

2024 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
BUILDING TECHNOLOGIES OFFICE

BTO Peer Review: Refrigeration Energy Management

Field Validation of an Integrated
Refrigeration Energy Management
Technology for Controls, Active
Demand Response, and
Continuous Commissioning in
Grocery Stores

Rhode Island Office of Energy Resources



Refrigeration Energy Management



Rhode Island Office of Energy Resources, National Grid, Axiom Cloud
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Project Summary

OBJECTIVE, OUTCOME, & IMPACT

Pilot intelligent forecasting and control of refrigeration systems, active demand response, and continuous commissioning for grocery stores and supermarkets. If successful, pilot will save an estimated \$400,000 in annual benefits to grocery stores through demand reductions and energy savings.



STATE OF RHODE ISLAND

**OFFICE OF
ENERGY RESOURCES**

TEAM & PARTNERS

Rhode Island Office of Energy Resources
National Grid – Utility Partner
Axiom Cloud – Technology Partner

STATS

Performance Period: 7/1/2021 – 3/31/2024

DOE Budget: \$987,560 Cost Share: \$473,164

Milestone 1: Minimum 15 stores recruited

Milestone 2: At least 15 sites are commissioned and are able to demonstrate an average of at least 15 kW in peak load reduction per site.

Milestone 3: Final Report to DOE



Problem

- Grocery stores are a typically inflexible load within electrical grids, largely due to the refrigeration systems that consume 60-70% of a store's energy
- These customers are also typically harder to reach for energy efficiency and demand management programs due to low capital availability, and tight profit margins, and a lack of technology that addresses the power inflexibility of their refrigeration systems
- With the more than 2,000 grocery stores across Rhode Island and Massachusetts, a load shifting potential of roughly 40MW to 100MW may be possible should this technology be widely accepted and deployed



Alignment and Impact

- The project will validate the performance of the technology partner's platform's ability to effectively reduce electricity bills and generate demand response revenue through monitoring and control of the site's refrigeration systems, particularly in the New England climate zone
- the project will verify demand reduction potential with an average of 15 kW in reduction during demand response events and total financial value of at least \$15,000 per site over the course of 12 months
- These criteria will indicate that the platform is viable and desirable for grocery store customers in New England, and continuous commissioning activity will indicate further opportunities for energy efficiency interventions, and consequent further energy savings
- Final report to DOE will include demand response and continuous commissioning performance data, customer value and savings documentation, and customer satisfaction survey data



Alignment and Impact

- Two percent of total U.S. emissions in 2023 came from refrigerants and fluorinated gases
- A 2015 National Renewable Energy Laboratory and Bonneville Power Administration study suggests 15 to 20 kW of load flexibility available per grocery store
- The USDA estimates about 50,000 total grocery stores in the United States, correlating to a load shifting potential of roughly 1 GW to 2.5 GW nationwide
- Equity – Grocery stores are essential in all communities and reducing operating costs can make it easier to maintain and open stores in potential food deserts
- Affordability – Grocers have tight profit margins (1.5% on average), and this could reduce energy burdens
- Resilience – Shifting energy load can help reduce peaks, improving grid reliability and grid stress
- Transforming the grid edge by tripling demand flexibility potential by 2050 from a 2020 baseline



Approach

- Utilities, such as National Grid, offer demand response programs such as ConnectedSolutions
- ConnectedSolutions is technology agnostic and can support a variety of opportunities for reducing peak demand
- Using innovative software solutions from our technology partner, Axiom Cloud, grocers are able to pre-cool and load-shed refrigeration assets to adjust power consumption on demand
- Our program and technology deployed is targeting the commercial sector
- This approach is 100% autonomous and has no impact on shoppers or day-to-day operations
- Participating customers are then able to receive financial benefits from their utility for participating in demand response programming



Approach

- Our program plan is to recruit 15-50 grocery stores in Rhode Island and Massachusetts to pilot this technology and demonstrate its value
- Project partners will then be able to explore opportunities for expanding this programming to other stores and regions
- A key barrier and risk is successfully identifying grocery stores willing to participate in a pilot program
- To help mitigate this risk, we are relying on trusted utility grocery store partners for outreach
- Benefits will be validated with energy savings data in both kwh and dollar values, and through estimated savings of issue mitigation from continuous commissioning from program partners

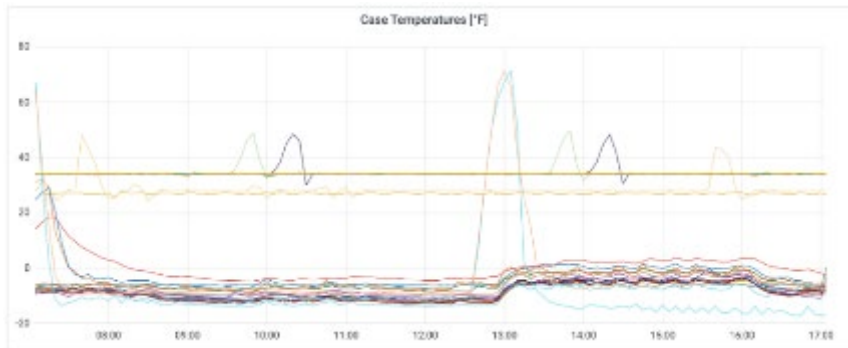


Progress and Future Work

- We are nearing program completion
- Program has successfully met goal of demonstrating At least 15 sites are commissioned and are able to demonstrate an average of at least 15 kW in peak load reduction per site
- 21 sites have participated to date
- Programming has also demonstrated significant customer savings through continuous commissioning and anomaly resolution
- Unexpected challenge – recruiting participants during Covid pandemic
- Over the coming months, we will be conducting a customer satisfaction survey and work on compiling a final report of our program results



Progress and Future Work



Low temperature cases at one site throughout a demand response event

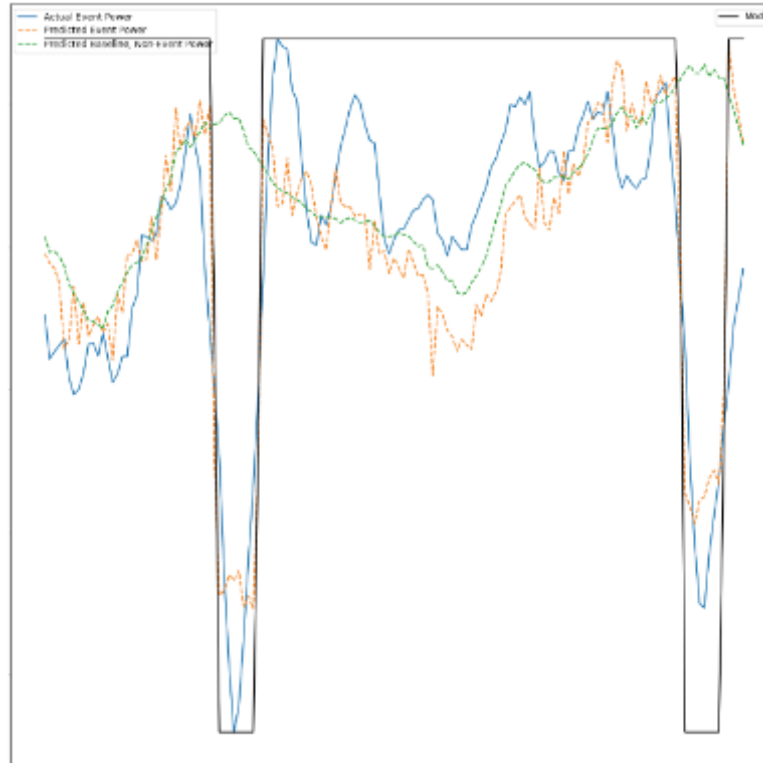


Run status of compressors during demand response event



Progress and Future Work

Load-shed data:
a plot of two days of
demand response
events.



Black Line - Indicates what mode the site was in. When it drops, it is indicating a demand response event.

Green Line - Baseline power trace

Blue Line - Actual power trace

Thank you

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Resources

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Reference Slides



Project Execution



	FY2021				FY2022				FY2023				FY2024			
Planned budget																
Spent budget																
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Past Work																
Q4 Milestone: Submit final draft of marketing materials																
Q2 Milestone, Go/No-Go 1: Submit record of customers with program agreements																
Q3 Milestone: Submit documentation of site acceptance tests																
Q4 Milestone: Submit documentation of successful commissioning																
Q3 Milestone: Submit report of continuous commissioning																
Current/Future Work																
Q3 Milestone, Go/No-Go 2: Submit comparison of customer bills before and during programming																
Q4 Milestone: Report documenting total value and savings for each site																



Team



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Rhode Island Office of
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Maxwell Halik

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Senior Product
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