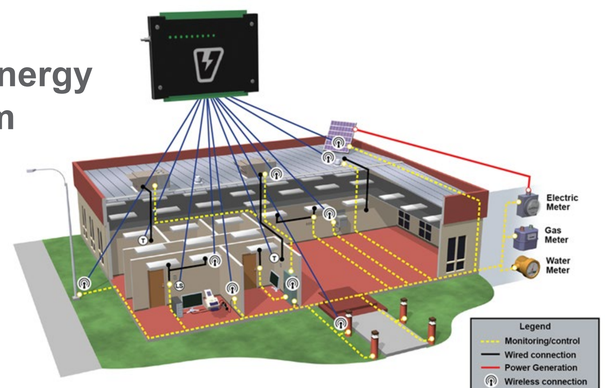
- Peak load management
- Price-based controls (e.g., time-of-use, critical peak price, real-time price)
- RTU coordination to mitigate both winter and summer peaks using Intelligent Load Control

Status

- Working with the project partner, developed AEMS system requirements and software implementation plans.
- Selected BACnet/WIFI communicating thermostats for testing AEMS system features.
- Development of the AEMS system underway.

Goals

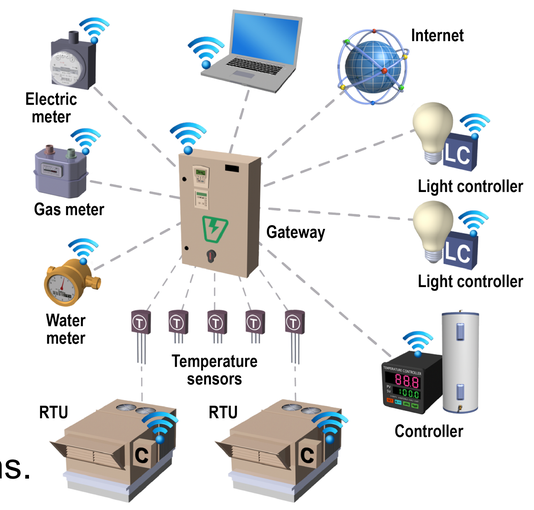
Develop and validate an automated energy management software (AEMS) system to continuously optimize energy consumption and cost of SMBs, including all-electric buildings, and provide a means for maximizing decarbonization benefits.



- **Not a hardware or controls platform development.**
- Targeted towards buildings without an automation system.
- Initially, the focus is on managing RTUs, but extensible in the future to manage other end-uses.
- Increase operational efficiency of SMBs by 20-25%.
- Increase demand flexibility of SMBs by 10-20%.

Objectives

- Cost-effectively increase efficiency and grid flexibility of the underserved SMB sector, resulting in significant energy, cost, and emissions reduction while maintaining occupant comfort.
- AEMS system must:
  - Be autonomous after initial user set up.
  - Provide user the ability to override certain actions.
  - Ensure persistence of building operations.
  - Be easy to deploy and configure.
  - Be extensible in the future to manage other end-uses.



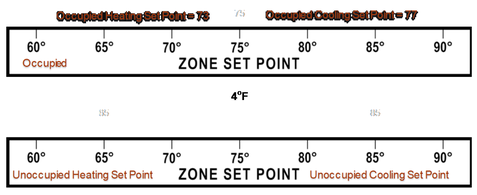
Approach

- **First year:** Working with project partner, the AEMS system will be specified and developed.
- **Second year:** AEMS system will be tested in a laboratory environment.
- **Third year:** Working with project partner, the AEMS system will be tested and validated in the field.

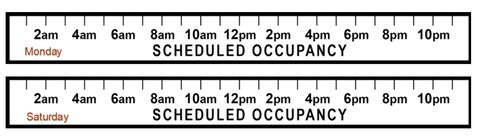
Impact

- Potential control solution for 85% of commercial buildings lacking automation system.
- Widespread deployment of the AEMS system will result in source energy reductions between 2,000 and 2,500 Trillion Btus and emission reduction between 2.4 and 3.0 $MMTCO_2$

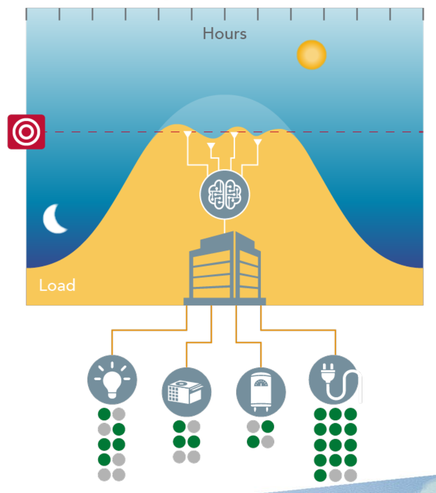
1 Managing Set Points



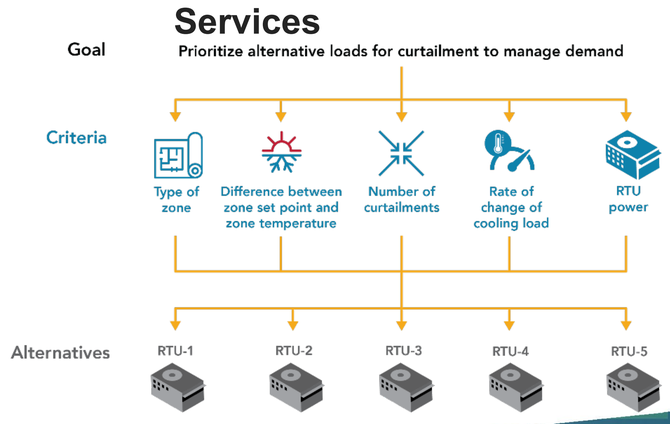
2 Managing Schedules



3 Intelligent Load Control



4 RTU Coordination for Grid Services



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