Technology Innovation Project *Project Brief*

TIP 307: Demand Response for Retail Supermarkets

Context

Historically, the primary driver of supermarket refrigeration design has been to keep refrigerated display cases sufficiently cold to preserve perishable items. More recently, driven by energy costs and corporate sustainability initiatives, energy efficiency (EE) has become a key consideration.

Over the past 10 years, the implementation of advanced metering infrastructure (AMI, also known as the "smart grid") and centralized building energy management and control systems has allowed automation of demand response (DR) in lighting and HVAC systems.

In the case of supermarket refrigeration, DR has lagged because refrigeration typically uses a separate measurement and control system with limited Web-enabled communication and visualization capabilities, and because of concern that DR strategies could jeopardize product safety and integrity.

Nevertheless, building information and control technologies have advanced to the point that they are adequate to enable DR in commercial refrigeration systems, a substantial load that utilities can use to provide extra capacity and balance system loads.

Description

The project will demonstrate technologies and controls for DR and EE in supermarket refrigeration systems using numerical modeling at the National Renewable Energy Laboratory (NREL) and field testing in the Pacific Northwest (PNW).

The project encompasses the entire refrigeration system, including compressors, condensers, and refrigerated case equipment such as anti-condensate heaters, lighting, fans, and defrost equipment. The scope also includes service water heating, which is closely related to refrigeration in supermarkets because refrigeration waste heat is often captured for service water heating. There will thus be a great deal of flexibility in shaping the overall system load shape— either increasing or decreasing loads—as required by BPA or the utility provider. The mix of loads also provides flexibility in terms of the DR time scale.

The project lowers the risk of adopting DR strategies in supermarket refrigeration systems. These systems represent a significant resource for adding grid capacity, increasing loads during light load hours, and balancing the grid.

Numerical modeling is used to assess feasibility of DR in supermarkets and to evaluate the potential DR and EE resources available in supermarkets.

The field tests will be carefully monitored to avoid any impact on the shopping experience of supermarket customers and to make sure that refrigerated items are kept cold enough to insure food safety. The results will provide high-quality data needed to assess the business case for DR in supermarkets and identify key practices needed to achieve successful outcomes.

Why It Matters

The project will provide compelling evidence that DR is feasible in supermarket refrigeration and represents a significant resource for BPA and utility providers. Successful pilot testing will lower the risk of adoption for supermarket owners, leading to broad application of the tested DR strategies.

Project results can be applied in supermarkets throughout BPA's grid wherever AMI has been installed. Supermarkets that have legacy control solutions will present a business opportunity to enable other controllers for automated DR. . This required technology development will lead to longer term application as DR in supermarkets diffuses through the market.

The project will demonstrate the same type of capacity and grid balancing benefits as other existing types of DR and therefore can be integrated into existing utility programs for incentivizing DR.

Goals and Objectives

The goal is to demonstrate that substantial DR and energy savings are achievable in supermarket refrigeration systems and that the integrity and safety of refrigerated products will be maintained to minimize risks to supermarket owners and customers.

The project aims to achieve two main objectives:

1. Analyze supermarket refrigeration energy loads in the Pacific Northwest in the context of both DR and EE, leveraging previous data collection and numerical modeling projects in supermarkets. The purpose is to identify the most promising control strategies and technologies that can yield energy savings and DR (increased and decreased loads) as part of an integrated energy management approach.

2. Evaluate the performance of the control strategies and technologies identified in the energy modeling studies by field testing them in real supermarkets, carefully documenting best practices and lessons learned for BPA, utility providers, and supermarket owners.

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Project Start Date: December 1, 2013

Project End Date: September 30, 2015

Funding

Total Project Cost:	$891,581
BPA Share:	$445,781
External Share:	$445,800
BPA FY2014 Budget:	$265,538

Reports & References (Optional)

Links (Optional)

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Participating Organizations

National Renewable Energy Laboratory
Whole Foods
Emerson
Parasense