SAM’S CLUB

THE NEED FOR SPEED DOORS

8 HIGH SPEED DOORS IN 30 STORES

~22 MILLON POUNDS OF C02 *SAVED* PER YEAR

= 2,000 CARS OFF THE ROAD A YEAR

$3 MILLON SAVINGS PER YEAR

$17 MILLON NET PRESENT VALUE

Our focus is to reduce the stress of the HVAC & refrigerator systems at Sam's Club stores by installing automatic high-speed doors (operates 17x faster than automatic sliding doors) that will keep highly temperature-controlled areas more sealed and improve temperature and moisture control. This proposal is for the 30 new Sam's Club stores opening in the next few years to avoid costs with retrofitting stores to install the doors. We have targeted 8 doors - both exterior doors and interior doors. The exterior doors we seek to replace are Curbside Pickup (CPU) and Delivery from Club (DFC). The interior doors are CPU Cooler, CPU Freezer, Cooler to Freezer, POS Cooler, POS Freezer, and the rear door of the produce shop-in area. Conventional doors open and close slowly and are subject to breakouts, obstructions, and manual hold open, leading them to needlessly be open for long periods of time. Speed doors open and close quickly, are not subject to breakouts, and able to self-repair in case of an obstruction. By keeping doors closed for longer we reduce HVAC usage, save energy, and decrease carbon production. Rolling this out to each of the 30 new clubs proposed results in a carbon savings of 21,611,244.58 pounds per year.

Motivation and Background

Sam's Club is a membership-only warehouse-style store that provides a large selection of groceries, household essentials, electronics, and other merchandise in bulk at cheaper prices. Sam's Club values sustainability and, in conjunction with Walmart, has targeted to reach zero emissions by 2040. Key initiatives include a 100% transition to renewable energy by 2035, electrification of all transportation vehicles by 2040, and the adoption of low-impact refrigerants and electrified heating by 2040 (Walmart).

The Carbon Reduction Challenge is an initiative organized by Georgia Tech that challenges interns to find carbon savings within their companies. After coming up with an idea, interns must collect data and calculate carbon savings, cost of the project, and the payback period. Participants share their findings with their company with the goal of the company implementing the recommended changes.

At the beginning of the summer our team started by brainstorming ideas to make Sam's more sustainable. We then met with Sam's Club leaders in sustainability to receive feedback. We saw reducing the use of refrigerants as a huge potential for improvement and decided to target this area. From conversations with the Prototype Development team, we learned about the existing efforts to replace refrigerants, so we sought another angle. We instead decided to investigate how efficiently refrigerants were being used. We found a report relating to this done by DH Pace, a door products and services company. They installed IoT devices on Walmart store doors to track how long they were held open, errors, breakouts, and obstructions. The analysis had been done by DH Pace to promote their service of repairing doors when an error was known or a new solution of installing of high-speed doors. We thought this was a great solution for Sam's Club associate facing doors and worked closely with DH Pace and Jon Chaufty from the Prototype Development Team to create a business case. We had the opportunity to tour a Sam's Club with Jon and learned that many doors to highly temperature-controlled areas like freezers were left open for long periods of time when stocking. We see significant potential in this project and believe Sam's should move forward with implementation immediately.

Carbon Reduction Calculations

To calculate the carbon reductions, we had to understand the reduction of stress on the HVAC system with implementing these doors. To find that we needed to understand the heat transfer allowance of the old doors versus the new doors. We used three key equations to calculate the heat transfer. First, we considered sensible heat: the energy associated with temperature change. Since temperature changes both when the door is open and closed, we needed two calculations to account for both situations. Additionally, we considered latent heat: the energy associated with moisture change. Since moisture only changes when the door is open, we only considered latent heat for the time the door is open.

- $Q_{Sensible\ Open} = 1.08 * \dot{V} * \Delta T = 1.08 * 50 * A * \Delta T$
- $Q_{Sensible\ Closed} = \frac{1}{R} * A * \Delta T$
- $Q_{Latent\ Open} = 4.5 * \dot{V} * \Delta T = 4.5 * 50 * A * \Delta T$

Variables used:

- Door Opening Dimensions (A): We needed to know the size of the door opening to calculate how much area heat and moisture would flow through.
- R-Value (R): This value quantifies the insulation quality of the door. Higher R-values correspond to doors with better insulation.
- Interior/Exterior Temperature(ΔT): Heat transfer increases as the difference between interior and exterior temperature increases.

Special Cases:

- Sectional Door: Exterior speed doors need to be properly secured at night with a sectional door. This provides additional insulation which must be accounted during the hours when the store is closed. We performed separate calculations of sensible and latent heat for night and day.
- Air Door: Some doors include an air door which blows air across the door opening when it is open. The Air door's efficiency is the percentage of heat prevented from passing through the open door when it is in operation. For sensible and latent heat when the door was open Q was multiplied by the efficiency of the air door.

The units of sensible and latent heat are BTUs per hour. We next found exactly how many BTUs were used by each door per day using the following formula:

- $BTUs = (Hours\ Open) * \left(Q_{SensibleOpen} + Q_{LatentOpen}\right) + (Hours\ Closed) * Q_{SensibleClosed}$

Variables Used:

- Open/Close Time: We calculated the rate of heat transfer for when each door is open and closed. We used open and close time to calculate the exact amount of heat that is transferred overall. For some of the doors, we had tracking information and estimated open and close time as an average of all locations. For the door where we tracking information does not exist, we worked with an engineer to create estimates. We also had several meets with our mentor and other key players to encourage the additional installation of door tracking devices.

Special Cases

- Sectional Door: We calculated BTUs for day and night separately and summed the results to find the BTUs per day.

Now that we have BTUs, we can convert it to pounds of CO2 by first converting the BTUs to kWh.

- $kWh = BTU * 0.000293071$

Then we can convert the kWh to CO_2.

- $CO_2 = kWh * 0.857$

Finally, we used the formula below to calculate the total pounds of CO2 saved for each store.

- $Total\ Pounds\ CO_2\ Saved = Total\ Pounds\ CO_2\ Old\ Doors - \ Total\ Pounds\ CO_2\ New\ Doors$

When considering the impact of implementing this at all 30 new stores, we found the final carbon savings of 21,611,244.58 pounds per year.

Cost Saving Calculations

To calculate the cost savings associated with installing high speed doors there are three components:

1. Initial Investment: The cost difference of the doors

Since this proposal is for stores that haven't been built yet, the only cost is the cost difference between the doors that would've been installed and the high-speed doors for the eight doors we are addressing. There are no costs associated with retrofitting openings to fit these new doors. The cost difference for all eight doors for one store is $150,966.70. Multiplying that across 30 stores, the initial investment required is $4,529,001.00.

2. Annual Cost Savings: Converting the carbon savings to cost savings

The annual cost savings are calculated by finding the difference in costs of the total kilowatt-hours used for the current doors and the high-speed doors. The kilowatt-hour difference per year for one club was 840,577.39 kWh. Using the national average for the commercial cost of a kilowatt-hour of 12.35 cents, the total savings in energy use for all 30 clubs per year would be $3,104,252.28 (EIA).

3. NPV, IRR, and Payback Period

The savings for implementing this project annually would be $2,270,027 after the investment. We determined the life of the project conservatively to be 14 years, which is when the warranty of the high-speed doors would expire. Taking this into consideration and using a WACC of 5.6%, the Net Present Value of this project is $17,101,275.03. This shows that the proposal is very profitable and a good solution for the company. The internal rate of return is 49.95% which is much larger than the WACC, also showing that the proposal is favorable. The Payback period of the project is almost 2 years. The life of a high-speed door ranges from 40-70 years versus the life of an automatic sliding door is 15-20 years. Since the life of the high-speed door is significantly longer, if we took the costs into perpetuity, installing high-speed doors would give $2,000 of savings annually. For more details please see the image in the appendix.

Co-Benefits

In addition to carbon savings, there are other benefits of speed doors.

- Maintenance: High-speed doors break less frequently than conventional doors and have a warranty of 1 million cycles (14 years of use). When a conventional door crashes into an obstacle it "breaks out" and remains in the open position until a switch is flipped. Unfortunately, the problem is frequently misdiagnosed as a broken door, and results in an expensive maintenance bill for a technician to simply flip a switch. Speed doors fix this problem by self-repairing after an obstruction, saving time and money.
- Safety: High speed doors have additional safety measures that often make them safer than conventional doors. The coiling door has a soft bottom and will not cause injury in the unlikely situation that it closes on an associate. Another safety issue is ice forming around the door entryway in freezers, posing a slipping hazard to associates. The ice forms when the moisture is let in from outside the freezer. The speed door will improve this problem because as the door is open for less time, less moisture and ice will build up in the freezers. The speed door will also improve visibility by removing the need for a strip curtain. Often, doors to coolers and freezers will need a strip curtain to help reduce ice formation, but these curtains reduce visibility and increase the likelihood of collisions (worse case is with a forklift). With the speed door the strip curtains don't need to be installed and this danger can be avoided.

- Labor Reduction: The automatic doors will reduce the labor of having to manually open doors or spend time waiting for doors to open. This will allow associates to better focus on their jobs and delighting the members. We estimated that an associate will save at least 3 seconds each time they open a CPU speed door compared to a conventional door. Considering Sam's Club's minimum wage of $15, this corresponds to $54,750 in wages per year for each club.

Anticipated Obstacles

A potential obstacle is a lack of associate adoption. Associates can hold the doors open by disconnecting the doors from the power source. Though the risk of the door being held open is reduced with a high-speed door, the possibility is still there. A thorough training session for the associates on the dangers and inefficiencies of holding the door open can avoid this obstacle.

Another potential obstacle is measuring success. There is insufficient data on how long the current doors are open for and their usage. Some of the doors we are proposing to change do not exist yet or are manual doors. We had to make predictions based on similar doors to estimate cost and carbon savings. For us to measure success, there needs to be IoT devices on all Sam's Club doors to get a more thorough understanding of how long doors are open for and its usage. There is work being done to understand how to track manual doors usage and what devices could be used. We worked with DH Pace, a door services and manufacturing company, to work on potential solutions for better tracking doors as they provided IoT devices on Walmart store. We met with DH Pace on a weekly basis to discuss details of the doors and to receive usage data on high-speed doors they are piloting in a few Sam's Clubs.

Next Steps

The first step would be to present the change initiatives for approval to leadership and implement the prototype and new club design. To date, we have presented our proposal to the VP of Real Estate and have worked closely with the Real Estate Prototyping team for this work to be carried out after our departure. The VP of Real Estate was very enthusiastic about our proposal and sought to learn more information. The Real Estate Prototyping team is developing a Change Initiative (CI) to present to the Leadership Council for approval. Following that step would include creating club operational procedures for the speed door operations. We need to understand the best method of automatically opening the door to limit the about of unnecessary openings. For example, using a sensor to detect movement to open the door might result in unnecessary openings, so a proposed solution is having a device carried by workers sensed by the door to enable it to open. The last step would be to create an education plan to educate the associates on the impacts of holding doors open and how to use a speed door.

References

https://corporate.walmart.com/newsroom/2020/09/21/walmart-sets-goal-to-become-a-regenerative-company

Electric Power Monthly - U.S. Energy Information Administration (EIA)).

Internal Sam's Club Documents

Internal DHPace Documents

Appendix

(1)

Cost savings from Implementing Carbon Neutral Suggestions				
NPV and IRR Analysis				
Initial investment	$4,529,001.00		Summary of Analysis	
Life of project (years)	14		NPV ($)	$17,101,275.03
Cost savings (pre-tax)	$3,104,252.28		IRR (%)	49.95%
Growth	0.00%		Payback (Years)	2.00
Required return (WACC)	5.60%	=G27		
Tax rate	30.00%			

(2)

WACC (required return) = D/V x R_D x (1-T) + E/V x R_E					
in $000s					
Firm Debt		165,820,000	R_D	0.05	
Firm Equity		79,230,000	R_E	0.1	
Total V (Debt + Equity)		245,050,000	Tax rate	30.00% =B8	
D/V	0.676678229 =C23/C25		WACC =	0.056015915	0.078984085
E/V	0.323321771 =C24/C25				

(3)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cost savings		3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252	3,104,252
(1) Cost savings x (1-T)		2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977	2,172,977
Depreciation expense		323,500	323,500	323,500	323,500	323,500	323,500	323,500	323,500	323,500	323,500	323,500	323,500	323,500	323,500
(2) Depreciation x T		97,050	97,050	97,050	97,050	97,050	97,050	97,050	97,050	97,050	97,050	97,050	97,050	97,050	97,050
(3) Initial Investment	$ (4,529,001)														
Total Cash Flows (1)+(2)+(3)	$ (4,529,001)	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027	$ 2,270,027
NPV	$ 17,101,275.03		Accept?	Accept		=NPV(B7,C17:P17)+B17									
IRR	49.95%		Accept?	Accept											

To calculate the NPV of this project, I used this formula:

$$NPV = \frac{R_t}{(1+i)^t}$$

First, I found the discount rate and calculated the $WACC$ (Weighted Average Cost of Capital) for Walmart. I used this formula to find the $WACC$:

$$WACC = (\frac{E}{V} * R_E) + (\frac{D}{V} * R_D \times (1 - T_C))$$

E = market value of the firm's equity
D = market value of the firm's debt
Tc = corporate tax rate
Re = cost of equity
Rd = cost of debt
V = E + D
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I found the total debt and equity that Walmart has (Sam's Club is under Walmart for all financials and considered R_D and R_E to be 5% and 10% respectively. The Tax rate I used is 30%. Plugging in these values, I found the $WACC$ to be 5.6%. You can see this in item 2. The second step in finding NPV is finding the net cash flow at time t. To do this, I add the depreciation expense and costs savings annually for 14 years (the life of the project). You can see this being done in item 3. Subtracting the initial investment from that total cost savings with respect to the $WACC$, I get the NPV of \$17.1M.