Carl's Jr. Installs Demand-Based Defrost Controller

CASE STUDY

Freezers and Coolers Bring Energy Cost Savings to CKE Restaurants

With more than 3,300 restaurants in 42 states and in 28 countries, CKE Restaurants, Inc. owns, operates, and franchises some of the most popular brands in the quick-service restaurant industry, including Carl's Jr.®, Hardee's®, Green Burrito®, and Red Burrito®. The business is committed to environmental responsibility, and is dedicated to reducing its energy consumption.

To advance its commitment to cutting energy waste, CKE, in collaboration with Southern California Edison's (SCE) New Products Development and Launch (NPDL) organization, field tested an advanced demand defrost control system for walk-in coolers and freezers in their Carl's Jr. restaurants.

"CKE is very committed to the long-term sustainability of our environment, wherever economically feasible."

—Juliann Rogers, Director of Energy, CKE

Energy Savings: Technology That Makes it Possible

Energy savings were 30% for the cooler and 11% for the freezer, which represent savings of 2.86 kWh/day and 7.18 kWh/day, respectively. (See Table 1S)

A conventional defrost controller operates the defrost heaters on a fixed schedule and terminates defrost when the coil reaches a set temperature. Defrost scheduling is used to prevent excessive frost build-up under worst-case conditions.

However, for many applications, this simplistic defrost scheduling exceeds the actual heat necessary to melt the accumulated volume of frost. The demand defrost control system instead adjusts the defrost cycle to the amount of frost that has accumulated. The controller first checks operating efficiency based on coil and air temperature, and then starts the defrost cycle only when the efficiency drops below a pre-determined point. The controller modulates defrost heater operation to avoid hotspots (which contribute to fogging and icing) and terminates the defrost cycle based on coil and air temperatures. This results in fewer and shorter defrost cycles, which manifests as reduced energy consumption compared to conventional control of resistance defrost heaters.

A Carl's Jr. restaurant (photograph courtesy of CKE Restaurants).

PROJECT SNAPSHOT

- The field test showed 11% to 30% reductions in walk-in energy consumption
- Reduced daily defrost cycles from 4 to 3 (typically)
- Retrofit with the demand defrost control system is technologically feasible and can provide encouraging financial paybacks
- More uniform walk-in temperatures help protect temperature-sensitive products

Table 1. Total Energy Savings for Walk-in Coolers and Freezers

	Cooler	Freezer
Savings Percentage (%)	30	11
Savings (kWh/day)	2.9	7.2
Savings (kWh/year)	1045	2622
Savings ($/year @ $0.15/kWh)	157	393

In addition, the controller operates the evaporator fan during the compressor off-period to extract additional refrigeration from the frost and cold coil, which reduces the compressor on-time and saves energy. By optimizing cooling strategy, using the evaporator fan to extract more cooling, and reducing defrost cycles, temperatures inside the walk-ins are more stable, which helps protect temperature-sensitive inventory.

Field Test at Carl's Jr.

Technicians at SCE first conducted a service check on the existing equipment at CKE's Huntington Beach, Calif., Carl's Jr. restaurants to ensure that it was well tuned to properly reflect baseline system performance. Field technicians then collected pre-retrofit data, installed the demand defrost control system on both walk-in coolers and freezers, and collected post-retrofit data.

SCE recorded air properties, door-opening status, and energy usage. The air temperature and relative humidity were measured at the inlet of the condenser, near the inlet of both cooler and freezer evaporators, and in the return air duct of the condensing unit.

SCE collected baseline data for about three months (from February to April 2015), and post-retrofit data for about six months (from May to October 2015). They analyzed the data using two approaches: 1) comparing before-and-after energy consumption trends plotted as a function of outdoor air temperature; and 2) direct before-and-after comparisons at similar outdoor conditions.

Economic Considerations

The cost of the advanced control system hardware is $800-$900 per unit depending on the applications and accessories. SCE estimates that installation labor cost can range from $500-$1,500 per unit, depending on complexity of installation.

Using the energy savings presented in Table 1 and utility incentives available to this restaurant,* payback periods are 7-8 years for the cooler and 2-3 years for the freezer (see Table 2). Freezer payback is shorter because the absolute energy savings are higher than for the cooler.

Table 2. Typical Payback for Walk-in Coolers and Freezers

	Cooler	Freezer
Payback with Incentive (Years)*	7 – 8	2 – 3
Payback without Incentive (Years)	8 – 9	3 – 4

*Based on $800-$900 for equipment, $500 for installation labor (assumes straight-forward installation), $0.15/kWh electricity cost and $0.15/kWh utility incentive on first year's savings. Energy savings, electricity costs and utility incentives are specific to this location.

Benefits Beyond Energy

In addition to the energy cost savings, non-energy benefits include fewer temperature excursions in the cooler or freezer that could degrade temperature-sensitive food products.

"Besides energy savings, reducing ice buildup and the associated risk of falls is also a key driver."

—Juliann Rogers, Director of Energy, CKE

Looking into the Future

If this new control system is installed on CKE's freezers at 150 Carl's Jr. restaurants, savings would be approximately 390,000 kWh annually (about $58,500). For the coolers, savings would be approximately 150,000 kWh annually (about $22,500).

CKE plans to expand this pilot program to 10-15 sites in various locations with varying freezer layouts. They are also adding a module that will allow them to monitor data collected on their EMS dashboard. If pilot testing continues to go well, CKE sees a good fit for their corporate and franchised sites.