

Minimizing Air Infiltration To Save Energy

Optimizing Refrigerators To Reduce Heat Load

TKS + 

Executive Summary



Opportunity

The average Walmart Supercentre incurs energy and utility costs of approximately \$420,000 a year. This cost can be brought down.



Solution

Install doors on doorless refrigerators to reduce air infiltration inefficiencies. This reduces the heat load refrigerators have to support, saving energy.



Impact

A more comfortable experience for the customer, \$15 million in savings per year, and improved PR.

The Problem

Open Refrigerators Are Inefficient

More heat infiltration

Doorless refrigerators typically cool the products inside to temperatures $< 4^{\circ}\text{C}$ while the rest of the store is kept at temperatures around $20\text{--}23^{\circ}\text{C}$. This causes two-way air infiltration.

High heat load

Right now, doorless refrigerators have a higher heat load meaning they have to use more energy to keep the fridge at optimal temperature. Estimates show that most fridge compressors use 75% of their energy just to deal with this infiltration. This also goes for the stores heating systems that have work to keep the store at a comfortable temperature.

Higher energy costs

Walmart currently uses industrial refrigerators from two different companies: Hussman and Hill Phoenix. We contacted these manufacturers and found that, on average, doorless refrigerators used 37 kWh per day. To put this in perspective, the energy cost for 60 doorless refrigerators would amount to about \$80K a year to operate per store.



The Solution

Retrofit Doorless Refrigerators With Doors

Increased Efficiency

Retrofitting existing refrigerators with doors could **reduce the heat load by 75%**. This means that the refrigerators' compressors could operate at only 11 kWh / day, as a direct result of reduced heat infiltration.

Big Savings & Fast ROI

The average Walmart supercentre has approximately 120 refrigerator units. Typically, about 60 of these are open and 60 are closed. By retrofitting even 40 of the 60 doorless fridges (per store) to have doors, Walmart can save **\$15 million** on energy bills. Looking at the average price of a single retrofit, energy savings can produce a payback period of 2-3 years. Doors are also low maintenance and won't require heavy upkeep costs.

Improved Customer Experience

Open fridges cause the aisles they're in to be noticeably colder. Installing doors on these refrigerators would help make the shopping experience more pleasant and comfortable for customers. Additionally, initiatives that help save energy portray Walmart as an eco-friendly company.



Why This is a Real Problem

This is what is happening now



Inefficient compressor usage

Current doorless refrigerators allocate 75% of their compressor energy to deal with heat loads caused by infiltration from outside air.



High annual energy consumption

Each store has approximately 120 fridges. 60 of those are open fridges functioning at the average of 37 KwH/day and 60 doored fridges functioning at 11 KwH/day. That's equivalent to 1 Million KwH of energy a year per store.



Increased energy costs

Energy prices vary across Canada, however, the average energy cost is around 10 cents/Kwh. Using the figure for annual energy consumption for all supercentres in Canada, energy bills for refrigeration are approximately 35 Million dollars annually.

This is how Walmart could benefit



Optimized compressor usage

Compressors in closed refrigerators only use 20% of their energy or less to deal with infiltration caused by opening and closing the doors.



Low annual energy consumption

By converting the 60 open fridges running at 37 KwH/day to doored fridges running at 11 KwH/day, annual energy consumption drops to 475,000 KwH a year per store.



Less spent on energy

At the lower rate of energy consumption, energy bills for refrigeration can drop to 17 million dollars annually which would lead to savings of 15 Million dollars in energy costs.

Moving Forward

Here are 3 options of potential retrofit kit suppliers that have experience with door retrofits. Most kits fall around the \$2000 mark (assuming same shelving and lights are kept). Depending on the scale of the retrofit, costs can reach \$37 million dollars but that would also mean increased savings and a complete payback in 2-3 years.



Benefits

- + Existing relationship with Walmart as refrigerator supplier.
- + Supplies "SweatMiser," a high efficiency compressor management system.
- + Has a program dedicated to reducing refrigeration costs known as the Energy Lock program.
- + Contact form submitted on website [Energy Lock inquiries](#)



Benefits

- + Existing relationship with Walmart as refrigerator supplier.
- + "EcoVision doors provide same amount of visibility and lock open to allow for efficient stocking
- + Large variety of doors adaptable to different sizes of fridges..
- + Contact form submitted on website [EcoVision Doors](#)



Benefits

- + Specializes in retrofitting fridge doors to increase energy efficiency.
- + "Eliminaator" doors use best energy efficient technologies for a higher price. This includes argon glass panels to minimize heat transfer.
- + Contact form submitted on website [Eliminaator doors](#)



Considerations

Variable energy costs



In the calculations, an average energy cost of 10 cents/KwH was used. However, energy costs vary by region and times of use.

Number of existing open fridges



Not all supercentres will have exactly 60 open fridges and 60 closed fridges. Some will have more/less and that would affect the returns gained from this investment.

Unpredictable air behavior



Heat loads on compressors were best scientific estimates since the thermodynamics of air are unpredictable.

Effect on HVAC



We are making an assumption that the reduction in heat infiltration would also reduce the heat load that Walmart's HVAC systems would have to take on, meaning more money saved but we could not find data to back this up.

Personal Note



We want to thank the Walmart team for creating this opportunity for us and taking the time to read our ideas. Thanks to this challenge, we learned a lot about the retail industry and about how to approach solving difficult problems. Special thanks to Fareena for taking the time to answer our questions and validating our areas of focus. Hopefully our recommendation can impact Walmart's objective of delivering a great customer experience while maintaining a low cost operating model. Feel free to contact us for more information and connect with us on LinkedIn!



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