CASE STUDY

COLD STORAGE DEMAND RESPONSE

Against the Grain goes into the green.

Collaboration taps cold storage for flexible load management program and energy savings.

Background

Operating out of Brattleboro, Vt., Against the Grain (ATG) is a producer of gluten- and grain-free pizzas, bagels and breads. Their factory contains cold storage facilities from which they distribute frozen foods to food retailers throughout the country. At any given moment, their walk-in freezers are stocked with gluten-free pizzas and frozen inventory worth millions of dollars.

Operating in Vermont provides opportunities to participate in the state's advanced energy management programs, which are helping to balance significant renewable energy resources and smooth peak electricity demands on the grid. For several years, ATG had been engaged in a flexible load management (FLM) program with a local utility, Green Mountain Power (GMP) — primarily leveraging the factory's HVAC system in dynamic demand response events.

During a refrigeration system tune-up, service technicians and energy management stakeholders explored the opportunity to include cold storage refrigeration into the existing FLM program. Doing so would require a robust refrigeration controls architecture capable of providing grid interactivity while maintaining refrigeration reliability.

In late 2023, three walk-in freezers were targeted as test assets for a proof-of-concept pilot. Copeland's Corey Wheat, business development manager for energy and utility solutions, was invited to participate, which led to a collaboration of multidisciplinary stakeholders, including:

- **Copeland** — The provider of E3 supervisory control and Copeland Load Management grid interactivity app, with expertise in leveraging refrigeration in demand response programs.
- **Dynamic Organics** — A smart grid software solutions company, providing distribution utilities FLM platform services. They also supply commercial and industrial customers like ATG with grid-edge software services to enable FLM from HVAC and other process loads. Morgan Casella, managing partner, served as the utility integration lead responsible for configuring software that connects HVAC and refrigeration assets to the grid.
- **Turner Piping and Refrigeration** —An energy, HVAC and refrigeration contractor/servicing company, founded and led by Sam Major.
- **VEIC** — A national clean energy nonprofit that delivers high-impact energy solutions focused on equity and innovation, led by Bill Karis, engineering/energy consultant.
- **Efficiency Vermont** — A statewide energy efficiency utility operated by VEIC, clean energy and energy management consultants led by Dave Adams, senior customer engagement manager.

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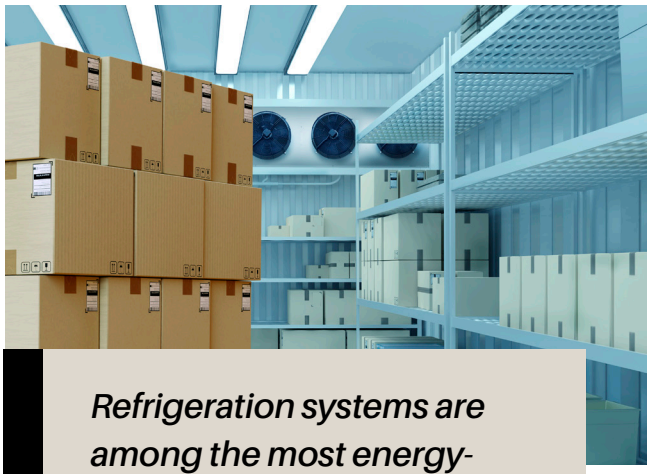
As a national leader in renewable energy, Vermont's in-state electricity generation comes almost entirely from renewable sources, and many utilities already have 100% renewable energy supply portfolios. In addition to regional and in-state hydropower, Vermont was an early adopter of solar photovoltaic (PV) energy systems and has seen significant growth of distributed generation over the last 15 years. Installations of heat pumps for space heating and conversions to electric vehicles have also increased in recent years, both of which risk increasing peak demands on the grid if left unmanaged.

GMP's FLM program is an example of a best-practice, least-cost method that grid operators can use to support beneficial electrification through grid-interactive flexible management of end-use equipment.



Refrigeration systems are among the most energy-intensive equipment in retail and cold storage facilities.

Challenge

Although refrigeration systems are among the most energy-intensive equipment in retail and cold storage facilities, operators have been reluctant to include refrigeration in demand response programs because of food safety and quality concerns. For ATG to add cold storage to its existing FLM program, it would need assurance that its perishables were not at risk.

To add to the challenge, the existing refrigeration system was still operating using its original mechanical controls architecture. Not only would an upgrade be needed to enable grid interactivity and manage demand response events, but it would also need to provide remote visibility to freezer status, setpoints and alarms.

From a power generation or grid-interactivity perspective, many utilities are simply unaware that technologies and safeguards exist to leverage refrigeration in demand response programs. However, with proper controls in place, both retail refrigeration — such as medium-temperature cases and walk-in coolers — and cold storage systems (i.e., freezers) can be included in these programs.

As a result, this cold storage pilot program represented a proof of concept for retailers, producers and utilities seeking to validate the emerging potential of shedding energy loads in refrigeration.



Solution

Copeland offered its deep energy management expertise and advanced controls to help facilitate the collaboration of regional stakeholders. Wheat said that the focus on cold storage was a unique application that offered inherent advantages.

"Due to the existing thermal mass of frozen product, we're exploring the built-in potential for demand response in cold storage facilities," he said.

As part of the refrigeration overhaul, Sam Major of Turner Piping needed to upgrade the freezers from traditional mechanical controls to a modern Copeland controls architecture, including: the E3 and Site Supervisor controls, and the CC200 case controller.

In particular, the E3 supervisory control and Copeland Load Management app were essential to enabling demand response capabilities in the refrigeration pilot program. Compared to the patchwork configuration of previous mechanical controls systems, Major said that the modern Copeland controls scheme was a robust upgrade.

"Copeland allowed us to streamline the controls into one simplified, connected system," he said.

The E3 provided visibility to refrigeration assets and alarms via remote monitoring, while anchoring the FLM program with its ability to adjust setpoints based on demand response events.

DO spearheaded the task of integrating refrigeration assets into the existing FLM program, which was previously enabled for HVAC only. During the summer of 2024, Cody Druschel, master systems integrator, configured DO's existing grid-edge software to communicate with the E3 and the Copeland Load Management app.

"Once we got communication dialed in between the Copeland app and our software, we could start exploring load shedding opportunities for the freezers," he said.

The cold storage load shedding solution was based on a pre-cooling and coast model. During the pre-cooling period when the utility has a high availability of solar power, setpoints were lowered to pre-cool the product. Then, during the utility's peak demand period, setpoints were raised above the setpoint baseline, essentially resting the refrigeration assets and coasting on the stored energy of the frozen product's thermal mass. Once the utility's peak demand period ended, the refrigeration would return to its normal setpoint operation.

Throughout each phase, the E3's Copeland Load Management app controls the refrigeration setpoint changes: pre-cooling, load shedding and stabilization. DO's grid-edge controller integrates with both the ATG HVAC management system and the Copeland E3 to provide monitoring and control of these distributed resources to grid operators like GMP.

To maintain ATG's food quality standards, Casella said the team conducted significant testing on the impacts of setpoint changes.

"We did a lot of testing regarding what our setpoints were going to be, in terms of how far we could lower the temperature and how long we could coast and still maintain quality," he said.

Major explained that in addition to the setpoint changes, the E3 enabled them to strategically coordinate defrost cycles with the FLM program.

"If you're shutting the coolers down four times a day to defrost them, then it makes the most sense to do that during load shedding events," he said.

Results

Participation in the FLM program drove rate-based benefits from the utility to ATG. The more they participated, the more their rates/charges were lowered. The cold storage pilot proved that the two primary goals of the program were achieved:

1. Lowering energy consumption during peak periods

2. Maintaining reliable refrigeration throughout demand response events

Collectively, the team was thrilled with the success of the pilot.

"Leveraging the availability of freezer loads as a flexible asset makes a strong business case for using E3 controls," said VEIC's Bill Karis.

From ATG's perspective, Casella said that the E3 provided a level of assurance to add cold storage to the FLM program without compromising its food quality standards.

"They were perfectly comfortable with moving setpoints because of the insight and awareness provided by the E3," he said.

After participating in the pilot, it was clear that adding cold storage to the FLM program lowered ATG's energy rates and saved energy in the process. According to Efficiency Vermont's Dave Adams, their energy cost savings were substantial. The efficiency measures alone saved roughly $55,000 annually. By combining HVAC and cold storage, his team estimated that ATG can now shed up to 20 percent of its power demand during peak grid events, saving an additional $20,000 a year. Between the FLM program and efficiency gains from improved control of the refrigeration system, ATG's collective efforts will save the company up to $75,000 annually.

Wheat explained how this proof of concept is a compelling business case for utilities exploring the potential of load shedding in cold storage facilities.

"Because frozen foods offer more thermal mass, we've shown that we can be even more aggressive with extended load shedding periods," he said.



Lowered energy consumption during peak periods



Maintained reliable refrigeration throughout demand response events



***20%** reduction in power demand during peak grid events*



***$75,000** yearly savings*

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