

W A F F L E H O U S E[®]



*“Long ago, Tom and Joe,
Planted little yellow seeds,
And watched ‘em grow.”*

Project Objective: Reduce the carbon footprint and energy expenditures for Waffle House restaurants in metro Atlanta by implementing a parking lot LED lighting retrofit program

Expected cost savings: \$20,120/year savings
Expected CO2 savings: 161,307 lbs CO2/year saved

Team: Scattered, Smothered, and Covered

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Carbon Reduction Challenge

The amount of CO₂ that we release into the environment has a major role in the issue of climate change. If we want to counteract the steady rise of global warming, we have to work together to reduce the amount of carbon that is released into the atmosphere. The Carbon Reduction Challenge is an 8-week project in which teams set out to create unique and effective ways to reduce the carbon footprint on varying scales. Teams that produce the highest carbon-saving results will receive a chance to travel to Washington, DC, to present their findings to legislative aides and/or lawmakers on Capitol Hill. The winning stakeholder will also get an opportunity to show the community the steps they have taken on television. The Weather Channel will be working with us on this project. We would love to partner with Waffle House, a staple in the Georgia Tech community, in playing a part in bettering our environment, while also reducing annual costs.

Purpose

This project is designed to analyze the amount of cost savings and carbon dioxide that

could be decreased by fitting specific Waffle House parking lot locations with LED (light-emitting diode) bulbs instead of high-pressure sodium lights (HPS). The selected 22 locations for this plan have been handpicked by the Research and Development Manager at Waffle House Inc., David Repp. This plan quantifies the electrical energy savings and detailed cost savings for the implementation of LED bulbs. All Waffle House locations are open 24 hours a day, all holidays, and seven days a week. The parking lot lights are timed to operate 12 hours a day, every day. Inventory of the light poles, on average, for these 22 locations varies from 4 to 5 poles with two bulbs per pole. Below, we compare the energy savings and CO2 savings associated with the parking light LED conversion, using the wattage difference between the LED vs HPS bulbs.



Fig (1) Information provided by ledlightexperts.com and 1000bulbs.com

What are high pressure sodium lights and why switch?

High-pressure sodium bulbs (HPS) are a type of gas discharge light bulb. The composition of the bulbs is unique. The tube is made of aluminum oxide, and inside the bulb, sodium metal is combined with other elements (like mercury) under high pressure. The bulbs evaporate the gas inside, into plasma, and this gives off light. The bulbs require ignition from a large voltage pulse and need additional voltage to operate. This voltage is balanced by a ballast that regulates the current. HPS lights require a significant amount of energy to run and thus making them more costly than other options like LED. The color of the light that radiates from HPS lights is a golden yellow and not a bright white. This is an unfavorable color for security purposes as security cameras have a hard time picking up clear images under a yellow light. The HPS bulbs contain small amounts of the toxic substance mercury, which poses a health risk to those who service the lights, and in the longer term, to the broader community.

Aiding the bottom line

Over time, there are significant financial and environmental benefits associated with switching from the less efficient HPS bulbs to the LED bulbs. The LED lights only require about a third of the wattage to function, which reduces power bill costs. Additionally, their lifetime is about twice that of the HPS bulbs, meaning they need to be replaced and maintained less often. Finally, the use of LED bulbs eliminates potential costs associated with proper disposal of mercury-containing HPS bulbs, while also eliminating potential mercury exposure of electrical workers. In summary, LED bulbs are much safer, cheaper, and last longer than HPS bulbs.

LED retrofitting process:

LED retrofitting kits allow consumers to keep their existing light fixtures, with the benefits of more efficient lighting, while also saving on costs. Two main types of light fixtures: Shoebox and Cobra Head. There are retrofit kits made for both. The standard kit usually comes with the LED itself, LED Driver, wiring, and mounting brackets. According to the vendors, the retrofitting process takes roughly 15-20 minutes, and can be easily done by maintenance workers who are already tasked with changing out the HPS bulbs.

LED replacement steps:

1. Ensure that the power to the light fixture is turned off.
2. Remove lamp and separate wiring from the ballast & capacitor.
3. Remove the ballast & capacitor from the fixture.
4. Attach the LED driver's mounting plate to the fixture.
5. Attach the LED driver to the plate.
6. Attach light brackets onto the LED and attach it to the fixture.
7. Attach power to the LED driver.
8. Attach wires from the LED driver to the LED.
9. Turn the power back on.

Methods and Calculations:

By following the methodology defined in, (T.M. Mahlia, 2011) , we are able to quantify the energy cost savings and reduction amount of carbon dioxide.

Calculations:

22 locations x 9 bulbs per location = 198 bulbs total

198 bulbs x 320Watts for HPS bulbs x 12hrs/day runtime = 760.32 kwh/day

376kwh/day * 365 days/yr = 277,516.8 kwh/yr

The same calculation for 120Watt LED bulbs = 104,068.8 kwh/yr

Difference between HPS and LED bulbs = 173,448 kwh/yr

Given electricity rate for Atlanta of 11.6 cents/kWh, cost savings = \$20,120/yr

Given 0.93lbs CO2/kwh in Atlanta, CO2 savings = 161,307 lbs CO2/yr

Given that the average American's CO2 footprint is 44,000lbs per year (MIT, 2008), the CO2 savings associated with the proposed retrofit is equivalent to the annual footprint of roughly 3.7 Americans.

Calculation of payback period:

LED retrofit bulbs=\$109.99 per bulb **bulk would be cheaper (1000bulbs.com)

Number of bulbs needed= 22 locations * 9 bulbs average= 198 bulbs total

Bulb cost= \$109.99 * 198 bulbs =\$ 21,778.00 total

Installation time= 20min per bulb * 9bulbs at 1 location= 180min = 3 hours per location

Normal working hours = 8 hours a day = 6 hours a day + drive time =2 locations a day

For 22 locations at 2 per day installed = 11 days ~ 2 weeks for total installation

Truck (bucket, 60 ft) Rental = \$700 per week = \$1400 total

Hourly pay (maintenance worker) ~\$16.50per hour * 11 days of 8 hours shifts= \$1452.00 total

Total upfront cost: \$24,630.00 **covered by Ga Power in exchange for a 2 year lease on selected locations. (David Repp confirmed 5/2)

Year 1 projected savings = -\$4510

Year 2 projected savings = \$15,610

Year 3 projected savings = \$ 20,120 *savings for following years

Fig (2) projected savings and payback period

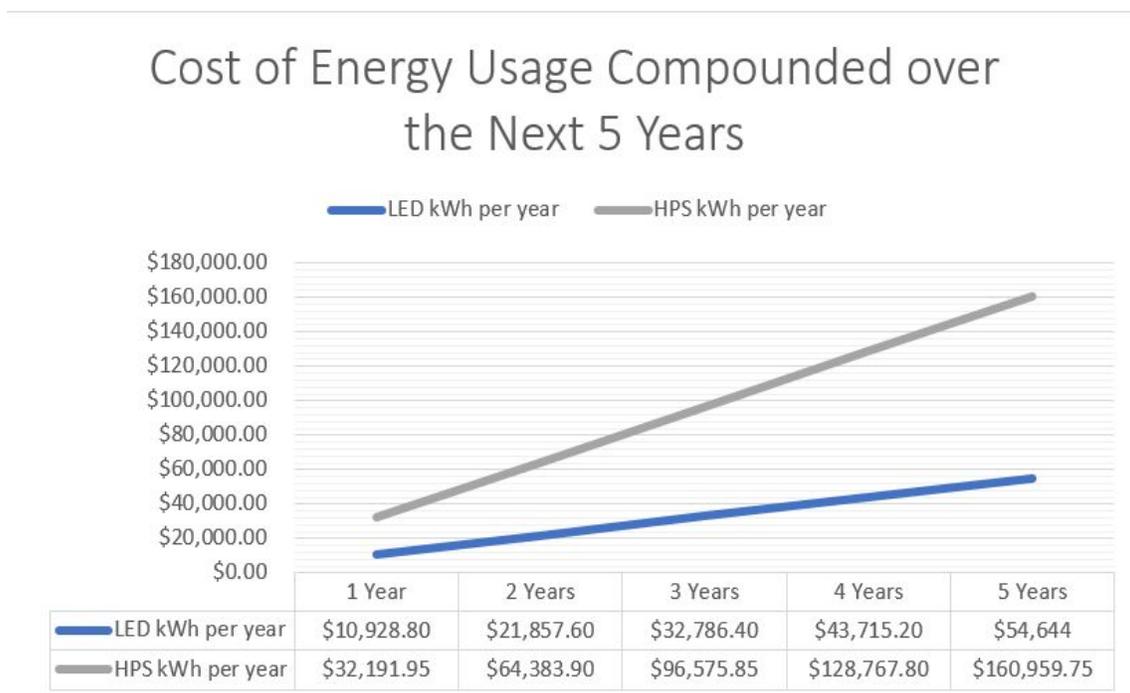


Fig (3) Here is the compounded cost of energy with replaced LED bulbs and current costs with HPS bulbs. This does not reflect the initial costs of bulb replacement.

Status and Next Steps

COVID19 will likely pose some unique challenges to the implementation of the project. Moving forward may be better timed when the Coronavirus is no longer a threat, and the economy has recovered. There are many anticipated obstacles with the continuing situation of covid19. It may be challenging to reach out to certain vendors who provide lighting solutions at more reasonable costs due to the shut down. Also, getting maintenance service workers to all locations will have to wait. Furthermore, if Georgia Power decides not to cover costs in exchange for a contractual agreement, the total upfront cost will be \$24,630. This is a large amount, and there may be ways of cost savings that are not included in this document that we can explore at a later date. We hope to continue correspondence with David Repp after The Waffle House has resumed normal operations.

To conclude

If all goes as planned, we hope to replace all HPS light bulbs with LEDs in the 22 Waffle House locations David Repp has chosen across Metro Atlanta. This will cut carbon emissions by a total of 161,307 pounds per year and result in a three-year projected savings of \$20,120. This small but critical change will not only greatly benefit the environment but is cost-effective as well. We hope Waffle House will use our method of installation to decrease its carbon footprint and increase their energy savings. Although COVID-19 has caused a devastating blow to the economy and the Waffle House franchise, we hope that the management will move forward with this cost-saving project at a later date.

References:

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