

Case Study: Use of the Ecoflex Cooler/Freezer Door at Steak and Shake

Steak 'n Shake is an American casual restaurant chain located primarily in the Midwestern and Southern United States with locations also in Mid-Atlantic and Western United States and Europe. There are 544 locations, of which 417 are company-operated and 127 are franchised. Many Steak 'n Shake restaurants are open 24 hours a day, seven days per week. The menu features primarily hamburgers and hand-dipped milkshakes.



The Problem

Like many restaurants, Steak and Shake locations have substantial energy costs, which have only risen in recent years. The company is always seeking a better understanding of consumption patterns and where to invest to reduce energy consumption and costs. Steak and Shake wanted to learn how their locations could consume less energy, not only to benefit the bottom line, but also the environment. In food service applications like Steak and Shake, walk-in coolers and freezers are used for storage of fresh and frozen food. Walk-ins are kept at different temperatures depending on the contents. There are two major classes of walk-ins:

- 1) Coolers - Medium refrigerated space temperature (10° to 38° F)
- 2) Freezers - Low refrigerated space temperature (0° to -20° F)

Steak and Shake locations typically have one walk-in cooler and one walk-in freezer in each location. They are used to store the food (beef, chicken, vegetables, and dairy products such as ice cream for milkshakes). The staff receives incoming supply trucks

throughout the week and enters the walk-in cooler and freezer throughout the day to retrieve food items in short supply in the kitchen.

Each time a staff member opens the insulated metal door to the cooler or freezer, cold air escapes into the kitchen and warm air from the kitchen infiltrates the walk-in. The temperature in the walk-in rises accordingly. It's important to understand the way a walk-in cooler or freezer works in cycles. Each walk-in cooler has a set point and a differential. The thermostat's set point is the temperature at which the air is no longer substantially cold enough to maintain the food at proper temperatures. When the temperature has risen to the set point, the thermostat signals the compressor, condenser fans and evaporator fans to come on.

The differential is the number of degrees below the set point that the walk-in must reach before the thermostat cuts the compressor and the fan motors off. Slowly, heat is absorbed through the walls, from door openings and from the products inside the walk-in, causing the temperature to gradually rise again. When the doors are open, warm air infiltration accelerates the rise in temperature. When the temperature reaches the limit of the differential, the thermostat calls for cooling again.

According to a report by the US Department of Energy, walk-in coolers and freezers account for 15 to 20 % of the total energy consumption in a typical food service application. With such a large share of its energy consumption going toward walk-ins, Steak and Shake was interested to learn more about the energy savings potential of various technologies and equipment. Specifically, the company wanted to learn how the use of a bi-parting flexible PVC swing door could help to reduce energy use by preventing the escape of cold air from the walk-ins while the insulated metal doors are opened for loading and unloading.



Clearway, the world's leading supplier of flexible PVC door products, agreed to participate in an energy savings test to determine how their Ecoflex Walk-In Cooler/Freezer door could impact the energy consumption in a typical Steak and Shake walk-in application.

The Test

Clearway performed the two month test over two subsequent 30 day periods from December 2016 to February 2017 at Steak and Shake's Hoover, Alabama location. Clearway engineers conducted the test under the supervision of Steak and Shake management and with the assistance of a third-party independent electrical engineer.

In order to isolate the energy consumption of the walk-in, the independent electrical engineer (Thobias Marandu) installed a DAE sub-meter. Sub-meters are used to isolate the energy consumption of a specific appliance. The sub-meter was installed by disconnecting the current temporarily from the breaker box, routing the wires through a set of solid core current sensors (CTs), and reconnecting them to the breaker box.

The Results

Start Date	End Date	Start	Ending	Days	Total Change	Change Per Day	Kwh Saved
12-12-16	01-11-17	13450.4 KWh	14857.6 KWh	30	1407.2 KWh	46.91 KWh	218.2 KWh
01-18-17	02-17-17	15201.4 KWh	16390.4 KWh	30	1189.0 KWh	39.63 KWh	

Using the sub-meter, engineers recorded the energy consumption (kWh) of the walk-in freezer (Kolpak Model #5171409) for a period of 30 days, without the Ecoflex Walk-In Cooler/Freezer door installed. Then after the installation of the Ecoflex Walk-In Cooler/Freezer door, the same sub-meter device was used to record energy consumption (kWh). This walk-in has a temperature set point at 0 degrees. The dimensions of the walk-in are 8' x 16' x 8'6".

At the conclusion of the testing period, engineers gathered and analyzed the data that had been collected.



Observations

The results indicate that the presence of the Ecoflex Walk-In Cooler/Freezer door prevented the infiltration of warmer air into the walk-in freezer when staff members opened the door. As a result, the thermostat didn't activate the compressor and fan motors as often and the walk-in didn't require as much energy during the second 30-day period, with the Ecoflex in use. The actual reduction in energy consumption between these two 30 day periods was 218.2 kWh (Annualized at 2654.8 kWh per year).

According to the US Department of Energy, the typical new self-contained walk-in freezer has an annual energy consumption of 194.1 (kWh/yr/ft²)(see breakdown below):

US Department of Energy

Component	Energy Consumption	
	(kWh/yr)	Energy Consumption per Area (kWh/yr/ft ²) ³
Compressor	8861.0	110.8
Evaporator Fans	1577.0	19.7
Condenser Fan	2017.0	25.2
Coil Defrost	548.0	6.9
Drip Pan Heater	183.0	2.3
Anti-Sweat Heater	2015.0	25.2
Lighting	324.0	4.1
TOTAL	15525.0	194.1

*Source: US Department of Energy

Based on the US Department of Energy study, the walk-in freezer at Steak and Shake would have a monthly energy consumption of 24,845 kWh (194.1 x 128 ft²). The two month study with and without the Ecoflex revealed a savings of 218.2 kWh per month.

The 2016 average cost of each kWh of energy consumed in the commercial sector in the United States is \$.1008 (source: US Energy Information Administration www.eia.gov). Using 2016 averages, we can estimate the achievable cost savings with the use of the Ecoflex Walk-In Cooler Freezer Door .

Energy Cost Savings Estimate

Average Energy Cost per kWh:	\$	0.1008
Energy Savings (kWh/month)		218.2
Energy Savings (\$/month)	\$	21.99*
Energy Savings (kWh/year)		2618.4
Energy Savings (\$/year)	\$	263.93*

*Results based on average energy cost per kWh of \$.1008. All situations are different and actual savings could be more or less depending on your average energy cost per year. Consult your energy bill or local energy company to determine your cost per kWh.

