

**UNIVERSITY OF MIAMI**  
**INDUSTRIAL ASSESSMENT CENTER**



DEPARTMENT OF INDUSTRIAL ENGINEERING  
COLLEGE OF ENGINEERING  
UNIVERSITY OF MIAMI  
P.O. BOX 248294  
CORAL GABLES, FL 33124-0623

**DIRECTOR**  
DR. RAMIN MOGHADDASS  
[ramin@miami.edu](mailto:ramin@miami.edu)

---

**THE UNIVERSITY OF MIAMI INDUSTRIAL  
ASSESSMENT CENTER (MIAC)**

---

Department of:

Industrial & Systems Engineering  
Coral Gables, Florida

**Report No. MDC07**

**Assessment Date**

September 14<sup>th</sup>, 2023

**Industrial Assessment at:**

Doral Government Center

**Team Members:**

**Ramin Moghaddass, Ph.D.**

University of Miami Industrial Assessment Center Director

**Ibrahim Ahmed, Ph.D.**

University of Miami Industrial Assessment Center Assistant  
Director

**Marta Marello**

Building and Energy Analyst  
Miami-Dade County Office of Resilience

**Afshin Asadi**

University of Miami  
Graduate PhD Student, Industrial and System Engineering

**Kyounghee Kim**

University of Miami  
Undergraduate Student, Electrical and Computer Engineering

**Enrique Alonso**

University of Miami  
Undergraduate Student, Industrial and System Engineering

## DISCLAIMER

The contents of this report are offered as guidance in an effort to reduce energy, waste disposal, and other costs both directly and indirectly. University of Miami and all sources referenced in this report do not (a) make any warranty or representation, expressed or implied, with respect to accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe on privately owned rights; (b) assume any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this report. The report does not reflect official views or policy of the above-mentioned institutions. Mention of trade names or commercial products does not constitute endorsement or recommendation of use.

# TABLE OF CONTENTS

<b>SECTION 1</b>	<b>ADMINISTRATIVE SUMMARY</b>	<b>5</b>
<b>SECTION 2</b>	<b>BUILDING OVERVIEW</b>	<b>8</b>
<b>SECTION 3</b>	<b>UM INDUSTRIAL ASSESSMENT CENTER AND YOU</b>	<b>10</b>
<b>SECTION 4</b>	<b>ASSESSMENT RECOMMENDATION #1</b> INCREASE THERMOSTAT SETTINGS	<b>17</b>
<b>SECTION 5</b>	<b>ASSESSMENT RECOMMENDATION #2</b> TURN OFF ALL UNUSED EQUIPMENT AND APPLIANCES DURING NON-OPERATING HOURS	<b>24</b>
<b>SECTION 6</b>	<b>ASSESSMENT RECOMMENDATION #3</b> REPAIR REFRIGERANT LEAKS IN ROOF PACKAGED UNIT	<b>29</b>
<b>SECTION 7</b>	<b>ASSESSMENT RECOMMENDATION #4</b> INSTALL AIR CURTAINS ON MAIN LOBBY DOORS	<b>33</b>
<b>SECTION 8</b>	<b>ASSESSMENT RECOMMENDATION #5</b> APPLY WHITE REFLECTIVE COATING ON ROOF	<b>40</b>
<b>SECTION 9</b>	<b>ASSESSMENT RECOMMENDATION #6</b> CONTROL AC IN CHAMBER ROOM	<b>48</b>
<b>SECTION 10</b>	<b>ASSESSMENT RECOMMENDATION #7</b> CONTROL SHADES TO AUTOMATICALLY LOWER WITH DIRECT SUNLIGHT	<b>54</b>
<b>SECTION 11</b>	<b>ASSESSMENT RECOMMENDATION #8</b> REPLACE FLUORESCENT LIGHTING WITH LED IN SELECTED AREAS	<b>59</b>
<b>SECTION 12</b>	<b>ASSESSMENT RECOMMENDATION #9</b> ENROLL IN FPL AUTOPAY	<b>64</b>
<b>SECTION 13</b>	<b>ASSESSMENT RECOMMENDATION #10</b> DO NOT OVERWRITE LIGHT CONTROL	<b>67</b>
<b>SECTION 14</b>	<b>ADDITIONAL CONSIDERATION #1</b> INSTALL SOLAR PANEL SYSTEMS ON ROOF	<b>70</b>
<b>SECTION 15</b>	<b>ADDITIONAL CONSIDERATION #2</b> APPLY FOR ISO 50001 CERTIFICATION	<b>77</b>
<b>APPENDICES</b>	<b>APPENDIX A – SUMMARY OF BILLS</b>	<b>81</b>
	<b>APPENDIX B – ELECTRICAL DATA LOGGING</b>	<b>84</b>

# **SECTION 1**

---

## **ADMINISTRATIVE SUMMARY**

## Preface

This Preliminary Report was prepared under the direction of the University of Miami Industrial Assessment Center and Data Analytics Lab and the Miami Dade County Office of Resilience. The work is based on a 2-year project between Miami-Dade County Office of Resilience and the University of Miami. The objective of this project is to identify, evaluate, and recommend opportunities to conserve energy, minimize waste, and reduce the overall energy costs of commercial buildings. Our recommendations are based on observations and measurements we made at your building. As our time was very limited, we do not claim to have complete details on every aspect of the building. At all times, we try to offer specific and quantitative recommendations for cost savings, energy conservation, and waste minimization to the buildings we serve. However, we do not attempt to prepare engineering designs or otherwise perform services that you would expect from an engineering firm, a vendor, or a manufacturer’s representative. When the need for that kind of assistance arrives, we urge you to consult them directly. If, however, you would like to discuss the contents of this report or if you have other questions about energy use, process recommendations, and/or waste minimization, please feel welcome to contact the assistant director Dr. Ramin Moghaddass at (305) 284-3297. Please note that all numbers in this report are just based on our best estimation methods. The actual savings after implementing our recommendations may vary depending on many factors, such as the cost of energy, implementation cost, and other details that were not included in our estimation. This report also does not recommend any specific vendor or contractor to implement our recommendations.

## Executive Summary

Energy consumption at the building for the one year consisted of the following:

<b>Electricity:</b>	<b>1,728,720 kWh</b>	<b>\$116,911</b>
<b>Elec. Demand:</b>	<b>3,656 kw-month</b>	<b>\$45,221</b>

A summary of assessment recommendations (AR’s) described in this report is contained in Table 2. The sum of the total annual cost savings achieved by individual recommendations will be approximately **\$42,916** which corresponds to **22%** savings. The total implementation cost is **\$20,060**.

All of the assessment recommendations are described in detail in this report. The annual cost savings and implementation costs represent our best estimates, according to the data collected during the visit, which you provided us, or that is a common benchmark in your industry. You may want to consult other sources and verify these estimates before making a final decision for implementing these AR's. We welcome inquiries and further discussion on any information contained in this report. As discussed earlier, we will contact you later regarding the actual benefits obtained through implementing our recommendations.

## Summary of Building Statistics

### Building Data

Report No.:	MDC07
Location:	Doral FL, 33133
Principal Service:	Government Building
Building Area:	250,671 ft <sup>2</sup>
No. of Personnel:	150
Date of Building Visit:	9/14/2023
Motor Horsepower Capacity:	1,000
Largest Motor Horsepower	370

### Operating Hours

The main area of the building has a working hour of 10 hours/day, 5 days/week, and 52 weeks/yr.

**Table 1: Summary of utility bills**

Utility Sources	Cost /yr	Unit	Unit Cost	Units
1 Energy Charges	\$116,911	kWh	\$0.068	1,728,720
2 Demand Charges	\$45,221	kW-month	\$12.369	3,656
3 Elec Fees/Taxes	\$15,783			
<b>Total Cost</b>	<b>\$177,915</b>			

**Table 2: Estimation Summary of assessment recommendations**

No.	Assessment Recommendation Description	Type of AR	Annual Savings (\$)	Annual Energy Savings kWh	Annual Energy Savings kW-months	Implementation Cost (\$)	Simple Payback (years)
1	Increase Thermostat Settings	Electricity Usage	\$20,747	244,162	335	\$580	0.03
2	Turn off All Unused Equipment and Appliances During Non-Operating Hours	Electricity Usage	\$8,530	125,441	0	\$0	1.7
3	Repair Refrigerant Leaks in Roof Packaged Unit	Other Liquid (non-Haz)	\$3,400	0	0	\$3,000	0.9
4	Install Air Curtains on Main Lobby Doors	Electricity Usage	\$2,979	32,460	62	\$4,472	1.5
5	Apply White Reflective Coating on Roof	Electricity Usage	\$2,244	17,937	83	\$7,688	3.4
6	Control AC in Chamber Room	Electricity Usage	\$1,845	20,048	39	\$0	0.0
7	Control Shades to Automatically Lower with Direct Sunlight	Electricity Usage	\$1,588	17,298	33	\$1,476	0.9
8	Replace Fluorescent Lighting with LED in Selected Areas	Electricity Usage	\$884	9,635	19	\$2,847	3.2
9	Enroll in FPL Autopay	Electricity Fees	\$596	0	0	\$0	0.0
10	Do not Override Light Control	Electricity Usage	\$103	1,527	0	\$0	0.0
<b>Totals</b>			<b>\$42,916</b>			<b>\$20,060</b>	

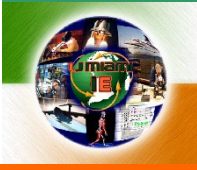
ADDITIONAL CONSIDERATIONS

1	Install Solar Panel Systems on Roof	Electricity Usage	\$40,893.00	247,774	1,944	\$251,454.00	6.2
2	Apply for ISO 50001 Certification	NA	\$0.00	0	0	\$0.00	0.0

# SECTION 2

---

## Building Overview



## Building Overview

### Mission

The Doral Government Center is dedicated to fostering a team of adaptable, customer-focused, and easily accessible professionals who are wholeheartedly committed to safeguarding the well-being and security of building occupants by facilitating efficient and effective permitting and inspection procedures.

### History

The Building Fund, established through Florida House Bill 127 and Florida Statutes Chapter 553, is used to track all Building Department expenditures and revenues related to building permits and fines for permit violations. Other Building Department revenue is part of the General Fund. The department is dedicated to ensuring the health, safety, and welfare of residents and businesses by efficiently enforcing building codes and local ordinances. They prioritize customer service, innovation, professionalism, and cooperation to foster positive relationships within the building community and with citizens.

### Description

#### Building Description

Area (sq. ft)	Usage	# of Floors	Year Built	Own/ Lease	# of Residence/Employee
50,671	Commercial	3	2009	Own	150
200,000	Garage	3	2009	Own	/

### Major Equipment

1. 1 x 275 kW Generator
2. Intellipak 20-75 packaged Air-Conditioning Split Units
3. Intellipak 90-162 packaged Air-Conditioning Split Units

### Existing Best practices

1. Natural Light Utilization
2. Window Shading
3. Partial LED Lighting Integration

# SECTION 3



## UM AND YOU



### 3. About Us:

**University of Miami - Industrial Assessment Center**

**University of Miami - Data Analytics Lab**

---

## Introduction

---

The Preliminary Energy Efficiency Report that is detailed in this report was developed under the direction of Dr. Ramin Moghaddass, Director of the **University of Miami Industrial Assessment Center and Data Analytics Lab**. The center is located at the University of Miami in the Department of Industrial Engineering. This report is based on the agreement between Miami Dade County Office of Resilience and University of Miami. Students work for the Center on a part-time basis, under the direct supervision of Dr. Ramin Moghaddass. Our work focuses on many aspects of energy efficiency, waste minimization, pollution prevention, and productivity enhancement.

The first step in the assessment process requires a team of undergraduate and graduate students to perform a preliminary engineering analysis by examining the building's energy, water, and waste bills. After the information is analyzed, the team formulates a strategic plan for the site visit. Once on-site, the team tours the building, reviews the building layout, collects production and operating data, and tests and inspects the building's equipment and procedures to identify efficiency recommendations. Additional data are collected through interviews or discussions with the building's management and staff. The initial findings are then presented to the building's management.

Most of our recommendations are based upon observations and measurements made at the building. However, with our time constraints, it is difficult to have complete details on every aspect of the building's operations, energy consumption, and production processes. At all times, we try to offer specific and quantitative recommendations for cost savings, energy conservation, and waste minimization to the buildings we serve. With respect to the consumption of electrical power, the team implements a data logging session (when possible) which is described in detail in the following section. Also, some parts of our calculations are based on data from FPL dashboard.

The assessment recommendation report tells a story about your Building. With the aid of our data loggers, we identify such things as Program Power, i.e., isolating time-of-usage (on-peak/off-peak); Alignment Power, transferring on-peak to off-peak usage; Ghost Power, identifying wasteful consumption of electrical energy when the building is vacant; Effective Power, identifying motors with low-efficiency ratings; and Re-Engineering Power, finding ways to streamline usage from manufacturing processes. Please note that all of our calculation steps are based on various types of estimation methods; thus, the total saving amounts and implementation costs are subject to error.

For any questions regarding this report, feel free to contact Dr. Ramin Moghaddass via email ([ramin@miami.edu](mailto:ramin@miami.edu)) .

## Electrical Data Logging Process

---

### **CAPTURE THE DATA:**

The process begins with a tour of the building which is typically led by the building manager, or someone else with extensive knowledge of the building and its facilities. This is to expose the team to the locations of the power distribution, various consumption sources, and work processes. Once the electrical team has observed the general layout of the building in person, they develop a strategy for logging the data. This is based upon several factors, such as access to panels and the types of devices that need to be logged.

To obtain the electrical data, the team uses HOB0<sup>1</sup> data loggers. These devices are configured to take amperage readings every fifteen or twenty-four seconds continuously for a seven-day period. Depending upon the number of loggers used, the team can capture as many as 2.9 million data points for analysis.

These loggers are attached as much as possible to the service panel itself. However, if there is more than one device on a circuit that needs to be logged individually the loggers are then attached to the individual units, depending on necessity. For example, if a circuit services more than one air compressor motor, or multiple cooling towers, a logger might be attached to each individual unit's disconnect box. After a week, the loggers are collected and brought back to our center where the raw data is downloaded and then imported into our software program developed in-house several spreadsheets.

### **ANALYZE THE DATA:**

Once the raw data is fully compiled, the analysis process begins. The first step is to calculate the total electrical costs for the week using the Peak Demand<sup>2</sup> that was captured, along with the hourly consumption. This is based on the current electric utility rate. These costs are then broken down into the four service areas that we look at – Lighting, Cooling, Information Technology, and Processes. As mentioned earlier, this is constrained by the amount of access that the team has to the various panels and electrical consumption sources.

Beginning at this point, the data is also broken down in two ways. The first is by comparing On-Peak to Off-Peak costs, when applicable, while the second is done by breaking the 24-hour day into 4 periods. These periods are:

1. Gate Power – 6am to Noon
2. Stretch Power – Noon to 6pm
3. Red-eye Power – 6pm to Midnight
4. Ghost Power – Midnight to 6am

The next step is to use the data that was collected and use it as a basis to break down the previous year's consumption, which is given on the utility bills. This breakdown is performed under the assumption that the percentages of consumption for the week logged, but not the actual consumptions, are representative and consistent throughout the year. In other words, if the data shows that on Monday the Gate Power is 1.6% of the electricity consumed for the week, we then assume that percentage to be the same for all identical periods over the previous year. At the same time, we also break out the Summer and Winter periods for our financial analysis since the hours of on- and off-peak change depending on the season<sup>3</sup>. This procedure is a lengthy multi-step process and is performed with a software package that has been developed in-house over the past few years by our team of engineers.

---

<sup>1</sup> <http://www.onsetcomp.com/>

<sup>2</sup> Peak electrical demand is calculated by using the utility's meters to identify the single 30-minute period during the month in which the most electrical energy (kWh) was consumed. At the same time, the consumption calculation is based on actual logged current (ampere) values and is then adjusted for power factor. It is worth noting that power quality problems could affect electrical equipment such as lighting controllers, programmable time clocks, computers, other electronic equipment and controllers, and emergency alarms. Upon request, the utility company will perform a power quality and reliability analysis. This customer side power monitoring is done to identify and detect power problems such as wiring and grounding deficiencies, power harmonic distortion, transient spikes, and other electrical problems that affect the load. The analysis will also recommend solutions to help resolve problems that affect the sensitive electronic equipment.

<sup>3</sup> On-Peak Periods:

- a) Winter Schedule - November 4 to April 7; Monday through Friday from 6am - 10am and from 6pm - 10 pm
- b) Summer Schedule - April 8 to November 3; Monday through Friday from 12:00pm to 9:00pm

Off-Peak Periods: All remaining hours, and major holidays.

### **PUT THE DATA TO WORK:**

The last step is to use the data that is extrapolated and put it to work. Although every site assessment is different, there are certain opportunities that are always looked for. The first is to look at the current utility rate structure and see if there is a more advantageous plan available. Although electrical costs can change during the year, this is done using the most current pricing structures obtainable from the utility. Then the usage pattern that was extrapolated using our software is used to run a cost analysis against every pricing structure. As a result, it is typically possible to recommend a change in pricing structure that will provide considerable economic benefit.

The second area that is always targeted is identifying consumption occurring during non-operational periods. One of the most basic examples of this would be lights unnecessarily being left on overnight. A third area would be to check high power-consuming equipment for efficiency. For example, the team can use the actual data collected on a motor and compare its actual to theoretical efficiency. The Department of Energy's Motor Master software is then used to help make recommendations for improvement.

Lastly, the data collected with our logging strategy is used to evaluate building processes. This analysis is largely dependent upon the equipment employed by the building and obviously varies from site to site. A flow chart diagram is provided in Figure 1 in order to obtain a visual step-by-step understanding of the electrical logging process. Also, a complete breakdown of the electrical consumption separated into Summer and Winter periods as well as percentages and KWH related to total consumption is presented in Appendix B.

### **ADDITIONAL NOTES:**

The utility company's electric rate classification is based upon an assumed minimum electrical usage. Discounts are available to higher-volume users through a variety of programs. For example, customers can reduce their consumption costs through programs such as *Time-of-Use (TOU)* and *Curtailable Service (CS)*. TOU is practical if the company can shift its electrical consumption from on-peak to off-peak periods. The rate structure of this program is such that the customer is billed at a lower rate during off-peak while the on-peak rates are higher. Therefore, the more work that is shifted to off-peak, the greater the savings. The utility company will gladly help commercial or industrial accounts evaluate which rate schedule will be most economical.

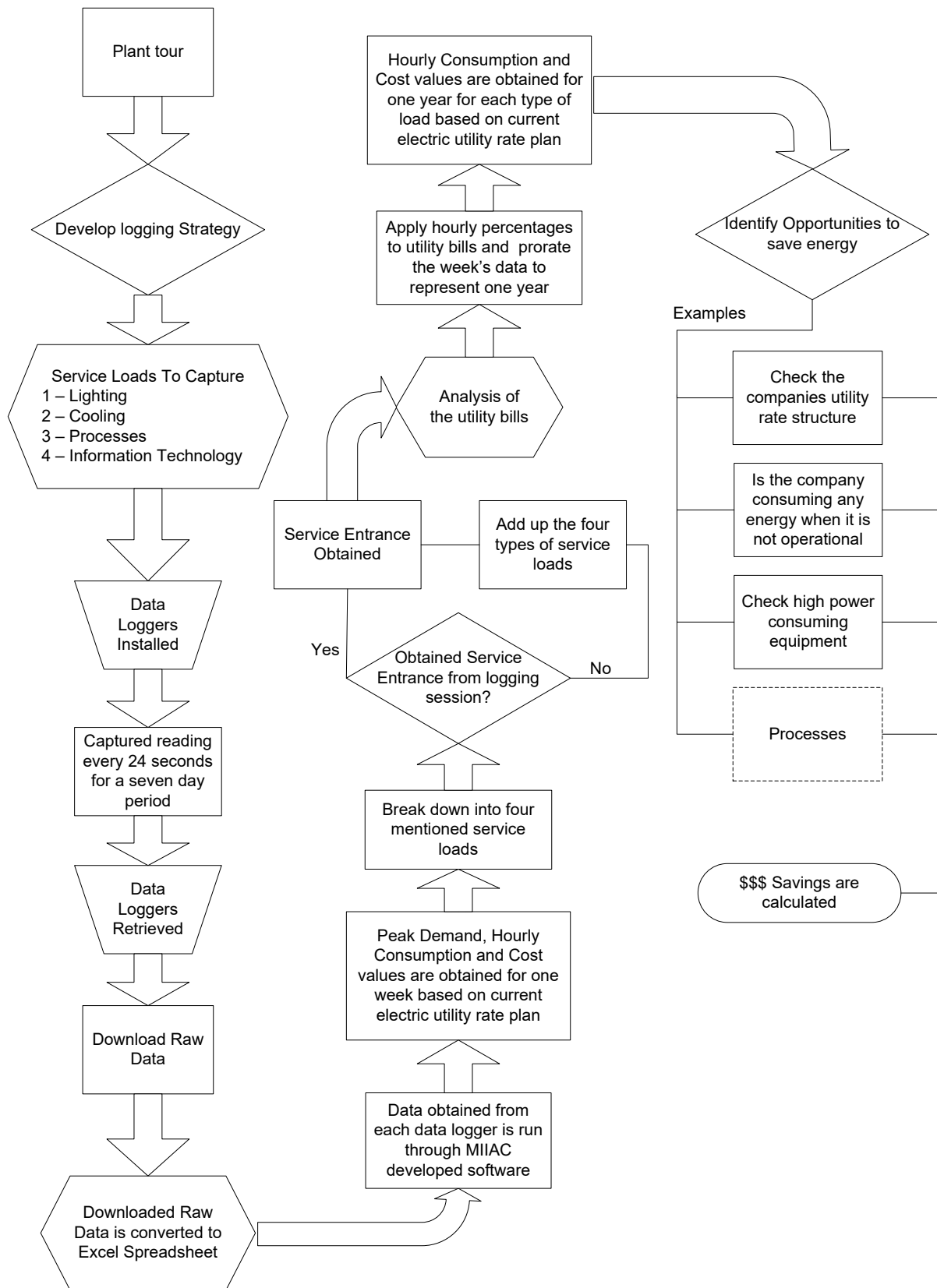


Figure 1 - Electrical Process Flow Chart

## Compressed Air System Audit

---

### **CAPTURE THE DATA:**

The process begins with a tour of the building which is typically led by the building maintenance manager, or someone else with extensive knowledge of the compressed air system of the building. This is to expose the team to the locations of the compressed air system components such as compressors, after coolers, dryers, air storage tanks, etc. Once the compressed air team has observed the compressed air system in the building, they develop a strategy for logging the compressed air system components.

To obtain the electrical data, the team uses HOBO data loggers. These devices are configured to take amperage readings every twenty-four seconds continuously for a seven-day period. Additionally, the compressed air team directs the building maintenance manager to leave the compressors on during non-working hours of the building for a 24-hour period during which each phase of the electrical connection to the compressor is logged for an eight-hour period. Three loggers are set to capture the data points in 1-second intervals in a staggered fashion. This is done due to the physical space limitation on the electrical panel and memory limitations of the data loggers. Each logger can capture up to 32,400 or 9 hrs worth of data points. Therefore, we have to use a minimum of three loggers to capture 24 hrs worth of 1-second interval amperage readings.

After a week, the loggers are collected and brought back to our center where the raw data is downloaded from the loggers and then imported into a software program developed in-house by our team of engineers. The electrical team uses the 24-second interval data to predict the yearly power consumption of the compressors. The compressed air team on the other hand uses the 1-second interval data to quantify the use of un-regulated compressed air in the manufacturing area of the building.

### **ESTIMATING THE LEAK LOAD:**

For compressors that use start/stop controls (very common in the Miami area), there is an easy way to estimate the amount of leakage in the system. This method involves starting the compressor when there are no demands on the system (when all the air-operated, end-use equipment is turned off). The compressed air team uses the 1-second interval logging to determine the average time to load and unload the compressor. The compressor will load and unload because the air leaks will cause the compressor to cycle on and off as the pressure drops from air escaping through the leaks. Total leakage (percentage) can be calculated as follows:

$$\text{Leakage (\%)} = [(T \times 100)/(T+t)]$$

where: T=on-load time (seconds) t=off-load time (seconds)

Leakage will be expressed in terms of the percentage of compressor capacity lost. The percentage lost to leakage should be less than 10 percent in a well-maintained system. Poorly maintained systems can have losses as high as 20 to 30 percent.

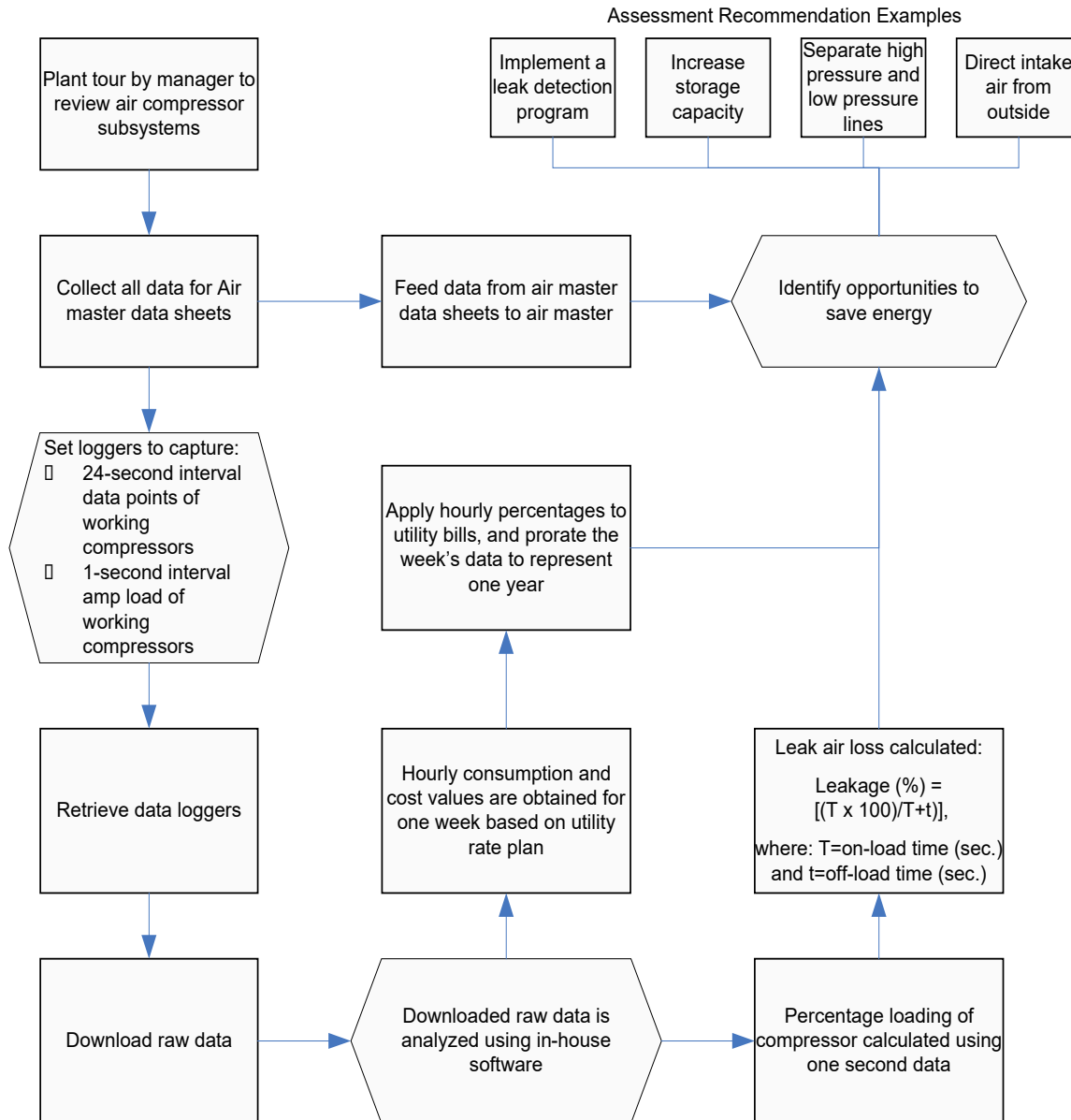
### **DETECTING AND QUANTIFYING AIR LEAKS:**

The compressed air team uses an Ultraprobe 9000® ultra-sonic leak detector (Figure 2) to detect and quantify air leaks on the shop floor. The leak detector measures the ultrasonic frequency of sound emanating from the leak which can be correlated to the CFM loss using a leak chart provided by the company (UE Systems; [www.uesystems.com](http://www.uesystems.com)).



**Figure 2 - The Ultraprobe 9000 leak detector**

Please refer to the flowchart for the methodology of data collection and analysis for the compressed air system (Figure 3) for a schematic explanation of the logging and analysis process.



**Figure 3 - Flow chart of compressed air system audit**

# SECTION 4

---

## ASSESSMENT RECOMMENDATION # 1 INCREASE THERMOSTAT SETTINGS



## Assessment Recommendation # 1: Increase Thermostat Settings

### Opportunity

After logging the temperature in the air-conditioned portions of the building the average temperature was determined to be set at 70° F. OSHA recommends that employers keep the indoor thermostat between 68 and 76 degrees and up to 60% humidity<sup>1</sup>. By increasing the thermostat setting to 75°F, potential energy savings can be realized.

### Recommended Action

Program thermostat temperatures to 75° F for all the cooled portions of the facility during operating hours and allow an extra hour of cooling before the start of the working shift for non-operating hours. This action should be implemented gradually for the employees to adapt to changes in AC conditions.

### Summary of Estimated Savings and Implementation Cost

- Estimated Total Cost Savings = \$20,747
- Estimated Energy Savings = 244,162 kWh/yr
- Estimated Demand Savings = 335 kW-month/yr
- Estimated Implementation Cost = \$580
- Simple Payback = 0.03 years

### Implementation Cost:

The cost associated with monitoring thermostats and programming the thermostats is \$480 in labor and \$100 in capital costs.

### Anticipated Savings:

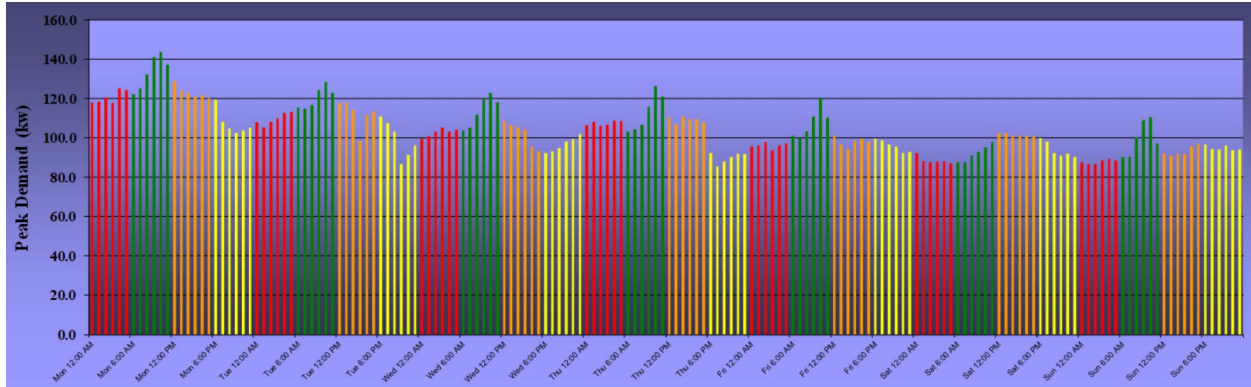
By adjusting the thermostat temperature settings in the facility, the management will realize \$16,603 in annual energy cost savings and \$4,144 in demand cost savings.

### Detailed Analysis

#### **BACKGROUND:**

It was observed through our data logging session that the temperature in the air-conditioned spaces for the facility was 70° F during both operating and non-operating hours as shown in **Figure 3**. It is recommended that the facility increases the air temperature. The total cooling load is based on our data logging. It is a combination of two large roof top packaged units as shown in **Figures 1 and 2**. These cooling units are the focus for savings.

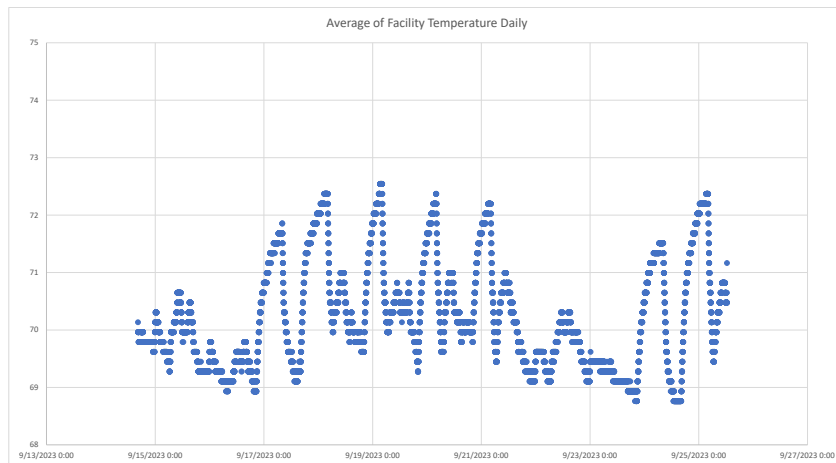
<sup>1</sup> <https://www.hseblog.com/oshas-recommendation-for-temperatures-and-humidity-in-the-workplace/>



**Figure 1 Demand profile of INTELLIPAK II**



**Figure 2 Demand profile of INTELLIPAK**



**Figure 3 Temperature logging of facility**

It is recommended that the building increases the thermostat settings gradually to 75°F. According to the Florida Light & Power Building (FPL), for every degree raised in temperature, the building can save about 5% on monthly cooling costs during the summer months<sup>2</sup>. In addition, assuming slow air movement (less than 40 feet per minute) and 65% indoor relative humidity, the operative temperatures recommended by ASHRAE range from 68.5°F to 75°F in the winter, and from 75°F to 80.5°F in the summer. The difference in temperature ranges between the seasons is largely

<sup>2</sup> <https://www.fpl.com/save/lower-bill/seasonal-residents.html>

due to clothing selection. ASHRAE also recommends that indoor relative humidity be maintained at or below 65% [ANSI/ASHRAE/IES 2019]<sup>3</sup>.

There are five main cooling loads for air conditioning:

1. Conduction and convection through walls, windows, etc.
2. Absorption of solar radiation on walls, windows, etc.
3. Heat emission of occupants.
4. Infiltration of warm outdoor air.
5. Heat emission of lights and other electrical or mechanical purposes.

By increasing the temperature to ASHRAE’s standard of 75°F, the cooling load will be reduced due to the reduction of Cooling Degree days (CDD). A degree-day is a measure of heating or cooling. A degree-day is defined as a departure of the mean daily temperature from a given standard: one degree-day for each degree of departure above (or below) the base temperature for one day. The degree-day is related to the outside temperature and is not related to time.

**ANTICIPATED SAVINGS:**

On the day of the assessment, electric data loggers were installed on the AC unit for the facility. These loggers captured the energy consumption of the unit, allowing us to analyze the cooling demand for several weeks during September 2023. This information is shown in Tables 1 and 2. Complete logging data analysis is presented in Appendix B.

To adjust for seasonality and to estimate an annual consumption, we consider Cooling Degree Days (CDD). A cooling degree-day is every degree that the mean temperature is above 71 or 72 degrees during a day. Therefore, if the high temperature for the day is 95, and the minimum is 51, the average temperature for the day is 73. That would be 1 or 2 cooling degree-days (73-72 or 73-71). This way we can calculate the CDD with respect to a different base temperature. In our case, we will use the data for CDD with respect to 70 base <sup>4</sup>, which will allow us to calculate exactly how many days cooling is needed according to the outside temperature. The location chosen is Miami International Airport due to its proximity to Doral, FL , where the building is located.

**Table 1. INTELLIPAK II weekly energy consumption**

#	Day	Vertical Cross Analysis			
		Cost (\$)	Kw-Hrs	Pctg	Cumu %
1-	Monday	\$193.4	2844.0	16.63%	16.63%
2-	Tuesday	\$175.5	2581.3	15.10%	31.73%
3-	Wednesday	\$165.6	2434.9	14.24%	45.97%
4-	Thursday	\$167.5	2462.6	14.40%	60.37%
5-	Friday	\$158.6	2331.8	13.64%	74.01%
6-	Saturday	\$151.8	2232.5	13.06%	87.06%
7-	Sunday	\$150.4	2212.3	12.94%	100%
8-	Work Week	\$860.5	12654.6	74.0%	74.0%
9-	Week End	\$302.2	4444.8	26.0%	100%
10-	Total Week	\$1,163	17099.5	100%	100%

<sup>3</sup> [https://www.energycodes.gov/sites/default/files/2021-07/20210407\\_Standard\\_90.1-2019\\_Determination\\_TSD.pdf](https://www.energycodes.gov/sites/default/files/2021-07/20210407_Standard_90.1-2019_Determination_TSD.pdf)

<sup>4</sup> The data for Doral can be downloaded from here <https://www.degreedays.net/>. For our purposes, we use the monthly data; however, daily data are also available.

**Table 2. INTELLIPAK weekly energy consumption**

#	Day	Vertical Cross Analysis			
		Cost (\$)	Kw-Hrs	Pctg	Cumu %
1-	Monday	\$115.70	1701.6	18.96%	18.96%
2-	Tuesday	\$85.50	1256.7	14.00%	32.96%
3-	Wednesday	\$75.00	1102.4	12.28%	45.24%
4-	Thursday	\$83.40	1226.9	13.67%	58.91%
5-	Friday	\$97.40	1432.7	15.96%	74.87%
6-	Saturday	\$78.50	1153.9	12.86%	87.73%
7-	Sunday	\$74.90	1101.5	12.27%	100%
8-	Work Week	\$457.00	6720.3	74.90%	74.90%
9-	Week End	\$153.40	2255.4	25.10%	100%
10-	Total Week	\$610	8975.7	100%	100%

From Tables 1 and 2 we calculated the weekly consumption of the facility’s AC to be 26,075.2 kWh/week for both non-operating and operating hours. To estimate the monthly cooling load for this area for September, we multiply the weekly consumption by 4.

**Monthly Cooling Load**

$$= 26,076 \frac{kWh}{week} \times 4 weeks$$

$$= \mathbf{104,304 kWh}$$

The daily mean temperature in September 2023 was 82 on average. The number of cooling degree-days for this month is 411.1 degree-days if the base temperature was 70°F and 261.5 degree-days if the base was 75°F as we suggest.

$$= \frac{104,304 kWh}{460 CDD}$$

$$= \mathbf{226.75 \frac{kWh}{CDD}}$$

By increasing the thermostat temperature to 75, the number of degree-days will reduce to 380 degree-days only. This means that the facility will not require as much cooling as before. Rather, the cooling load will now be:

$$= \text{Number of cooling degree days @ base 75} \times \frac{kWh}{\text{Cooling degree day}}$$

$$= 380 CDD \times 226.75 \frac{kWh}{CDD}$$

$$= \mathbf{86,164 kWh}$$

**February kWh Savings**

$$= 104,304 kWh - 86,164 kWh$$

$$= \mathbf{18,140 kWh}$$

These savings are equivalent to 17% of the monthly cooling load. Similar calculations were carried out for the rest of the year as seen in Table 3 below.

**Table 3. Energy Savings**

Month	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Total
Cooling Load (kWh)	69,770	56,800	31,835	29,795	36,484	47,572	59,748	74,623	88,658	111,038	110,834	104,304	821,462
Daily Mean Temperature (°F)	79	75	71	68	70	72	76	79	82	83	83	82	
Number of CDD @70°F	307.7	250.5	140.4	131.4	160.9	209.8	263.5	329.1	391	489.7	488.8	460	
kWh/CDD @ 70	226.75	226.75	226.75	226.75	226.75	226.75	226.75	226.75	226.75	226.75	226.75	226.75	
Number of CDD @75	209	130	75	81	100	160	178	235	278	360	360	380	
Projected consumption at 75F	47,390	29,477	17,006	18,367	22,675	36,280	40,361	53,286	63,036	81,629	81,629	86,164	577,300
Energy Savings (kWh)	22380	27323	14829	11428	13809	11292	19387	21337	25623	29409	29205	18140	244,162

Using this method, **Total Annual Energy Savings:**

$$= 821,462 \text{ kWh} - 577,300 \text{ kWh}$$

$$= \mathbf{244,162} \frac{\text{kWh}}{\text{yr}}$$

The corresponding **Energy Cost Savings:**

$$= 244,162 \frac{\text{kWh}}{\text{yr}} \times \$0.068 \frac{\$}{\text{kWh}} \text{ (From Appendix A)}$$

$$= \mathbf{\$16,603} \frac{\$}{\text{yr}}$$

**Demand Cost Savings**

$$= \frac{\text{Annual kWh Savings}}{\text{Annual Operating Hours}} \times 12 \text{ months}$$

$$= \frac{244,162 \text{ kWh}}{8736 \frac{\text{hr}}{\text{yr}}} \times 12 \frac{\text{month}}{\text{yr}}$$

$$= \mathbf{335 \text{ kW months}}$$

$$= 335 \text{ kW months} \times \$12.369 \frac{\$}{\text{kW months}}$$

$$= \mathbf{\$4,144} \frac{\$}{\text{yr}}$$

The **Total Energy Cost Savings** equals energy savings plus demand savings:

$$= \$16,603 \frac{\$}{\text{yr}} + \$4,144 \frac{\$}{\text{yr}}$$

$$= \mathbf{\$20,747} \frac{\$}{\text{yr}}$$

**IMPLEMENTATION COST:**

About 1 hour per month will be needed to program and/or ensure correct thermostat settings.

**Total Labor Cost** is thus:

$$= 1 \text{ hr} \times 12 \times \$40 \frac{\$}{\text{hr}}$$

$$= \mathbf{\$480}$$

Additionally, it is estimated the facility could spend \$100 on thermostat controllers which is widely available with prices ranging from \$25 to \$200 for smart thermostats.<sup>5</sup>

<sup>5</sup> <https://www.grainger.com/product/ROBERTSHAW-Digital-WiFi-Wall-Thermostat-361YG4>

**Materials Cost**

= \$100

**Total Implementation Cost**

= Labor Cost + Materials Cost

= \$480 + \$100

= \$580

**SIMPLE PAYBACK:**

#1- Implementation Cost.....	\$580
#2- Total Annual Savings..... /	\$20,747
#3- Simple Payback (years)..... =	0.03

# SECTION 5

---

**ASSESSMENT RECOMMENDATION #2  
TURN OFF ALL UNUSED EQUIPMENT AND  
APPLIANCES DURING NON-OPERATING HOURS**



## **Assessment Recommendation #2: Turn off All Unused Equipment and Appliances During Non-Operating Hours**

### **Opportunity**

---

During the assessment visit, it was observed that many small appliances, such as coffee machines, toasters, refrigerators, printers, ovens, vending machines, and microwaves were left plugged in during non-working hours (ghost power). After observing the energy usage during working hours and non-working hours, it was found that there is a possibility that the small plug appliances are using energy, even when not in use.

### **Recommended Action**

---

**The Message: ‘STOP THE LEAK’, Eliminate Ghost Power.**

Assign building personnel to unplug equipment at the end of the day. In addition, install signs for unplugging equipment when not in use.

### **Summary of Estimated Savings and Implementation Cost**

---

- Estimated Total Cost Savings = \$8,530
- Estimated Total kWh Savings = 125,441 kWh
- Estimated Implementation Cost = \$0
- Simple Payback = Immediate

### **Implementation Cost:**

---

There is no additional cost associated with implementing this recommendation.

### **Anticipated Savings:**

---

The building can save \$8,530 in energy savings per year by eliminating ghost power consumption.

## Detailed Analysis

### ANTICIPATED SAVINGS:

Elimination of usage of electrical power when the plant is vacant, i.e., when all employees have gone home, can amount to a substantial amount savings per calendar year. In this case the vacant time is 6PM-7AM. The FPL dashboard displays when the energy is being used, and the hours when not in use can be seen in Figure 1. Figure 2 displays the continuous shift of not in use to in use over 30 days. Although energy consumption and/or productivity may change from one week to the other, the hourly percentage every day typically stays the same. From the logging of the Roof Top Units (Appendix B), we were able to calculate the yearly cooling load. From the cooling load, we were able to use the information from the FPL dashboard to estimate the amount of kWh being used on the small appliances when not in use. From the FPL dashboard, we were able to calculate the energy consumption for each hour. Even though the office hours were reported to be 7AM to 6PM, we focused on the period from 8PM to 4AM as our main source of savings.

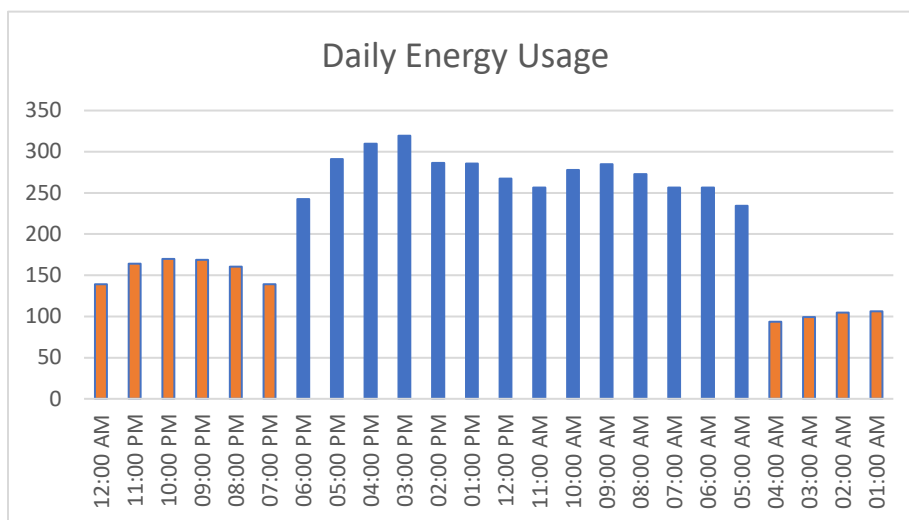


Figure 1: Daily Energy Usage

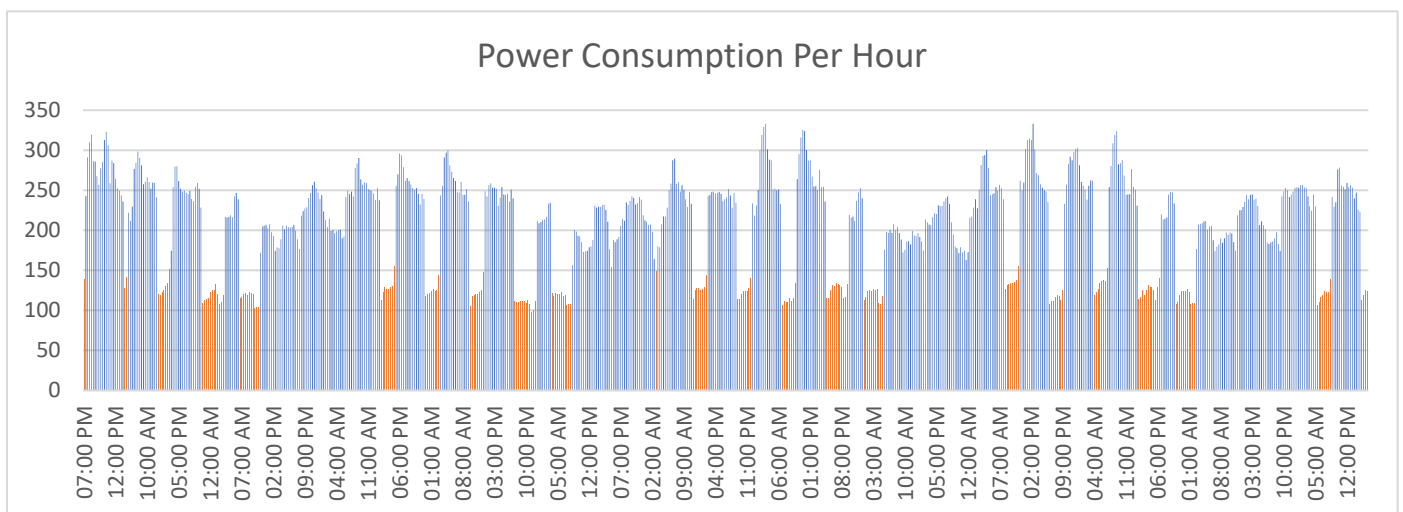
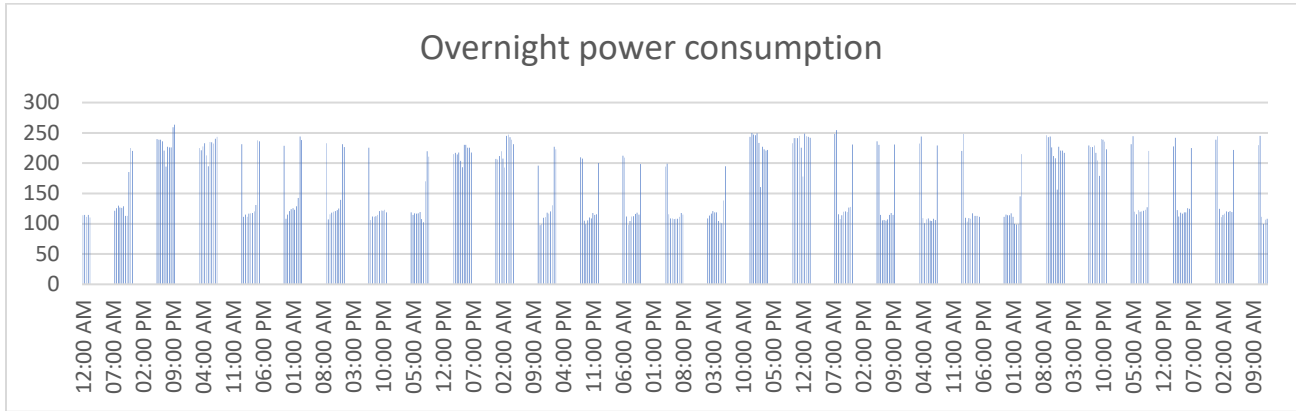


Figure 2: Power Consumption in a Month

From the FPL dashboard and the cooling load, the following calculations were found.



**Total Energy Savings:**

Estimated plug load = Energy used daily between (8pm-4am) - cooling load estimate during this time period

The summary of the energy savings is shown in Table 1 below.

**Table 1 Monthly plug load savigns**

Oct-22	11,039.3
Nov-22	11,039.3
Dec-22	15,337.2
Jan-23	13,563.4
Feb-23	12,406.5
Mar-23	12,918.9
Apr-23	7,716.5
May-23	7,818.7
Jun-23	6,306.0
Jul-23	5,216.4
Aug-23	11,039.3
Sep-23	11,039.3
<b>Total</b>	<b>125,440.8</b>

Energy Savings from Small Appliances during Non-Operating Hours

= 125,441 kWh

**Energy Cost Savings**

= Annual Energy Savings × Electrical Rate kWh

= 125,441 kWh × 0.068  $\frac{\text{dollars}}{\text{kWh}}$

= **\$8,530**

Since the savings result from energy saved away from peak times, there will be no demand savings from this recommendation.

**IMPLEMENTATION COST:**

It is estimated that it will take an existing staff member less than one hour a day to make sure devices are unplugged at the end of the day. No additional outside cost is needed.

**SIMPLE PAYBACK:**

The payback is immediate.

# SECTION 6

---

## ASSESSMENT RECOMMENDATION # 3 REPAIR REFRIGERANT LEAKS IN ROOF PACKAGED UNIT



## Assessment Recommendation #3: Repair Refrigerant Leaks in Roof Packaged Unit

### Opportunity

It was observed and also reported by maintenance personnel that one of the 100-ton packaged units is experiencing lots of refrigerant leaks. By improving the maintenance and ensuring that the system is running optimally without any refrigerant leaks, you can achieve higher efficiency. This results in less energy consumption and reduced utility bills.

### Recommended Action

If the HVAC unit requires frequent recharging of refrigerant, it's an indication of a leak somewhere in the system. Addressing this leak can prevent the need for constant recharges, saving money in the long run and ensuring optimal operation of the unit.

### Summary of Estimated Savings and Implementation Cost

- Estimated Total Cost Savings = \$3,400
- Estimated Implementation Cost = \$3,000
- Simple Payback = 0.88 years

### Implementation Cost:

The cost associated with this recommendation is approximated to be \$500 in materials and \$2,500 in labor.

### Anticipated Savings:

By repairing the refrigerant leaks and recharging the system, the building is expected to save approximately \$3,400 in maintenance cost.

### And Detailed Analysis

#### BACKGROUND:

R410A is a common refrigerant used in many HVAC systems. It's known for being non-ozone-depleting, but it is a greenhouse gas and has a Global Warming Potential (GWP).

In Case of a Leak:

It's essential to locate and fix the leak. Professionals should be called in to pinpoint the source of the leak and repair it. Do not vent R410A into the atmosphere; it should be reclaimed. It's critical to recharge the system with the exact



**Figure 1 Existing situation of leaking unit with the replacement refrigerant on floor**

amount of R410A. Overcharging or undercharging can lead to inefficiencies and potential system damage. Management reported that this particular unit required quite significant replacement of leaking refrigerant with an estimated recharge every 3 weeks. :

If the system is frequently leaking, it may be more cost-effective in the long run to replace the unit, especially if it's old. A newer unit will also likely be more energy-efficient, leading to energy savings. However, even regarding the existing recharging situation, there could be an opportunity for a significant amount of savings in maintenance cost just by properly repairing the unit.

### **ANTICIPATED SAVINGS:**

From Figure 1, it is estimated that the system takes an entire jug of R410A to recharge. If we assume the following:

1. The box contains a standard jug of refrigerant. These jugs typically come in 25 lb. quantities.
2. Maintenance has to recharge the unit every 3 weeks, which means approximately 17 times a year (52 weeks in a year divided by 3).

Then, we can calculate the following estimation (assuming the smaller size):

If one full jug is used every time:

$$17 \text{ jugs} \times 25 \frac{\text{lb}}{\text{jug}} = 425 \text{ lbs of refrigerant per year.}$$

The cost of refrigerants can vary greatly depending on the type of refrigerant and the market fluctuations., common refrigerants like R-410A might cost anywhere from \$8 to \$12 per pound (or even more, depending on various factors). Assuming the building uses the cheapest values to be conservative,

$$= 425 \text{ lbs} \times \frac{\$8}{\text{lb}} = \$3,400$$

So, based on these broad estimations, the cost for refrigerant alone could range between \$4,250 to \$15,300 annually. Note that these are just approximate costs and can vary based on actual refrigerant type, local prices, and labor costs for the recharge process.

### **IMPLEMENTATION COST:**

If the HVAC unit requires frequent recharging of refrigerant, it's an indication of a leak somewhere in the system. Addressing this leak can prevent the need for constant recharges, saving money in the long run and ensuring optimal operation of the unit. The ideal approach to address the issue involves:

- Leak Detection: The first step is to locate the leak(s). There are various methods to detect refrigerant leaks:
  - Electronic Leak Detectors: These are hand-held devices that detect refrigerant in the air.
  - Ultraviolet (UV) Dye: This is added to the refrigerant, and it circulates through the system. If there's a leak, the dye will seep out with the refrigerant and can be spotted using a UV light.
  - Soap and Water: Applying a soap and water solution to suspected leak sites. Bubbles will form if there's a leak.
  - Infrared Cameras: These can be used to visualize leaks in real-time.
- Leak Repair: Once the leak has been identified, it can be repaired. Common repair methods include:
  - Brazing: This involves using a torch to seal small leaks in copper lines.
  - Sealants: Some minor leaks can be sealed using specialized sealants, though this is usually a temporary solution.
- Part Replacement: In some cases, the faulty component (like a coil or a valve) might need to be replaced if it's the source of the leak.
- Recharging: After the leak has been addressed, the system should be recharged with refrigerant to its optimal level.
- Regular Maintenance: Periodic maintenance can help in early detection of potential issues, reduce the likelihood of future leaks, and ensure the system operates efficiently.

Costs:

Leak Detection: Costs can range from \$100 to \$400 or more depending on the method and region.

Leak Repair: The repair cost can vary widely based on the nature and location of the leak. A simple brazing might cost \$100-\$200, while replacing a major component like a coil can run from \$500 to \$2,000 or even more.

Estimated material cost: \$500.

Estimated labor cost: \$2,500.

Note: These are estimates only, for an accurate quote and assessment, it is essential to consult with a local HVAC professional to physically inspect the system.

Therefore, the total cost of implementation will be:

$$= \$2,500 + \$500$$

$$= \$3,000$$

**SIMPLE PAYBACK**

#1- Implementation Cost.....	\$3,000
#2- Total Annual Savings...../	\$3,400
#3- Simple Payback (year)..... =	0.88

# SECTION 7

---

---

**ASSESSMENT RECOMMENDATION # 4  
INSTALL AIR CURTAINS ON MAIN LOBBY DOORS**



## Assessment Recommendation # 4: Install Air Curtains on Main Lobby Doors

### Opportunity

At present, cool air is leaking from both the front and rear entrances of the main lobby area. These openings in doors are causing an additional cooling demand on the HVAC units. By effectively sealing these door openings, we can significantly reduce the loss of cold air, presenting a valuable opportunity for energy savings.

### Recommended Action

Make sure the front and back doors in the main lobby area are closed when not in use and install an air curtain to minimize the amount of cooled air escaping the plant.

### Summary of Estimated Savings and Implementation Cost

- Estimated Total Cost Savings = \$2,979
- Estimated kWh Energy Savings = 32,460 kWh
- Estimated Demand Savings = 62 kW-months
- Estimated Implementation Cost = \$4,472
- Simple Payback = 1.5 years

### Implementation Cost:

The cost associated with installing the air curtains with the necessary materials is \$4,152 and the cost of installation is \$320, for a total implementation cost of \$4,472.

### Anticipated Savings:

It is estimated that the company will save \$2,207 in annual energy cost and \$772 in electricity demand cost by installing air curtains for a total cost savings of \$2,979.

### Detailed Analysis

#### **BACKGROUND:**

Air curtains are typically used for one of the following three reasons:

1. In cold weather, they reduce the load on heating systems. By drawing warm air down to floor level where it is needed, air curtains utilize 25% of wasted heated air trapped under ceilings. Stratified air is mixed and circulated with building heat and heat given off by lights and machinery, etc.
2. The high velocity curtain of air deflects winds and reduces excessive heat loss through open doorways.
3. During warm weather, they can direct a stream of air downward to help keep dust, dirt, insects and fumes from entering through open doorways. If air conditioning exists in the building during warm weather, the air curtains can be used to prevent loss of conditioned air as well.

During the assessment visit, it was observed that warm air was entering the building through the main lobby doors that were open frequently, as well as a gap in the doors that was open all the time. The draft-leak is creating an extra cooling load on the cooling units. If these doors were properly protected, less cold air would escape, generating savings from the reduction of cooling demand.

At the time of assessment, we use an airflow meter to measure the wind velocity. We use data from Climate-data, for Miami, which states that the yearly average high daily temperature is 84°F (see Figure 1). Additionally, we use the Annual

Cooling Hours (ACH) for the manufacturing buildings, which is assumed to be during operating hours, 6,240<sup>1</sup> hours.

Furthermore, we installed a data logger that measures temperature in the main lobby. On average, the temperature in the interior part of the building was 72°F as per temperature data loggers.

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F	76	78	80	83	87	89
Average low in °F	60	62	65	68	73	76
Days with precipitation	6	5	6	7	10	13
Hours of sunshine	222	227	266	275	280	251
Av. precipitation in inch	1.62	2.25	3.00	3.14	5.34	9.67

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F	91	91	89	86	82	78
Average low in °F	77	77	76	74	68	63
Days with precipitation	17	16	18	15	8	7
Hours of sunshine	267	263	216	215	212	209
Av. precipitation in inch	6.50	8.88	9.86	6.33	3.27	2.04

Figure 1: Doral, FL Climate Graph<sup>2</sup>

**ANTICIPATED SAVINGS:**

The annual Cooling Energy Savings (CES) obtained by reducing infiltration can be estimated from the following relationship:

$$CES = \frac{C_p \times \rho \times v \times A \times \Delta T}{CoP} \times (ACH \times C_1 \times C_2 \times F_2 \times TO)$$

Where,

$C_p = 0.241 \text{Btu/lb}^\circ\text{F}$	Specific heat of infiltrating air
$\rho = 0.0788 \text{lb/ft}^3$	Density of air
$V(\text{ft/min})$	Wind velocity in this area
$A (\text{ft}^2)$	Area of infiltration opening
$\Delta T = T_2 - T_1$	Change in temperature
$T_1$	Temperature where cooled air is escaping

<sup>1</sup> Based on operating schedule 24 hours per day, 5 days per week, and 52 weeks per year

<sup>2</sup> <https://www.usclimatedata.com/climate/miami/florida/united-states/usfl0316>

$T_2$	Average High Temperature outside
$Cop = 2$ (conservative estimate)	Coefficient of performance
ACH = 6240 hrs/yr	Annual cooling hours
$C_1 = 60$ min/h	Conversion constant
$C_2 = 0.0002928$ kWh/Btu	Conversion factor
$F_2 = 50\%$	Fraction of infiltration that can be avoided
TO = 15%	Percentage of time the doors are open

Cooling Energy Savings from Gap:

In both the front and back doors of the main lobby, a gap is evident, leading to continuous air release at 100% efficiency. The doors remain open throughout the year, totaling 6,240 hours annually, and this gap significantly affects the calculation of cooling energy savings.

$$\begin{aligned}
 CES_{\text{gap front door}} &= 1 \text{ gap} \\
 &\times \left[ \left( \frac{0.241 \text{ Btu}}{\text{lb}} \text{ } ^\circ\text{F} \right) \left( \frac{0.0788 \text{ lb}}{\text{ft}^3} \right) \left( 990 \frac{\text{ft}^3}{\text{min}} \right) (80 - 72) ^\circ\text{F} \right. \\
 &\quad \left. \times (6240/\text{yr})(60\text{min}/\text{hr})(0.0002928\text{kwh}/\text{Btu})(0.50)(1) \right] \\
 &= \mathbf{8,244} \frac{\text{kWh}}{\text{yr}}
 \end{aligned}$$

Where the measured CFM (wind velocity x area) was recorded as 990 cfm.

$$\begin{aligned}
 CES_{\text{gap backdoor}} &= 1 \text{ gap} \\
 &\times \left[ \left( \frac{0.241 \text{ Btu}}{\text{lb}} \text{ } ^\circ\text{F} \right) \left( \frac{0.0788 \text{ lb}}{\text{ft}^3} \right) \left( 1152 \frac{\text{ft}^3}{\text{min}} \right) (77 - 74) ^\circ\text{F} \right. \\
 &\quad \left. \times (6240/\text{yr})(60\text{min}/\text{hr})(0.0002928\text{kwh}/\text{Btu})(0.50)(1) \right] \\
 &= \mathbf{3,597} \frac{\text{kWh}}{\text{yr}}
 \end{aligned}$$

Where the measured CFM (wind velocity x area) was recorded as 1152 cfm.

Cooling Energy savings from Front Door:

$$\begin{aligned}
 CES_{\text{front door}} &= 1 \text{ door} \\
 &\times \left[ \left( \frac{0.241 \text{ Btu}}{\text{lb}} \text{ } ^\circ\text{F} \right) \left( \frac{0.0788 \text{ lb}}{\text{ft}^3} \right) \left( 11,883 \frac{\text{ft}^3}{\text{min}} \right) (80 - 72) ^\circ\text{F} \right. \\
 &\quad \left. \times (6,240/\text{yr})(60\text{min}/\text{hr})(0.0002928\text{kwh}/\text{Btu})(0.5)(0.15) \right] \\
 &= \mathbf{14,843} \frac{\text{kWh}}{\text{yr}}
 \end{aligned}$$

Where the measured CFM (wind velocity x area) was recorded as 11,883 cfm.

Cooling Energy savings from Back Door:

$$\begin{aligned} \text{CES}_{\text{backdoor}} &= 1 \text{ door} \\ &\times \left[ \left( \frac{0.241 \text{ Btu}}{\text{lb}} \text{ } ^\circ\text{F} \right) \left( \frac{0.0788 \text{ lb}}{\text{ft}^3} \right) \left( 13,821 \frac{\text{ft}^3}{\text{min}} \right) (77 - 74) ^\circ\text{F} \right. \\ &\quad \left. \times (6240/\text{yr})(60\text{min}/\text{hr})(0.0002928\text{kWh}/\text{Btu})(0.5)(0.15) \right] \\ &= \mathbf{6,474} \frac{\text{kWh}}{\text{yr}} \end{aligned}$$

Where the measured CFM (wind velocity x area) was recorded as 13,821 cfm.

Cooling energy savings two doors:

$$\begin{aligned} &= (\text{CES}_{\text{front door}} + \text{CES}_{\text{Gap 1}}) + (\text{CES}_{\text{back door}} + \text{CES}_{\text{Gap 2}}) \\ &= \left( 14,843 \frac{\text{kWh}}{\text{yr}} + 8,244 \frac{\text{kWh}}{\text{yr}} \right) + \left( 6,474 \frac{\text{kWh}}{\text{yr}} + 3,597 \frac{\text{kWh}}{\text{yr}} \right) \\ &= \mathbf{33,158} \frac{\text{kWh}}{\text{yr}} \end{aligned}$$

Next, the energy consumption of the new air curtains must be deducted from the savings.

Energy Consumption from Air Curtain for Front & Back Door<sup>3</sup>:

$$\begin{aligned} &= \text{Two air curtains} \times \frac{1}{2} \text{ HP motor} \times 0.746 \frac{\text{kW}}{\text{HP}} \times 6240 \frac{\text{hr}}{\text{yr}} \times 15\% \text{ Operating time} \\ &= \mathbf{698} \frac{\text{kWh}}{\text{yr}} \end{aligned}$$

**Net Electric Energy Savings** are therefore:

$$\begin{aligned} &= \text{Cooling Energy Savings} - \text{Sum of Air curtain consumption} \\ &= 33,158 \frac{\text{kWh}}{\text{year}} - 698 \frac{\text{kWh}}{\text{year}} \\ &= \mathbf{32,460} \frac{\text{kWh}}{\text{year}} \end{aligned}$$

The **annual cooling cost savings, CCS**, is estimated as follows:

$$\begin{aligned} &= \text{Net Energy Savings} \times \text{effective energy rate} \\ &= 32,460 \frac{\text{kWh}}{\text{year}} \times 0.068 \frac{\$}{\text{kWh}} \end{aligned}$$

<sup>3</sup><https://www.grainger.com/product/BERNER-Unhtd-15-H-75-W-18-D-Alumin-6JGG1>

$$= 2207 \frac{\$}{\text{year}}$$

**Demand Savings** are calculated as:

The corresponding **Demand Savings** is:

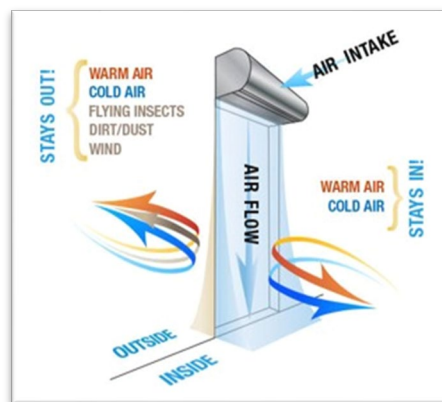
$$\begin{aligned}
 &= \frac{\text{Annual kWh}}{\text{Annual hrs}} \times 12 \text{ months} \times \text{Demand Charge} \\
 &= \frac{32,460 \text{ kWh}}{6,240 \text{ hrs}} \times 12 \text{ months} \times \$12.369 \frac{\$}{\text{kW month}} \\
 &= 62 \text{ kW months} \times \$12.369 \frac{\$}{\text{kW month}} \\
 &= \$772 / \text{yr}
 \end{aligned}$$

**Total Annual Cost Saving**

$$\begin{aligned}
 &= \text{Energy Cost Savings} + \text{Demand Cost Savings} \\
 &= \$2207 + \$772 \\
 &= \$2979 \frac{\$}{\text{yr}}
 \end{aligned}$$

**IMPLEMENTATION COST:**

The company needs to purchase two standard velocity industrial air curtains, one for the front door of the main lobby, and one for the back door. These air curtains will be installed just above the doors. Besides the cost of the unit, an additional cost in electrical parts, switches, and mounting hardware is estimated for each unit. Also, it will take a maintenance operator approximately 4 hours at \$40/hour to install one unit. Therefore, the cost of the unit is calculated as follows:



**Figure 2. Air curtain**

Material Cost:

An air curtain for a door width of 6ft, a mounting height of 10ft, and nominal voltage of 120V installation costs on average \$1,826<sup>4</sup>. We also estimate an additional \$250 in hardware per door.

**Material Cost**

$$\begin{aligned}
 &= \text{Total Cost of 2 unit of Air Curtains + Hardware} \\
 &= (\$1,826 \times 2 \text{ unit}) + (\$250 \times 2 \text{ unit}) \\
 &= \mathbf{\$4,152}
 \end{aligned}$$

**Labor** is approximated at \$40/hr.:

$$\begin{aligned}
 &= (2 \text{ unit}) \times \left( 4 \text{ hours} \times \frac{\$40}{\text{hr}} \right) \\
 &= \mathbf{\$320}
 \end{aligned}$$

**Total Implementation** is thus:

$$\begin{aligned}
 &= \text{Material Cost + Labor Cost} \\
 &= \$4,152 + \$320 \\
 &= \mathbf{\$4472}
 \end{aligned}$$

**SIMPLE PAYBACK**

#1- Implementation Cost.....	\$4,472
#2- Total Annual Savings..... / _____	\$2,979
#3- Simple Payback (years)..... =	1.50

---

<sup>4</sup> [Air Curtains - Grainger Industrial Supply](#)

# SECTION 8

---

---

**ASSESSMENT RECOMMENDATION #5  
APPLY WHITE REFLECTIVE COATING ON ROOF**



## Assessment Recommendation #5: Apply White Reflective Coating on Roof

### Opportunity

Currently, the roof covering the Commercial building does not have a reflective coating. By adding a white reflective coating to the roof, the amount of heat absorbed by the roof from the sun is reduced; thus, decreasing the amount of cooling required in the facility and generating potential savings. Decreasing the cooling costs will result in operational savings for the facility<sup>1</sup>.

### Recommended Action

Coat the Commercial building's roof with a white reflective paint.

### Summary of Estimated Savings and Implementation Cost

- Estimated Annual Total Savings = \$2,244
- Estimated Annual Energy Savings = 17,937 kWh
- Estimated Annual Demand Savings = 83 kW-months
- Estimated Implementation Cost = \$7,687
- Simple Payback = 3.4 years

#### Implementation Cost:

The cost associated with painting the roof is \$1,284 in labor cost and \$6,404 in materials cost resulting in \$7,687 for total implementation cost.

#### Anticipated Savings:

By painting the roof with white elastomeric paint, the company will save \$1,220 in energy cost savings and \$1,023.99 in demand cost savings totaling \$2,244 savings per year.

### Detailed Analysis

#### **BACKGROUND:**

Increasing a roof's solar reflectance, by either applying elastomeric paint or pressure washing an already painted surface, will decrease the amount of heat absorbed by the roof. When the solar reflectance is low, the roof absorbs a large amount of the heat generated from the sun, increasing the temperature of the facility. In addition, it is common to observe a higher roof surface temperature compared to the ambient temperature when there is an uncoated surface. An example of this phenomenon is observed in Figure 1, where we display the infrared image of a dark bitumen roof (solar reflectance 0.05).



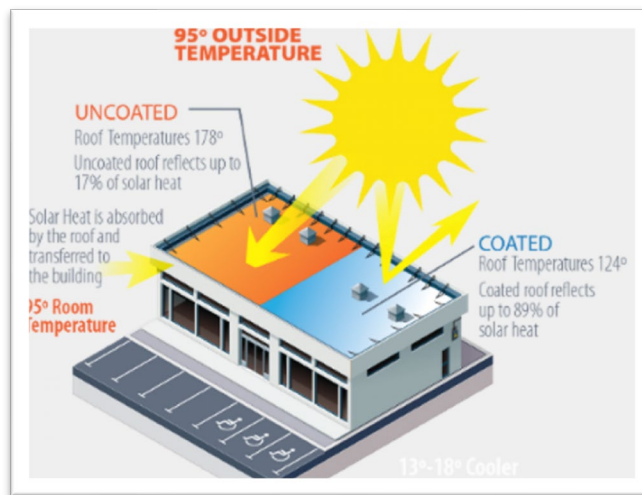
<sup>1</sup> <https://energy.gov/energysaver/energy-efficient-home-design/cool-roofs>

**Figure 1. Thermal Image of Traditional Bitumen Roof<sup>2</sup>**

Solar reflectance along with thermal emittance have considerable effects on roof surface temperature. Conventional roof surfaces have low reflectance but high thermal emittance; an example of this scenario, are standard black asphalt roofs, which can reach temperatures from 165°F to 185°F at midday during the summer. Even though these peak values vary by local conditions, research reveals that conventional roofs can be 55 to 85°F hotter than the air on any given day, while roofs with a cool reflective coating tend to stay within 10 to 20°F of the background temperature.

Due to the peak temperatures at the roof's surface, the facility's cooling load increases in order to remove the absorbed solar heat, which then, increases the overall energy consumption. To decrease the absorbed solar heat, we recommend increasing the roof's solar reflectance by two strategies: apply a white reflective coating to an uncoated surface, or pressure wash an existing coated roof every 3 years. Both strategies produce a larger solar reflectance, where values closer to 1 achieve larger energy savings.

For the first strategy, one of the most known and affordable coatings is applying elastomeric paint. Elastomeric paint is a thick, high fill paint with a flat, non-gloss smooth finish. The paint contains polymeric materials, like acrylic and titanium dioxide, which give the coating its white pigment and reflective qualities. This paint reflects a large amount of the heat generated from the sun. This decreases the amount of energy needed to cool the facility. This effect is shown in Figure 2.



**Figure 2. Cool roofing effect on outside temps**

The white color of this acrylic elastomeric roof coating provides two unique features:

- It reduces the temperature of the roof membrane to which it is applied. This, along with the UV blocking properties of the coating, reduces the degradation and deterioration of the roofing membrane enabling it to last longer.
- It has solar reflectance of 65 percent or higher when new and have a thermal emittance of 80 to 90 percent or more.

For more information about acrylic, elastomeric roof coatings visit <http://www.nationalcoatings.com/acrylic-roof-coatings-101/>. This site offers information about considerations and cost performances of reflective roof coatings.

To determine the savings, a Cool Roof Calculator<sup>3</sup> is used to compare savings of a proposed cool roof with varying reflectance values, to that of a black roof. The Cool Roof Calculator uses a baseline reflectance of 0.05 (black

<sup>2</sup> [https://www.epa.gov/sites/production/files/2017-05/documents/reducing\\_urban\\_heat\\_islands\\_ch\\_4.pdf](https://www.epa.gov/sites/production/files/2017-05/documents/reducing_urban_heat_islands_ch_4.pdf)

<sup>3</sup> <https://web.ornl.gov/sci/buildings/tools/cool-roof/peak/>

membrane). The calculator considers R-value (thermal resistance), solar reflectance, infrared emittance, cost of electricity and demand, air conditioning efficiency, and location of the facility<sup>4</sup>.

An aerial view of the facility is displayed in Figure 3, where the areas that need to be painted were estimated.



**Figure 3. Main Building Top View**

#### **ANTICIPATED SAVINGS:**

To determine savings, we use the cool roof calculator for the uncoated areas (100% of the total area). This calculator estimates savings for non-black surfaces with the assumption that the original roof is black bitumen.

#### **Shared calculator inputs for grey gravel roof and proposed roof**

- My city: Hialeah, FL
- R-value: we use the average value of 10.
- Energy Costs (summertime and winter): Energy and Demand costs obtained through utility bill analysis shown in Appendix A. \$0.068 /kWh and \$12.369/kW.
- Air Conditioner Efficiency (COP): assumed average efficiency of 2
- Heating System Efficiency: assumed average efficiency of 0.7, this term is not very useful for temperatures in Southern Florida.
- Months Charged for Peak Demand: According to annual weather conditions and average in indoor temperatures above 70°F, there were 10 months out of the year in which the average temperature per month was above the indoor temperature<sup>5</sup>.

#### **Specific inputs for proposed high solar reflectance roof**

- Solar Reflectance, SR: Depending on the type of coating used, this number can vary. We recommend companies to purchase Energy Star Coatings which have a high reflectance<sup>6</sup>. The Energy Star Website contains an updated list of all certified materials including SR and IE values. It is important to mention that more savings can be achieved with a higher SR coefficient, but at a higher implementation cost. Furthermore,

<sup>4</sup> <https://web.ornl.gov/sci/buildings/tools/cool-roof/input/>

<sup>5</sup> <https://en.climate-data.org/north-america/united-states-of-america/florida/deerfield-beach-1624/>

<sup>6</sup> [https://www.energystar.gov/products/building\\_products/roof\\_products](https://www.energystar.gov/products/building_products/roof_products)

the calculator does not accept SR values above 85. For this company, we suggest Acrymax AF-130<sup>7</sup> with an initial reflectance of 83. The reflectance degrades after 3 years to 75. We use a conservative average of **50**.

- Infrared Emittance, IE: Obtained from product specification, 90.

My State Florida ▾

My City Miami ▾

Click to see [Data for All 243 Locations](#)

My Proposed Roof:

R-value (HIGH=20; AVG=10; LOW=5) [h·ft<sup>2</sup>·°F/Btu] 10

Solar reflectance, SR (HIGH=80; AVG=50; LOW=10) [%] 50

Infrared emittance, IE (HIGH=90; AVG=60; LOW=10) [%] 90

My Energy Costs and Equipment Efficiencies:

Summertime cost of electricity (HIGH=0.20; AVG=0.10; LOW=0.05) [\$/KWh] 0.068

Air conditioner efficiency (COP) over cooling season (HIGH=2.5; AVG=2.0; LOW=1.5) 2

Energy source for heating (choose one)  Electricity  Fuel

If electricity, wintertime cost (HIGH=0.20; AVG=0.10; LOW=0.05) [\$/KWh] 0.068

If fuel, cost (Natural gas: HIGH=1.00; AVG=0.70; LOW=0.50) [\$/Therm]

(Fuel oil: 2002 East coast=0.85; 2002 Midwest=0.70) [\$/Therm]

Heating system efficiency (Furnace or boiler: HIGH=0.8; AVG=0.7; LOW=0.5)

(Electric heat pump: HIGH=2.0; AVG=1.5) (Electric resistance: 1.0) 0

My Electricity Demand Charges and Duration:

Demand charge during cooling season (HIGH=15.00; AVG=10.00; LOW=5.00) [\$/KW] 12.369

Months charged for peak demand (Typical = 6) [-] 10

**Figure 4. Cool Roof Calculator Input**

The savings are obtained by comparing electric consumption and demand when using black roof versus a higher reflectance coating. Figure 5 shows the resulting savings per square foot<sup>8</sup>. We only use cooling energy savings due to the company's location.

<sup>7</sup> [http://www.acrymax.com/PDF/AF-130-ProductData-2004\(Rev.2\).pdf](http://www.acrymax.com/PDF/AF-130-ProductData-2004(Rev.2).pdf)

<sup>8</sup> A degree-day is a unit used to determine the heating or cooling requirements of buildings, representing a fall of one degree below a specified average outdoor temperature (usually 65°F) for one day.

Total Annual Energy + Demand Savings (relative to a black roof) [\$/ft <sup>2</sup> per year]	-Infinity
Cooling energy savings [\$/ft <sup>2</sup> per year]	0.076
Heating energy savings (heating penalty if negative) [\$/ft <sup>2</sup> per year]	-Infinity
Cooling season demand savings [\$/ft <sup>2</sup> per year]	0.091
Insulation in Black Roof for Same Total Annual Energy Savings (ignores demand savings):	
Upgrade from R- <input type="text" value="10"/> to R- <input type="text" value="NaN"/> [h·ft <sup>2</sup> ·°F/Btu]	
Details of Energy and Demand Savings:	
Heating degree days for location chosen [Annual °F-day]	<input type="text" value="141"/>
Cooling degree days for location chosen [Annual °F-day]	<input type="text" value="4126.5"/>
Solar load for location chosen [Annual average Btu/ft <sup>2</sup> per day]	<input type="text" value="1556.8"/>
Cooling load for black roof (SR=5%;IE=90%) [Btu/ft <sup>2</sup> per year]	<input type="text" value="18193"/>
Heating load for black roof (SR=5%;IE=90%) [Btu/ft <sup>2</sup> per year]	<input type="text" value="650"/>
Cooling load for proposed roof [Btu/ft <sup>2</sup> per year]	<input type="text" value="10562"/>
Heating load for proposed roof [Btu/ft <sup>2</sup> per year]	<input type="text" value="715"/>
Average heat load reduction during cooling season [Btu/ft <sup>2</sup> each month]	<input type="text" value="5"/>
Maximum heat load reduction during cooling season [Btu/ft <sup>2</sup> ]	<input type="text" value="5.6"/>

**Figure 5. Savings for the proposed roof with a high reflectance of 83**

**Energy Cost Savings:**

Energy savings in dollars are calculated as Cooling Energy Savings per Sq. ft. (as given by the output of the calculator) multiplied by the total area to be painted which we estimate is 100% of the total roof area of 16,049.00 ft<sup>2</sup>. However, we must first compute the difference in savings from the grey roof to the proposed roof (which results in savings of 0.005 \$/ft<sup>2</sup>).

**Energy Cost Savings**

$$\begin{aligned}
 &= \text{Cooling Energy Savings per Sq Feet} \times \text{Area} \times 25\% \\
 &= \frac{0.076 \frac{\$}{\text{ft}^2} \times 16,049.00 \text{ ft}^2}{\text{yr}} \times 100\% \\
 &= \$1,220 \frac{\$}{\text{yr}}
 \end{aligned}$$

**This is equivalent to Energy Savings:**

$$\begin{aligned}
 &= \frac{\text{Energy Cost Savings}}{\text{Energy Cost}} \\
 &= \frac{\$1,220 \frac{\$}{\text{yr}}}{\$0.068 \frac{\$}{\text{kWh}}} \\
 &= 17937.12 \frac{\text{kWh}}{\text{yr}}
 \end{aligned}$$

There is also a corresponding **Demand Savings** that is calculated below:

Demand is a term to describe how much electricity is used at any given moment. Most businesses have a meter that tracks and records the highest 30-minute level of electricity demand for each billing period. Demand is measured in kilowatts (kW), while the total amount of electricity used is measured in kilowatt-hours (kWh). When energy savings are achieved, it is not always possible to accurately know when these savings are achieved and thus, demand savings have to be estimated. One of the methods used to estimate demand savings averages the electrical savings through the operational hours and multiplies them by a factor of 12 to obtain an estimate of kW-month savings.

$$\begin{aligned}
 &= \frac{\text{Energy Savings}}{\text{Annual hours}^9} \times 12 \text{ Months} \\
 &= \frac{17937.12 \text{ kWh}}{2600 \text{ hours}^{10}} \times 12 \text{ Months} \\
 &= 82.787 \text{ kW} - \text{Months}
 \end{aligned}$$

**Demand Cost Savings:**

$$\begin{aligned}
 &= 82.787 \text{ kW} \times \$12.369 \frac{\$}{\text{kW}} \\
 &= \$1,023.99
 \end{aligned}$$

**The Total Cost Savings are:**

$$\begin{aligned}
 &= \text{Energy Savings} + \text{Demand Savings} \\
 &= \$1,220 + \$1,023.99 \\
 &= \$2,244
 \end{aligned}$$

**IMPLEMENTATION COST:**

The implementation costs of this recommendation can take several factors included size, type, complexity, and building location. The U.S Environmental Protection Agency estimates Cool roof coatings might cost between \$0.75 and \$1.50 per square foot for materials and labor, which includes routine surface preparation like pressure-washing, but which does not include repair of leaks, cracks, or bubbling of the existing roof surface<sup>11</sup>.

As previously mentioned, one of the high reflectance coatings that can be purchased is the Acrymax AF-130. A 5-gallon bucket can be purchased at a cost of \$199.50 and can cover 100 ft<sup>2</sup> per bucket. The process requires that the surface has been properly treated and primed before application of the cool coat white insulating paint. The application method can be an airless sprayer, or a roller as shown in Figure 6. The company may also consider applying an extra layer of paint. However, for the purposes of our calculations, we shall consider only one coat.

**Material Cost**

Total cost of cool coat white insulating elastomeric paint

$$\begin{aligned}
 &= 16,049.00 \times 100\% \times \frac{1 \text{ gallon}}{100 \text{ sq.ft.}} \times \frac{1 \text{ bucket}}{5 \text{ gallons}} \times \$199.50 \frac{\$}{\text{bucket}} \\
 &= \$6,404
 \end{aligned}$$

<sup>9</sup> Based on operating hours for manufacturing, 13 hours per day, 5 days per week, 52 weeks per year

<sup>10</sup> Production and offices schedules run Monday through Friday from 7:00 am to 1:00 am, split into two shifts. This totals 13 hours per day, 5 days per week, 52 weeks per year

<sup>11</sup> [https://www.epa.gov/sites/production/files/2017-05/documents/reducing\\_urban\\_heat\\_islands\\_ch\\_4.pdf](https://www.epa.gov/sites/production/files/2017-05/documents/reducing_urban_heat_islands_ch_4.pdf)



**Figure 6. Cool coating being sprayed onto a rooftop**

We now calculate the labor cost for both painting the roof. It is conservatively estimated that a maintenance worker can paint the roof at a rate of 500 ft<sup>2</sup>/hour at \$40 per hour labor cost.

**Labor Cost**

$$\begin{aligned}
 &= \text{Labor Cost Painting} \\
 &= \frac{16,049.00 \text{ ft}^2 \times 100\%}{500 \frac{\text{ft}^2}{\text{hr}}} \times \$40 \frac{\$}{\text{hr}} \\
 &= \$1,284
 \end{aligned}$$

**Total Implementation Cost:**

$$\begin{aligned}
 &= \text{Material Cost} + \text{Labor Cost} \\
 &= \$6,404 + \$1,284 \\
 &= \$7,687
 \end{aligned}$$

**SIMPLE PAYBACK**

#1· Implementation Cost.....	\$7,687
#2· Total Annual Savings..... /	\$2,244
#3· Simple Payback (years)..... =	3.43

# SECTION 9

---

---

## ASSESSMENT RECOMMENDATION # 6 CONTROL AC IN CHAMBER ROOM



## Assessment Recommendation # 6: Control AC in Chamber Room

### Opportunity

The Chamber Room is only occupied for four to six hours every week. However, the air conditioner is on at all times. After logging the temperature in the air-conditioned portions of the Chamber Room, the average temperature during operating and non-operating hours was determined to be set at 71° F. According to the American Society of Heating, Refrigerating, and Air Conditioning Engineers, ASHRAE<sup>1</sup>, the ideal temperature for a working environment during operating hours is 75°F and 65% humidity. By increasing the thermostat setting to 75°F, potential energy savings can be realized. By increasing the thermostat setting to 75°F then potential energy savings can be realized.

### Recommended Action

Ask building management to modify the Building Management System (BMS) temperatures for the Chamber Room to 75° F for all the cooled portions of the Chamber Room.

### Summary of Estimated Savings and Implementation Cost

- Estimated Total Cost Savings = \$1,845
- Estimated Energy Savings = 20,048 kWh/yr
- Estimated Implementation Cost = \$0
- Simple Payback = Immediate

### Implementation Cost:

The cost associated with controlling the AC in the Chamber Room is \$0.

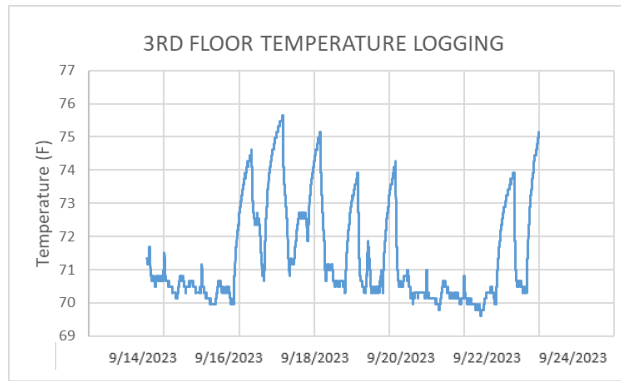
### Anticipated Savings:

By adjusting the thermostat temperature settings in the Chamber Room, the management will realize \$1,363 in annual energy cost savings and \$482 in demand cost savings, for total cost savings of \$1,845.

### Detailed Analysis

#### **BACKGROUND:**

It was observed through our data logging session that the temperature in the air-conditioned spaces for the Chamber Room was 71° F during both operating and non-operating hours as shown in **Figure 1**. It is recommended that the facility increases the air temperature. The overall cooling load is based on data logging from RTU#2, which delivers cooling to floor 3, where the Chamber Room is located. These cooling units are the focus for savings.



**Figure 1 Temperature logging of 3<sup>rd</sup> Floor of Facility**

It is recommended that the building increases the thermostat settings gradually to 75°F. According to the Florida Light & Power Building (FPL), for every degree raised in temperature, the building can save about 5% on monthly cooling costs during the summer months. In addition, assuming slow air movement (less than 40 feet per minute) and 65% indoor relative humidity, the operative temperatures recommended by ASHRAE range from 68.5°F to 75°F in the winter, and from 75°F to 80.5°F in the summer. The difference in temperature ranges between the seasons is largely due to clothing selection. ASHRAE also recommends that indoor relative humidity be maintained at or below 65% [ANSI/ASHRAE 2013b]<sup>1</sup>.

There are five main cooling loads for air conditioning:

1. Conduction and convection through walls, windows, etc.
2. Absorption of solar radiation on walls, windows, etc.
3. Heat emission of occupants.
4. Infiltration of warm outdoor air.
5. Heat emission of lights and other electrical or mechanical purposes.

By increasing the temperature to ASHRAE’s standard of 75°F, the cooling load will be reduced due to the reduction of Cooling Degree days (CDD). A degree-day is a measure of heating or cooling. A degree-day is defined as a departure of the mean daily temperature from a given standard: one degree-day for each degree of departure above (or below) the base temperature for one day. The degree-day is related to the outside temperature and is not related to time.

**ANTICIPATED SAVINGS:**

On the day of the assessment, electric data loggers were installed on the AC unit for the facility. These loggers captured the energy consumption of the unit, allowing us to analyze the cooling demand for several weeks during September 2023. This information is shown in Tables 1. The cell that is highlighted in yellow is the total energy consumption for one week. Complete logging data analysis is presented in Appendix B.

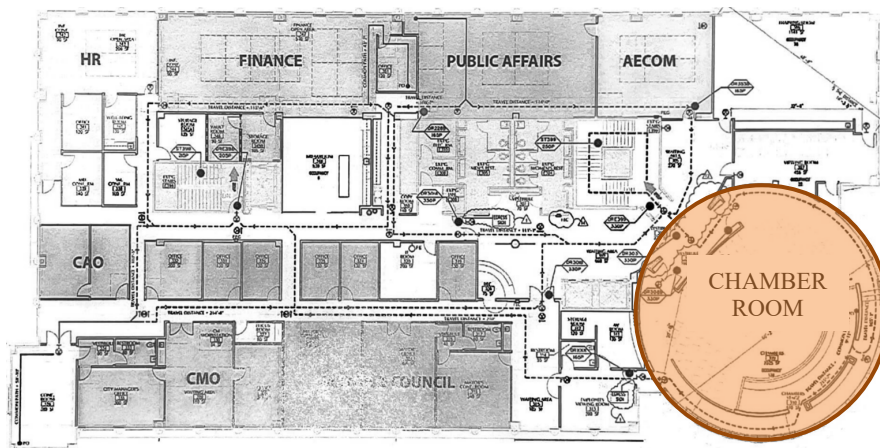
To adjust for seasonality and to estimate an annual consumption, we consider Cooling Degree Days (CDD). A cooling degree-day is every degree that the mean temperature is above 71 or 72 degrees during a day. Therefore, if the high temperature for the day is 95, and the minimum is 51, the average temperature for the day is 73. That would be 1 or 2 cooling degree-days (73-72 or 73-71). This way we can calculate the CDD with respect to a different base temperature. In our case, we will use the data for CDD with respect to 71 base <sup>2</sup>, which will allow us to calculate exactly how many days cooling is needed according to the outside temperature. The location chosen is Miami International Airport Weather Station due to its proximity to Doral, FL, where the building is located.

<sup>1</sup> <https://www.cdc.gov/niosh/topics/indoorenv/temperature.html>

<sup>2</sup> The data for Doral can be downloaded from here <https://www.degree-days.net/>. For our purposes, we use the monthly data; however, daily data are also available.

**Table 1. RTU#2 weekly energy consumption**

Vertical Cross Analysis					
#	Day	Cost (\$)	Kw-Hrs	Pctg	Cumu %
1-	Monday	\$115.7	1701.6	18.96%	18.96%
2-	Tuesday	\$85.5	1256.7	14.00%	32.96%
3-	Wednesday	\$75.0	1102.4	12.28%	45.24%
4-	Thursday	\$83.4	1226.9	13.67%	58.91%
5-	Friday	\$97.4	1432.7	15.96%	74.87%
6-	Saturday	\$78.5	1153.9	12.86%	87.73%
7-	Sunday	\$74.9	1101.5	12.27%	100%
8-	Work Week	\$457.0	6720.3	74.9%	74.9%
9-	Week End	\$153.4	2255.4	25.1%	100%
10-	Total Week	\$610	8975.7	100%	100%



**Figure 2 Chamber Room Area in 3<sup>rd</sup> Floor of Facility**

From Table 1, we calculated the weekly consumption of the RTU#2 to be 8,976 kWh/week for both non-operating and operating hours. Since the RTU#2 cools the entire third floor, we included a 17.60% conservation factor, which is the percentage of the Chamber Room area in the building, as highlighted in **Figure 2**. Likewise, there is a 96% utilization factor added to the calculation, which is the time the room is unoccupied, as the room is only used a maximum of six hours per week. The calculation would be as follows:

$$= 8,976 \times 17.60\% \times 96\% = 1,523 \text{ kWh}$$

**Monthly Cooling Load**

To estimate the monthly cooling load for this area for the month of September, we multiply the weekly consumption by 4.

$$= 1,523 \times 4 = 6,093 \text{ kWh}$$

The daily mean temperature in September 2023 was 82°F on average. The number of cooling degree-days for this month is 373.3 degree-days if the base temperature was 71°F and 254.7 degree-days if the base was 75°F as we suggest. This is equivalent to consuming

$$= \frac{6,093 \text{ kWh}}{373.3 \text{ CDD}}$$

$$= 16.32 \text{ kWh/CDD}$$

By increasing the thermostat temperature to 75, the number of degree-days will reduce to 254.7 degree-days only. This means that the facility will not require as much cooling as before. Rather, the cooling load will now be:

$$\begin{aligned}
 &= \text{Number of cooling degree days @ base 75} \times \frac{\text{kWh}}{\text{Cooling degree day}} \\
 &= 254.7 \text{ CDD} \times 16.32 \frac{\text{kWh}}{\text{CDD}} \\
 &= 4,158 \text{ kWh}
 \end{aligned}$$

September kWh Savings will now be:

$$\begin{aligned}
 &= 6,093 \text{ kWh} - 4,158 \text{ kWh} \\
 &= \mathbf{1,936 \text{ kWh}}
 \end{aligned}$$

These savings are equivalent to 32% of the monthly cooling load. Similar calculations were carried out for the rest of the year as seen in Table 3 below.

**Table 2. Energy Savings**

Month	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Total
Cooling Load (kWh)	4,541	3,625	1,925	1,815	2,233	2,992	3,820	4,869	5,893	7,487	7,473	6,093	52,767
Daily Mean Temperature (°F)	79	74	70	67	69	72	75	79	82	83	83	82	
Number of CDD @71°F	278.2	222.1	117.9	111.2	136.8	183.3	234	298.3	361	458.7	457.8	373.3	
kWh/CDD @ 71	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	
Number of CDD @75°F	166.4	120.4	44.9	45.4	60.7	92.1	128.7	180.1	242.5	334.7	333.8	254.7	
Projected consumption at 75°F	2,716	1,965	733	741	991	1,503	2,101	2,940	3,958	5,463	5,449	4,158	32,718
Energy Savings (kWh)	1,825	1,660	1,192	1,074	1,242	1,489	1,719	1,929	1,934	2,024	2,024	1,936	20,048

Using this method, **Total Annual Energy Savings:**

$$\begin{aligned}
 &= 52,767 \text{ kWh} - 32,718 \text{ kWh} \\
 &= \mathbf{20,048 \frac{\text{kWh}}{\text{yr}}}
 \end{aligned}$$

The corresponding **Energy Cost Savings:**

$$\begin{aligned}
 &= 20,048 \frac{\text{kWh}}{\text{yr}} \times \$0.068 \frac{\$}{\text{kWh}} \text{ (From Appendix A)} \\
 &= \mathbf{\$1,363 \frac{\$}{\text{yr}}}
 \end{aligned}$$

**Demand Savings**

$$\begin{aligned}
 &= \frac{\text{Annual kWh Savings}}{\text{Annual Operating Hours}} \times 12 \text{ months} \\
 &= \frac{20,048 \text{ kWh}}{6240 \frac{\text{hr}}{\text{yr}}} \times 12 \frac{\text{month}}{\text{yr}} \\
 &= \mathbf{39 \text{ kW months}}
 \end{aligned}$$

The corresponding **Demand Cost Savings:**

$$\begin{aligned}
 &= 39 \text{ kW months} \times \$12.369 \frac{\$}{\text{kW months}} \\
 &= \mathbf{482 \frac{\$}{\text{yr}}}
 \end{aligned}$$

The **Total Energy Cost Savings** equals energy savings plus demand savings:

$$\begin{aligned} &= \$1,363 \frac{\$}{yr} + \$482 \frac{\$}{yr} \\ &= \$1,845 \frac{\$}{yr} \end{aligned}$$

**IMPLEMENTATION COST:**

It is estimated that by requesting building management to modify the BMS temperatures for the Chamber Room, the company should be able to have a reduction in temperature, so there will be no implementation cost.

**SIMPLE PAYBACK:**

The payback is immediate.

# SECTION 10

---

## ASSESSMENT RECOMMENDATION # 7

### CONTROL SHADES TO AUTOMATICALLY LOWER WITH DIRECT SUNLIGHT



## Assessment Recommendation #7: Control Shades to Automatically Lower with Direct Sunlight

### Opportunity

During the assessment, it was noticed that all the window shades were raised, leading to an increase in the indoor temperature. The installation of motorized shade rollers, centrally controlled by software, has the potential to significantly reduce energy consumption.

### Recommended Action

Install motorized shade rollers for all windows to avoid direct sunlight.

### Summary of Estimated Savings and Implementation Cost

- Estimated Annual Total Savings = \$1,588
- Estimated Annual Energy Savings = 17,298 kWh
- Estimated Annual Demand Savings = 33 kW-month
- Estimated Implementation Cost = \$1,476
- Simple Payback = 0.93 years

### Implementation Cost:

The associated implementation cost is \$1,475.60 in materials.

### Anticipated Savings:

By implementing motorized shade rollers there will be energy cost savings of \$332 and demand cost savings of \$2,172.

### Detailed Analysis

#### BACKGROUND:

By installing motorized shade rollers to measure the amount of daylight entering and saving on ACs.

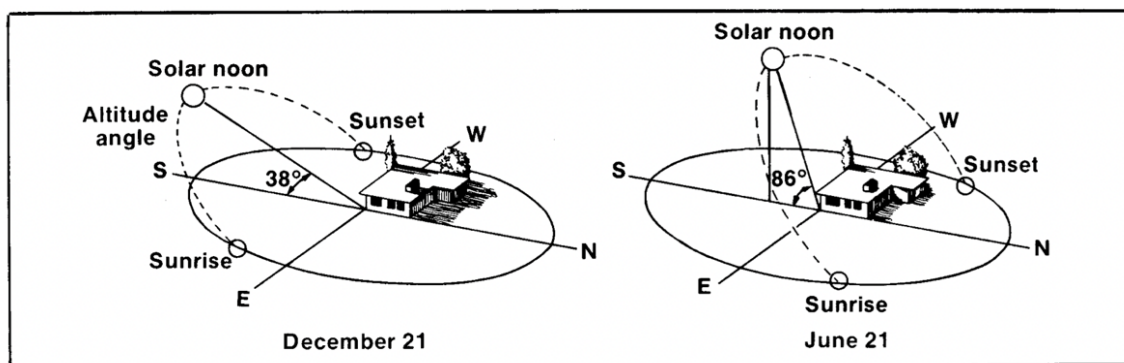


Figure 1. Seasonal Variations in Direct Sunlight Intensity in Florida

In Figure 1, a simplified representation illustrates the key scenario involving motorized shade rollers within an office space featuring a window<sup>1</sup>. This scenario addresses the impact of daylight penetration through windows. During the summer season, excessive sunlight ingress can inadvertently elevate indoor temperatures, consequently leading to increased energy consumption by the air conditioning system. In the subsequent calculations presented below, we quantify the potential energy savings achievable through the strategic adjustment of direct sunlight, shedding light on the economic and environmental benefits of such interventions.

Prior to proceeding, it is essential to assess the varying angles at which the sun rises and sets, as the amount of direct sunlight differs notably between summer and winter. The geographical location of the building is characterized by a consistent and substantial influx of sunlight throughout the year, with an annual average of approximately 250 sunny days. Based on our assumptions, we anticipate 4 hours of direct sunlight from April to October, and an additional 3 hours during the period from November to March, attributable to lower sun angles. Furthermore, in our calculations, we consider 150 of the 250 days falling within the April-to-October timeframe, with the remaining 100 days spanning the period from November to March.

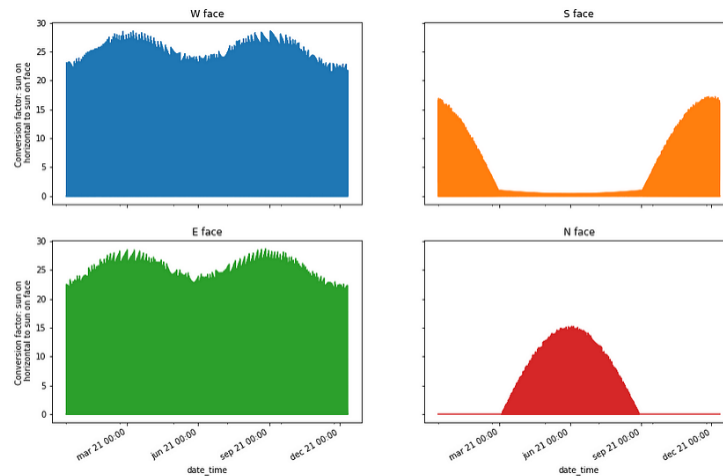


Figure 3. North, South, East and West Facing Walls Sun Example

As depicted in Figure 3, the incident direct sunlight from the North and South-facing windows is notably diminished when compared to that emanating from the West and East orientations. Consequently, our analysis concentrates exclusively on the windows situated in the latter two directions to mitigate the ingress of sunlight originating from the West and East.

Table 1. Units and Size of the Windows

Windows Direction	Units	Size
East	26	4x6ft
West	30	4x6ft
South	63	3x4ft
North	54	3x4ft
<b>Total</b>	<b>173</b>	

<sup>1</sup> Motorized Chain Roller Blinds Shade (<https://www.aliexpress.us/item/3256805761237668.html>)

### ANTICIPATED SAVINGS:

Table 1 provides a comprehensive representation of window counts across various orientations. In the context of calculating solar radiation cooling loads for glass, each window, with a 24 ft<sup>2</sup> surface area, receives an estimated 0.8581 kWh of direct sunlight. The cumulative total for the 56 windows facing East and West amounts to 48.05 kWh. It is important to consider that in our calculations, we have assumed a 40% partial opening of the currently installed window blinds. Subsequently, when analyzing energy consumption over 150 days with 4 hours of daily sunlight and 100 days with 3 hours of daily sunlight, the following insights are revealed:

#### ***Total Energy Savings:***

$$\begin{aligned} &= (150 \times 4hrs + 100 \times 3hrs) \times 48.05kWh \times 40\% \\ &= 17,298 \frac{kwh}{year} \end{aligned}$$

The corresponding **Energy Cost Savings** is:

$$\begin{aligned} &= 17,298 \frac{kwh}{year} \times 0.068 \frac{\$}{kWh} \\ &= \mathbf{\$1,176.26} \end{aligned}$$

#### ***Demand Savings:***

$$\begin{aligned} &= \frac{17,298 \frac{kwh}{year}}{6240} \times 12 \frac{months}{years} \times 12.369 \frac{\$}{Kw} \\ &= 33.27 \text{ kW} - \text{month} \times 12.369 \frac{\$}{kW} \\ &= \mathbf{\$411.46} \end{aligned}$$

#### ***Total Cost Savings:***

$$\begin{aligned} &= (energy\ cost\ savings) + (energy\ demand\ cost\ savings) \\ &= \$1,176.26 + \$411.46 \\ &= \mathbf{\$1,587.72} \end{aligned}$$

**IMPLEMENTATION COST:**

The implementation cost of this recommendation includes the cost of the motors and materials. The motors will be installed within the curtains of the windows on the East and West sides. These motors are entirely controllable and can be precisely timed through software integration. Furthermore, a notable advantage lies in their centralized management, facilitated by seamless software integration, which remains impervious to motor performance fluctuations.

Therefore, the total material cost is estimated as:

$$\begin{aligned} &= 56 \text{ motors} \times \frac{\$26.35}{\text{motors}} \\ &= \mathbf{\$1,475.6} \end{aligned}$$

The installation of motorized shade rollers incurs no labor cost and can be easily handled by the employees.

Total implementation is calculated as:

$$\begin{aligned} &= (\text{material cost}) \\ &= \mathbf{\$1,475.6} \end{aligned}$$

**SIMPLE PAYBACK:**

#1- Implementation Cost.....	\$1,476
#2- Total Annual Savings..... /	\$1,588
#3- Simple Payback (years)..... =	0.93

# SECTION 11

**ASSESSMENT RECOMMENDATION # 8**  
**REPLACE FLUORESCENT LIGHTING WITH LED IN**  
**SELECTED AREAS**



## Assessment Recommendation # 8: Replace Fluorescent Lighting with LED in Selected Areas

### Opportunity

The building is currently lit by mostly fluorescent bulbs. These lights can be replaced with more efficient LED lights that will provide the same amount of illuminance while simultaneously reducing the electrical consumption of the lights and the amount of radiant heat the lights produce. This provides a potential opportunity for electric energy savings and demand savings.

### Recommended Action

Replace existing fluorescent bulbs with LED lights.

### Summary of Estimated Savings and Implementation Cost

- Estimated Annual Total Cost Savings = \$884
- Estimated Annual Energy Savings =  $9,635 \frac{kWh}{yr}$
- Estimated Implementation Cost = \$2,847
- Simple Payback = 3.22 years

### Implementation Cost:

The cost associated with replacing lighting is estimated at \$982.5 in material and \$1,864 in labor for a total \$2,847.

### Anticipated Savings:

By replacing the current lighting system with LED fixtures, the company will realize \$655 in energy cost savings and \$229 in demand cost savings per year for a total of \$884 savings per year.

### Detailed Analysis

#### BACKGROUND:

The plant is currently lit with T8 fluorescent tubes and compact fluorescent bulbs (manufacturing and offices), which are less efficient than LED lighting. The lights are on during operational hours which yield to 6,240 hours yearly<sup>1</sup>. By converting the whole lighting system to LED lighting, there will be savings in energy due to the reduction in wattage of the fixtures.

The common measure of light source efficiency is lumens per watt (the amount of light produced by the source) divided by the power required to operate the light source. Although some lighting fixtures may have high source efficiency, this does not accurately reflect how much light is delivered from the light source to the target area.

The system efficiency, in contrast, considers the source when installed in a luminaire, and the fixture in which the lamp is installed. This measurement reveals how many lumens reach the target area; not simply how many lumens are emitted from the lamp.

#### ANTICIPATED SAVINGS:

<sup>1</sup>As reported by management.

By replacing the existing fixtures with LED lighting fixtures, energy savings can be achieved. When replacing fluorescent or incandescent lighting with LED lighting, there are three types of replacement: fixture replacement, bulb replacement in existing fixture bypassing fixture ballast, and bulb replacement in existing fixture using existing ballast. It is recommended to replace the bulbs in the existing fixture and bypass the ballasts.

A 32-watt (W) fluorescent T8-4ft bulb has a mean output of 2,600 lumens. These lumens are released from the bulb around its cylindrical surface including upwards into the fixture. Since an LED T8 bulb releases its lumens only downward, a 15-watt T8-4ft LED bulb with 2,000 – 2,200 lumens will deliver a comparable amount of light to the work plane<sup>2</sup>. A 25 Watt CFL bulb is equivalent to a 6 Watt LED. For all these differing fixtures, lighting lifetime will be increased with the switch to LED lighting. This will produce savings not taken into consideration for this report.

Using electrical sketches of the facility, a light count was derived and depicted in Table 1 provided below. The table also shows the wattage for replacement LED bulbs to compare the total wattage currently in use and the wattage after replacement. For the purposes of this recommendation, the bulb types, and count is estimated and that all bulbs will be replaced with similar bulbs as noted.

**Table 1 Light Count and Locations**

University of Miami Industrial Assessment Center							
Light Count: MDC07							
Room	Bulb Type	Watts/Bulb	Hours	Total Bulbs	Energy consumption per year (kWh)	LED Watt/Bulb	LED Energy consumption per year (kWh)
Floor 1 Wall Sconces	CFL	25	6240	24	3744	6	899
Floor 1 Ceiling Lights	T-8 4ft	32	6240	52	10383	15	4867
Floor 1 Staircase Lights	T-8 4ft	32	6240	12	2396	15	1123
Floor 2 Wall Sconces	CFL	25	6240	20	3120	6	749
Floor 2 Ceiling Lights	T-8 4ft	32	6240	40	7987	15	3744
Floor 2 Staircase Lights	T-8 4ft	32	6240	10	1997	15	936
Floor 3 Wall Sconces	CFL	25	6240	22	3432	6	824
Floor 3 Ceiling Lights	T-8 4ft	32	6240	43	8586	15	4025
Floor 3 Staircase Lights	T-8 4ft	32	6240	10	1997	15	936
<b>Total</b>				<b>88</b>	<b>16,524</b>		<b>6,889</b>

After analyzing the plant’s electric bills (see **Appendix A**) from the previous 12 months, the average cost the company is paying per kWh and kW demand was calculated. These charges of \$0.068/kWh and \$12.369/kW demand are used to calculate savings.

**Annual Energy Savings:**

$$= (\text{current consumption}) - (\text{projected LED consumption})$$

$$= (16,524 \frac{kWh}{yr}) - (6,889 \frac{kWh}{yr})$$

$$= 9,635 \frac{kWh}{yr}$$

<sup>2</sup> <https://www.1000bulbs.com/fil/categories/5000k-led-t8-tubes-direct-wire>

**Annual Cost of Energy Savings:**

$$= 9,635 \frac{kWh}{yr} \times 0.068 \frac{\$}{kWh}$$
$$= \$655$$

**Annual Demand Savings:**

Demand is a term to describe how much electricity is used at any given moment. Most businesses have a meter that tracks and records the highest 30-minute level of electricity demand for each billing period. Demand is measured in kilowatts (kW), while the total amount of electricity used is measured in kilowatt-hours (kWh). When energy is consumed, it is not always possible to accurately know when demand will be measured, thus this parameter has to be estimated. One of the methods used to estimate demand divides the electrical consumption by the operational hours and multiplies them by a factor of 12 to obtain an estimate of kW-months.

$$= \left( \frac{kWh \text{ Savings}}{\text{Operating Hours}} \right) \times 12 \text{ months}$$
$$= 9,635 / 6,240 \times 12 \text{ months}$$
$$= 18.5 \text{ kW-months}$$

**Annual Demand Cost Savings:**

$$= \text{Demand Savings} \times \text{Demand Rate}$$
$$= 18.5 \text{ kW-month} \times 12.369 \frac{\$}{\text{kW-month}}$$
$$= \$229$$

**Total Cost Savings:**

$$= \text{Energy Cost Savings} + \text{Demand Cost Savings}$$
$$= \$ 655 + \$229$$
$$= \$884$$

**IMPLEMENTATION COST:**

It is recommended to replace all non-LED lights with equivalent LED replacements. The LED replacement bulbs can be installed in the existing fixtures with Type A LED tubes or by bypassing the fixture ballast using Type B LED Tubes. It is recommended to bypass the ballast to reduce points of failure in the lighting system as well as reduce energy consumption of the ballast.

The average cost of the replacement LED bulbs are \$3.50 per bulb. The average cost of the replacement Type A LED Tubes is \$4.50 per bulb. It will take about 0.2 hours to replace a bulb and assume labor is \$40/hour.

Table 2 will show the material and labor costs associated with replacing all non-LED lights to equivalent LED replacements.

**Table 2. LED Bulb Replacement Cost<sup>3</sup>**

<b>University of Miami Industrial Assessment Center</b>							
<b>Bulb Replacement Cost: MDC07</b>							
Bulb Type	Total Bulbs	Replacement Bulbs	Cost Per Bulb	Material Cost	Labor Per Bulb (Hours)	Total Labor	Labor Cost
CFL	66	LED Bulb	3.50	231	0.2	13.2	528
T-8 4ft	167	Type A/B LED Tube	4.50	751.5	0.2	33.4	1336
<b>Total</b>				<b>982.5</b>			<b>1,864</b>

**Material Cost:**

The total cost of material is calculated as:  
 = LED Bulb Replacement Cost + T8-4ft Replacement Cost  
 = \$231 + \$751.50  
 = \$982.50

**Labor Cost:**

LED bulbs have a 50,000 hour operating life which is twice as long as traditional florescent bulbs. This results in labor savings of one bulb replacement for each florescent bulb when replaced by an LED. The LED bulb, however, requires minor rewiring labor to bypass the existing florescent fixture ballast. These two labor components associated with replacing florescent bulbs with LED bulbs are considered to cancel each other out. The labor to upgrade florescent bulbs to LED bulbs is thus calculated as:

$$\begin{aligned}
 &= \text{bulbs} \times \frac{\text{hr}}{\text{bulb replacement}} \times \frac{\$}{\text{hr}} \\
 &= (66 + 167) \text{ bulbs} \times 0.2 \text{ hr / bulb} \times \$40 / \text{hr} \\
 &= \$1,864
 \end{aligned}$$

**Total Implementation Cost**

$$\begin{aligned}
 &= \text{Material Cost} + \text{Labor Cost} \\
 &= \$982.5 + \$1,864 \\
 &= \$ 2,847
 \end{aligned}$$

**SIMPLE PAYBACK:**

#1- Implementation Cost.....	\$2,847
#2- Total Annual Savings..... /	\$884
#3- Simple Payback (years)..... =	3.22

<sup>3</sup> Replacement cost examples for type A/B LED tubes:  
<https://www.1000bulbs.com> , <https://www.superiorlighting.com> , <https://www.homedepot.com>  
 Replacement cost examples for LED bulbs:  
<https://www.walmart.com> , <https://www.amazon.com> , <https://www.homedepot.com>

# SECTION 12

---

---

## ASSESSMENT RECOMMENDATION # 9 ENROLL IN FPL AUTOPAY



## Assessment Recommendation # 9: Enroll in FPL Autopay

### Opportunity

Late payment fees were discovered upon examination of the Doral Government Center's electrical bills. Setting up the *FPL Automatic Bill Pay* can easily avoid these fees resulting in savings.

### Recommended Action

Enroll in FPL Automatic Bill Pay to pay for electrical bills on time and avoid late payment fees.

### Summary of Estimated Savings and Implementation Cost

- Estimated Total Cost Savings = \$596
- Estimated Implementation Cost = \$0
- Simple Payback (years) = Immediate

### Implementation Cost:

The cost associated with this recommendation is estimated to be \$0 for an employee to enroll in FPL's autopay program and manage on-time payments, as an employee is already paying the bills each month.

### Anticipated Savings:

By paying the electrical bill on time, the company will save around \$596 per year.

### Detailed Analysis

#### **BACKGROUND:**

Following our assessment visit, the team discovered that the company had been incurring late payment fees on their electrical bills for several months.

To get rid of late fees, the building should be enrolled in *FPL Automatic Bill Pay*. This is a free program that allows FPL to withdraw the bill amount from the building's checking account automatically on the day of the month you have previously chosen. It will only have to be set up once. FPL sends a reminder before the payments are withdrawn, and the employee in charge can always monitor payments and view statements on the FPL.com website.<sup>1</sup>

#### **ANTICIPATED SAVINGS:**

The following tables depict the past 12 months of electrical bills for the company. For 3 of those 12 months, the company incurred a late payment charge. These charges are highlighted in red.

<sup>1</sup> <https://www.fpl.com/account/bill/automatic-bill-pay.html>

Electric Bill Summary (October 2022 - September 2023)												GSD-1 KV81156			Total
	October-22	November-22	December-22	January-23	February-23	March-23	April-23	May-23	June-23	July-23	August-23	September-23			
Service Days	9/1/2022	10/3/2022	11/1/2022	12/1/2022	1/3/2023	2/1/2023	3/2/2023	4/3/2023	5/1/2023	6/1/2023	7/3/2023	8/2/2023	335		
Days	32	29	30	33	29	29	32	28	31	32	30	30			
Total Consumption kWh	148,560	126,720	142,800	152,400	132,960	134,880	151,200	131,520	155,520	154,320	150,480	147,360	1,728,720.00		
Energy Charge	\$3,905.64	\$3,331.47	\$3,754.21	\$4,255.01	\$3,712.24	\$3,765.85	\$5,242.11	\$4,559.80	\$5,391.88	\$5,350.27	\$5,217.14	\$5,108.97	\$3,994.60		
Energy (Non-Fuel) \$/kWh	\$0.026290	\$0.026290	\$0.026290	\$0.027920	\$0.027920	\$0.027920	\$0.034670	\$0.034670	\$0.034670	\$0.034670	\$0.034670	\$0.034670	\$0.034670		
Fuel Charge	\$5,654.19	\$4,822.96	\$5,434.97	\$6,167.63	\$5,380.89	\$5,458.59	\$5,999.62	\$4,650.55	\$5,499.19	\$4,862.62	\$4,741.62	\$4,643.31	\$3,316.15		
Fuel \$/kWh	\$0.038060	\$0.038060	\$0.038060	\$0.040470	\$0.040470	\$0.040470	\$0.039650	\$0.035360	\$0.035360	\$0.031510	\$0.031510	\$0.031510	\$0.031510		
Total kWh Cost Non Demand \$	\$9,559.84	\$8,154.43	\$9,189.18	\$10,422.64	\$9,093.13	\$9,224.44	\$11,241.73	\$9,210.35	\$10,891.07	\$10,212.90	\$9,958.77	\$9,752.28	\$116,910.75		
Demand \$/kW	\$11.93	\$11.93	\$11.93	\$11.28	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65		
Demand	295.00	288.00	300.00	286.00	290.00	324.00	290.00	286.00	305.00	334.00	322.00	336.00	3,656.00		
Total kW Cost Demand \$	\$3,519.35	\$3,435.84	\$3,579.00	\$3,226.08	\$3,668.50	\$4,098.60	\$3,668.50	\$3,617.90	\$3,858.25	\$4,225.10	\$4,073.30	\$4,250.40	\$45,220.82		
Total Energy Cost	\$13,079.19	\$11,590.27	\$12,768.18	\$13,648.72	\$12,761.63	\$13,323.04	\$14,910.23	\$12,828.25	\$14,749.32	\$14,438.00	\$14,032.07	\$14,002.68	\$162,131.57		
Base Charge	\$28.17	\$28.17	\$28.17	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$54.33		
Gross Receipts Tax	\$345.77	\$306.49	\$337.57	\$351.00	\$328.23	\$342.64	\$383.37	\$329.94	\$379.24	\$371.25	\$360.83	\$360.08	\$4,196.41		
Franchise Charge	\$843.51	\$747.69	\$823.50	\$879.66	\$822.61	\$858.72	\$960.79	\$726.90	\$950.44	\$930.42	\$876.91	\$875.08	\$10,396.23		
Utility Tax													0.00		
Florida Sales Tax													0.00		
Late Fee Charge			\$151.31	\$151.31	\$294.28								\$96.90		
Discretionary Sales Surtax											\$140.25		\$140.25		
Regulatory fee (State fee)				\$10.74	\$10.26	\$10.49	\$11.73	\$10.10	\$11.61	\$11.36	\$11.12	\$11.00	\$8.41		
Total Services and Taxes	\$1,217.45	\$1,082.35	\$1,340.55	\$1,422.69	\$1,485.36	\$1,241.83	\$1,385.87	\$1,196.92	\$1,371.27	\$1,343.01	\$1,419.09	\$1,276.14	\$15,782.53		
Total Charges	\$14,296.64	\$12,672.62	\$14,108.73	\$15,071.41	\$14,246.99	\$14,564.87	\$16,296.10	\$14,025.17	\$16,120.59	\$15,781.00	\$15,451.15	\$15,278.82	\$177,914.10		
Total amount per Qtr		\$41,077.99			\$43,883.27			\$46,441.85			\$46,510.97				
Percent of each quarter		23.09%			24.67%			26.10%			26.14%		100.00%		

**Table 1. Electrical Bills<sup>2</sup>**

The company incurred late payment charges from the electrical company in the past year. These late payments forced the company to pay an extra \$596.90 in fees. These extra payments could be saved in the future if the facility is enrolled in the autopay program.

**IMPLEMENTATION COST:**

The cost to ensure on-time payment of utility bills should be \$0 since the company is already paying an employee to do the task and FPL’s Automatic Bill Pay is a free program any company or person can be enrolled in.

To enroll in the program, visit FPL’s website<sup>3</sup> and log in. You will have to enter the bank account and routing numbers from a U.S. bank, then choose the day of the month the payments will be withdrawn. Provide them with basic contact information and the next day you will receive a confirmation email.

An employee should be instructed to enroll the building in the program to pay the electrical bills on time, resulting in savings.

**SIMPLE PAYBACK**

The payback for this recommendation is immediate.

<sup>2</sup> Appendix B (Bills)

<sup>3</sup> <https://www.fpl.com/my-account/autobillpay.html>

# SECTION 13

---

**ASSESSMENT RECOMMENDATION # 10  
DO NOT OVERRIDE LIGHT CONTROL**



## Assessment Recommendation #10: Do Not Override Light Control

### Opportunity

Upon a detailed examination of the existing Building Management System (BMS), it was found that its full potential is not being utilized. Notably, the lighting system is often manually overridden, negating the benefits of optimal lighting control. Our analysis indicates that by comprehensively implementing the BMS, particularly its lighting module, there are potential savings to be realized, albeit modestly.

### Recommended Action

Do not override the Light Control.

### Summary of Estimated Savings and Implementation Cost

- Estimated Total Cost Savings = \$103
- Estimated Energy Savings = 1,527 kWh
- Estimated Implementation Cost = 0
- Simple Payback = Immediate

### Implementation Cost:

The company already has the BMS system and there is no cost related to this AR.

### Anticipated Savings:

By implementing lighting control module of BMS, the building will realize \$103 in energy cost savings.

### Detailed Analysis

#### **BACKGROUND:**

The integration of smart software into building management systems, particularly for lighting control, is an emerging trend in the world. Smart lighting systems in buildings refer to the use of advanced technology, sensors, and software to control and automate the lighting based on various parameters like occupancy, ambient light levels, time of day. The main advantages of implementing these systems are energy efficiency, user comfort, reduced maintenance and ability to integrate with other systems. The building implements a great BMS system with a lighting control module. There is an option of overriding system which means not utilizing the ability of system to control lighting in software which just puts lighting control away.

#### **ANTICIPATED SAVINGS:**

The building mostly employs LED lighting. In the monitoring system, it was observed that the lighting control for the second floor was consistently overridden. We will conduct an analysis to determine the additional energy costs incurred due to the non-implementing of the existing control system.

Based on the electrical lighting plan provided by the building managers we estimate the total number of lightings for floor two as follow:

**Table 1- Light Count estimation based on electrical lighting plan.**

Type of Lighting	Count (Estimated)	Bulb Type	Watts	Hours	Energy Consumption per Year(kWh)	Projected Consumption	Energy
LED Wall Sconces	20	LED	15	2080	624	187	
LED Ceiling Lights	40	LED	15	2080	1,248	374	
LED Staircase Lights	10	LED	15	2080	312	96.6	
<b>Total</b>	<b>70</b>				<b>2,184</b>	<b>657</b>	

**Annual Energy Savings:**

= (current consumption) – (projected consumption)

$$= (2,184 \frac{kWh}{yr}) - (657 \frac{kWh}{yr})$$

$$= 1,527 \frac{kWh}{yr}$$

**Annual Cost of Energy Savings:**

$$= 1,527 \frac{kWh}{yr} \times (0.068)^1 \frac{\$}{kWh}$$

$$= \$103$$

Although turning the lights off when the area is vacant will reduce energy consumption, there is no guarantee that it may contribute to in-peak demand savings.

**IMPLEMENTATION COST:**

There is no implementation cost associated with this AR since they already have the system, and it should be utilized completely.

**SIMPLE PAYBACK**

**Payback is immediate.**

---

<sup>1</sup> Based on Bill analysis shown in Appendix A

# SECTION 14

---

---

## **Additional Consideration #1** **INSTALL SOLAR PANEL SYSTEMS ON ROOF**



## Additional Consideration # 1: Install Solar Panel Systems on Roof

### Opportunity

The Government center office building is currently connected to the FPL main utility line distribution. By replacing part of the current power system with an installed photovoltaic, on-grid system over the buildings' roof fields, there will be reductions in the electric bill.

### Recommended Action

Invest in small photovoltaic and energy inverter equipment from solar panel retail services, so that the building management can benefit from a long-term goal of producing its own energy, instead of importing all its energy from FPL owned Electric grids.

### Summary of Estimated Savings and Implementation Cost

- Estimated Total Cost Savings = \$40,893
- Annual Energy Saving = 247,774 kWh/year
- Annual Demand Saving = 1,944 kw-month
- Estimated Implementation Cost = \$251,454
- Simple Payback = 6.15 years

### Implementation Cost:

There is going to be an initial investment for the photovoltaic system of \$249,054, and the estimated total installation cost for the inspection engineer is approximately \$2,400.

### Anticipated Savings:

The building management can save \$40,893 annually due to the difference in rate between FPL and a new photovoltaic system (PV).

### Detailed Analysis

#### BACKGROUND:

Solar power-generating systems absorb sunlight and convert it into electricity that can be used. The main idea of solar power generation is the phenomenon of photoelectric effect; light striking a silicon semiconductor causes electrons to flow, creating electricity as shown in Figure 1.

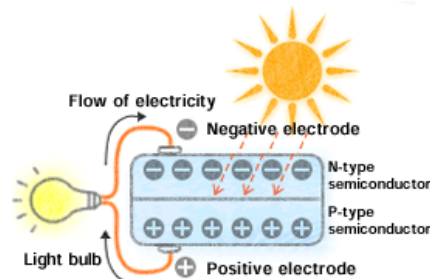


Figure 1: A diagram explaining the photovoltaic effect.

When sunlight hits the semiconductor, an electron springs up and is attracted to the n-type semiconductor. This causes more negative electrons in the n-type semiconductor and more positive electrons in the p-type, thus generating a flow of electricity in a process known as the “photovoltaic effect.”

There are two types of solar power generating systems: grid-connected systems, which are connected to the commercial power infrastructure; and stand-alone systems, which feed electricity to a facility for immediate use, or to a battery for storage. The grid-tied plan will be the recommended Photovoltaic system for implementation. A grid-tied solar system is a type of solar system that connects to the electrical grid, it doesn’t require a battery system. In this case, the Photovoltaic system produces more that the demand it can export to the grid and receive a credit, by using the Net Metering or a Utility Meter. Net metering is the meter that registers the flow of electricity in the opposite direction when a renewable system exceeds the demand. The greater the amount of excess energy generated and not used, the greater the credit will be for the customer. This is useful because it prevents unused energy produced by the solar panel to not be discarded or wasted. See Figure 2

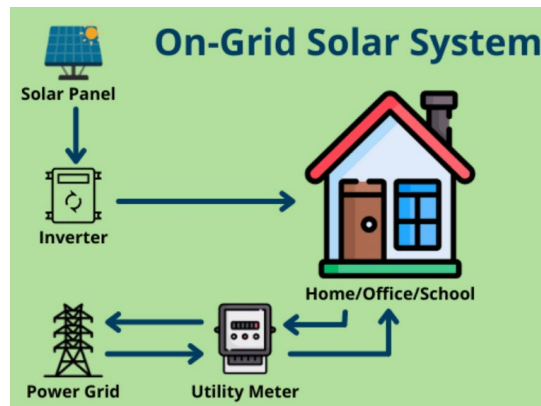


Figure 2: A diagram explaining the photovoltaic on-grid system.

The building is currently using FPL main utility as the primary energy source, paying an effective rate of \$0.068/kWh. According to the information provided in the period from October 2022 to September 2023, the total energy consumption was 1,728,720 kWh per year.

**ANTICIPATED SAVINGS:**

By using the PVWatts calculator, which estimates the energy production based on location and cost of energy for grid-connected photovoltaic (PV) energy systems, the overall capacity and size of the PV system were calculated. Table 1 shows the technical specifications of every PV system.

Location and Station Identification	
Requested Location	8401 NW 53rd Terrace, Doral, FL 33166
Weather Data Source	Lat, Lng: 25.81, -80.34 0.9 mi
Latitude	25.81° N
Longitude	80.34° W
PV System Specifications	
DC System Size	161.75 kW
Module Type	Standard
Array Type	Fixed (open rack)
System Losses	14.08%
Array Tilt	20°
Array Azimuth	180°
DC to AC Size Ratio	1.2
Inverter Efficiency	96%
Ground Coverage Ratio	0.4
Albedo	From weather file
Bifacial	No (0)
Monthly Irradiance Loss	Jan Feb Mar Apr May June 0% 0% 0% 0% 0% 0%
	July Aug Sept Oct Nov Dec 0% 0% 0% 0% 0% 0%
Performance Metrics	
DC Capacity Factor	17.5%

**Table 1: First Photovoltaic System Technical Specifications from PVWatts calculator<sup>1</sup>**

Table 2 results show a monthly estimation made by the calculator<sup>1</sup> of common parameters like solar radiation, generated AC energy, and cost of energy.

**RESULTS**

Print Results

**247,774 kWh/Year\***

System output may range from 235,187 to 257,660 kWh per year near this location.  
Click [HERE](#) for more information.

Month	Solar Radiation <small>( kWh / m<sup>2</sup> / day )</small>	AC Energy <small>( kWh )</small>
January	4.82	18,877
February	5.46	19,359
March	6.10	23,575
April	6.67	24,682
May	6.15	22,993
June	5.54	19,944
July	5.98	22,152
August	5.84	21,625
September	5.28	19,263
October	4.98	19,175
November	4.93	18,498
December	4.46	17,631
<b>Annual</b>	<b>5.52</b>	<b>247,774</b>

**Table 2: Estimated Results for the PV System**

<sup>1</sup> <https://pvwatts.nrel.gov/>

The required rooftop is to make the implementation of the photovoltaic system is 10881 ft<sup>2</sup>. Figure 1 shows an aerial image of the government center building with the suggested shaded area on where the first PV system should be installed, as can be seen in figure 1.



Figure 1. Aerial Image of the Recommended PV System Area

The total **energy production** of the PV systems is:

$$\text{PV Energy Production} = 247,774 \frac{\text{kWh}}{\text{year}}$$

Thus, the **energy used** from FPL's main utility is:

$$\begin{aligned} \text{FPL's Used Energy} &= \text{FPL's Previous Used Energy} - \text{PV Energy Production} \\ &= 1,728,720 \text{kWh} - 247,774 \text{kWh} \\ &= 1,480,946 \frac{\text{kWh}}{\text{year}} \end{aligned}$$

Thus, the **energy cost savings** from using PV system to generate this amount of energy will be:

$$\begin{aligned} \text{Cost Savings} &= \text{PV Energy Production} \frac{\text{kWh}}{\text{year}} * \text{FPL Utility Rate} (\$/\text{kWh}) \\ &= 247,774 \times \frac{\$0.068}{\text{kWh}} \\ &= \$16,848/\text{year} \end{aligned}$$

#### Demand Savings

**The demand(kw) used here would be the Photovoltaic (DC) System capacity or size used as an input for solar power calculation. So the demand savings-**

$$= 162 \text{ kW} \times 12 \text{ months}$$

$$\begin{aligned}
&= \mathbf{1,944 \text{ kW} - \text{month}} \\
&= 1,944 \text{ kW} - \text{month} \times 12.369 \frac{\$}{\text{kW month}} \\
&= \mathbf{\$24,045/\text{year}}
\end{aligned}$$

**Total Annual Savings**

$$\begin{aligned}
&= \text{Energy Cost savings} + \text{Demand Savings} \\
&= \$16,848 + \$24,045 \\
&= \mathbf{\$40,893}
\end{aligned}$$

**IMPLEMENTATION COST:**

For this case we are considering the basic material of the Photovoltaic System such panel of 440 W and inverters, the other implementation costs are also included, which are related to the necessary permitting, insurance, warranty approvals, as well as the labor cost to pay the inspection engineer working on the implementation of the project, etc.

**Material Cost**

$$\begin{aligned}
\text{Number of Solar Panels needed for demand} &= \frac{\text{Photovoltaic System Capacity (kW)} * 1000}{\text{Solar Panel Capacity (W)}} \\
&= \frac{162 \text{ (kW)} * 1000}{440 \text{ (W)}} \\
&= \mathbf{368 \text{ Solar panels.}}
\end{aligned}$$

For the Solar Panel investment, using the retailing services that sell Solar panels, it would be recommended to invest in Solar Panel Kits. These Kits include an inverter that can store up to **5,280 watts DC**, 12 pieces of 440-watt capacity solar panels (24ft<sup>2</sup> each piece, 282ft<sup>2</sup> in total, all generating 5,280 watts in all 12 of them), (2) x 100' PV wires with MC4 connectors, and (2) x 100' PV wires with MC4 connectors.

The total square feet of the field of the building are 10,881 around ft<sup>2</sup> based on Figure 1. By Dividing the Space available by the size piece of each solar panel, the following calculation would show **the maximum number of solar panel** pieces that can be installed:

$$\text{Number of Solar Panels can be installed} = \frac{10,881 \text{ ft}^2}{24 \text{ ft}^2} = \mathbf{453 \text{ of Solar Panels}}, \text{ but only } \mathbf{368} \text{ are needed.}$$

For the Solar Panel investment, using the retailing services that sell Solar panels, it would be recommended to invest in Solar Panel Kits. These Kits include an inverter that can store up to **5,280 watts DC**, 12 pieces of 440-watt capacity solar panels (24ft<sup>2</sup> each piece, 282ft<sup>2</sup> in total, all generating 5,280 watts in all 12 of them), (2) x 100' PV wires with MC4 connectors, and (2) x 100' PV wires with MC4 connectors.

So, 368 solar panels will take = **368\*24ft<sup>2</sup> = 8,832 ft<sup>2</sup>** of solar panels that will take up space in the field.

Therefore, at least 31, since 368 are needed, and each kit has 12 panels each. Therefore, these kits will be able to cover the space available. 31 of these kits, at the same time, mean 31 invertors and **31 x 12 = 372 Solar Panels**. This will be sufficient for the implementation.

Here are the following calculations of **costs of the Solar Kits**:

$$5.2\text{kW solar kit Cells 440 Bi-facial, SMA inverter}^2 = \mathbf{\$9,550} \text{ Each solar kit}$$

---

<sup>2</sup> [SunWatt - 5.2 kW Solar Kit](#)

Shipping cost for kits = **\$750**

31 Solar Kits needed =  $9,550 \times 31 + 750 \times 31 =$  **\$319,300**

When investing in solar panels for industrial sites, it is best to involve both state and federal tax deductions for lower prices. Since Florida has no tax for installing solar systems, there is no need to pay state taxes. With the federal tax credit (FTC), there can be deduction up to 22% of the cost of the solar energy system from the company's business taxes. This is a dollar-for-dollar credit toward the income taxes that would otherwise go to the federal government. To qualify, the business must have a tax liability upon filing.<sup>3</sup> For state Tax reduction, Florida offers up to 22% of tax reduction only for solar systems installed in 2023<sup>4</sup>.

The calculations for Labor work to install the Solar Panel Equipment is as follows:

**Labor Cost**

$$\begin{aligned} \text{Labor Cost (\$)} &= \text{Number of weeks} \times \text{Required Hours} \left( \frac{\text{hrs}}{\text{week}} \right) \times \text{LaborRate} \left( \frac{\$}{\text{hr}} \right) \\ &= (76) \times \left( \frac{8 \text{ hrs}}{\text{day}} \right) \times \left( \frac{\$50}{\text{hr}} \right) \\ &= \$2,400 \end{aligned}$$

**Federal Tax Credit:**

$$\begin{aligned} &= \text{Total Solar Kit cost (\$)} \times \text{FTC (\$)} \\ &= \$319,300 \times 0.22 = \$70,246 \\ &= \$319,300 - \$70,246 = \$249,054 \end{aligned}$$

**Total Implementation Cost:**

$$\begin{aligned} &= \text{Total Solar Kit cost after FTC (\$)} + \text{Labor cost (\$)} \\ &= \$249,054 + \$2,400 \\ &= \$251,454 \end{aligned}$$

**SIMPLE PAYBACK:**

#1- Implementation Cost.....		\$251,454
#2- Total Annual Savings.....	/	\$40,893
#3- Simple Payback (years).....	=	6.15

<sup>3</sup> [Federal Tax Credit - Solar Photovoltaics](#)

<sup>4</sup> [Homeowner's Guide to the Federal Tax Credit for Solar Photovoltaics](#)

# SECTION 15

---

---

**Additional Consideration# 2**  
**APPLY FOR ISO 50001 CERTIFICATION**



## Additional Consideration # 2: Apply for ISO 50001 Certification

### Opportunity

During the course of the visit, we determined that the organization would greatly benefit from a certification opportunity that would increase overall energy efficiency and sustainability management. Applying for ISO 50001 involves a series of requirements and reviewing processes that ensure compliance and reporting capabilities. While we were unable to evaluate these details within the limits of this initial study, these items warrant further attention.

### Recommended Action

An Energy Management System (EnMS) helps a facility establish the policies and procedures to systematically track, analyze, and improve energy efficiency. ISO 50001 is a global energy management system standard that specifies the requirements for establishing, implementing, maintaining and improving this Energy Management System (EnMS). The standard is based upon the Plan-Do-Check-Act management system, which is common to other ISO standards. The Department Of Energy's (DOE) Superior Energy Performance<sup>i</sup> (SEP) program provides guidance<sup>ii</sup>, tools, and protocols to drive deeper, more sustained savings from ISO 50001. SEP is a voluntary certification that industrial facilities earn by demonstrating continuous improvement in energy efficiency. Organizations can use SEP as a roadmap to achieve ongoing energy improvements and to boost their competitiveness, even if they are not yet ready to pursue SEP or ISO 50001 certification.

### Detailed Analysis

#### **BACKGROUND:**

The International Organization for Standardization (ISO) is the world's largest developer and publisher of international standards. ISO<sup>iii</sup> prioritized energy management as one of the top five fields for the development of International Standards. ISO 50001<sup>iv</sup> provides organizations with an internationally recognized framework for implementing an energy management system (EnMS). The standard addresses the following:

- Energy use and consumption
- Measurement, documentation, and reporting of energy use and consumption
- Design and procurement practices for energy-using equipment, systems, and processes
- All variables affecting energy performance that can be monitored and influenced by the organization.

The standard does not prescribe minimum performance criteria, energy reductions, or targets, however, it does require an organization and facility to demonstrate continuous energy performance improvement. The Department of Energy (DOE) is the administrator of the Superior Energy Performance (SEP) program. SEP certification is based on a portfolio of standards and protocols developed by experts from industry, national standards organizations, federal agencies, and academia. These collaboratively developed requirements ensure

broad applicability across industry and confidence that certified facilities have indeed achieved a measure of excellence agreed upon by a discerning community. More information about the SEP program can be found at the Office of Energy Efficiency & Renewable Energy website at <http://www.energy.gov/eere/amo/sep-and-iso-50001-certification-process#enroll>. SEP is designed to yield low-cost energy savings that directly impact the bottom line. Data from several SEP-certified facilities showed that these facilities achieved larger and more sustained energy savings:

- 10% reduction in energy costs within 18 months of SEP implementation, on average
- Annual savings of \$87,000 to \$984,000 using no-cost or low-cost operational measures
- Paybacks of one year or less in facilities with energy costs > \$3 million annually (less than two years for those with energy costs of \$1.5 - \$3 million per year)

Beyond impressive energy and cost savings, facilities stated that the combination of an ISO 50001 certified energy management system (EnMS) and a verified energy performance improvement delivers additional benefits<sup>v</sup>:

- Provides the data and analysis to inform decision making
- Takes EnMS to a new level using advanced, rigorous tools to create robust data tracking and measurement not previously available
- Raises the visibility of successful facilities within the company
- Gives proof of performance—certification gives credibility internally and externally
- Brings national recognition to your program, helping it grow and succeed

## Process Description

---

The certification process consists of four steps<sup>vi</sup>:

1. Implement: Establish an ISO 50001-compliant EnMS and improve energy efficiency.
2. Apply: Once the EnMS is implemented, submit the application to the program administrator. Choose a verification body to conduct an audit.
3. Certify: The SEP 50001 program administrator will send the approved application to the chosen verification body. Work with the verification body to schedule and complete the audit.
4. Get Recognized: The verification body will issue the certificate and DOE will recognize the achievement. Certification is valid for three years and exceptional performance may qualify for Silver, Gold, or Platinum.

For more information and detailed steps about the certification process please visit DOE's website: <http://www.energy.gov/eere/amo/superior-energy-performance>.

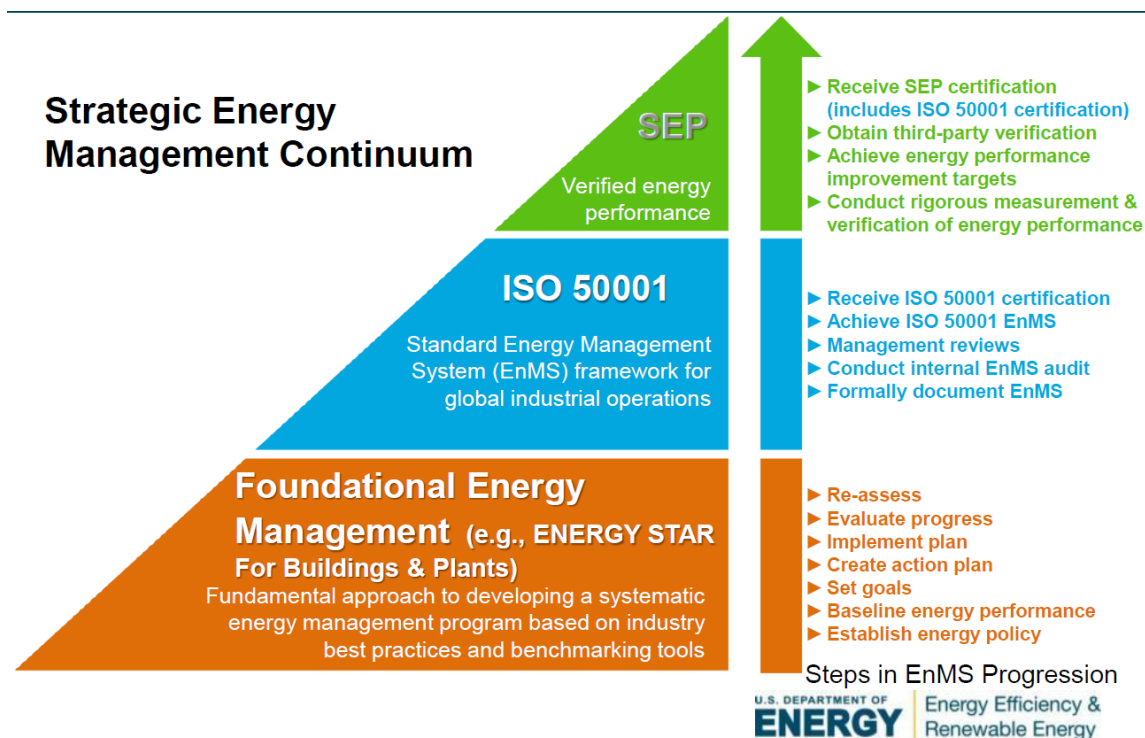
## Strategic Energy Management Process

There are two pathways to achieve SEP certification:

- Energy Performance Pathway (can be certified at these levels, when records of improvement over 2-3 years is displayed):
  - Silver – achieves 5% savings or at least 35 points from the Score on Best Practice Scorecard
  - Gold – achieves 10% savings or at least 61 points from the Score on Best Practice Scorecard
  - Platinum – achieves 15% savings over the last 10 years or at least 81 points from the Score on Best Practice Scorecard.
- Mature Energy Pathway – For facilities with a long track of energy use improvements. The organization will receive silver certification once 15% improvement in energy performance over the past 15 years can be displayed.

Furthermore, facilities can be certified at the Silver, Gold, or Platinum level.

The DOE's website presents the following figure to describe the Strategic Energy Management process:



Moreover, the DOE Advance Manufacturing Office has established that their Better Plants Program and the Superior Energy Performance Programs are complimentary which makes it easier for facilities to achieve.

<sup>i</sup> [http://www.energy.gov/sites/prod/files/2014/07/f17/superior\\_energy\\_performance\\_factsheet.pdf](http://www.energy.gov/sites/prod/files/2014/07/f17/superior_energy_performance_factsheet.pdf)

<sup>ii</sup> [https://ecenter.ee.doe.gov/\\_layouts/ecenter/ppc.eguide/home.aspx#](https://ecenter.ee.doe.gov/_layouts/ecenter/ppc.eguide/home.aspx#)

<sup>iii</sup> [www.iso.org/iso/home/standards/management-standards/iso50001.htm](http://www.iso.org/iso/home/standards/management-standards/iso50001.htm)

<sup>iv</sup> <http://www.energy.gov/eere/amo/about-iso-50001-and-doe>

<sup>v</sup> <http://www.energy.gov/eere/amo/business-case-sep#case-studies>

<sup>vi</sup> <http://www.energy.gov/sites/prod/files/2014/09/f18/SEP-overview-slides.pdf>

# **APPENDIX A**

---

---

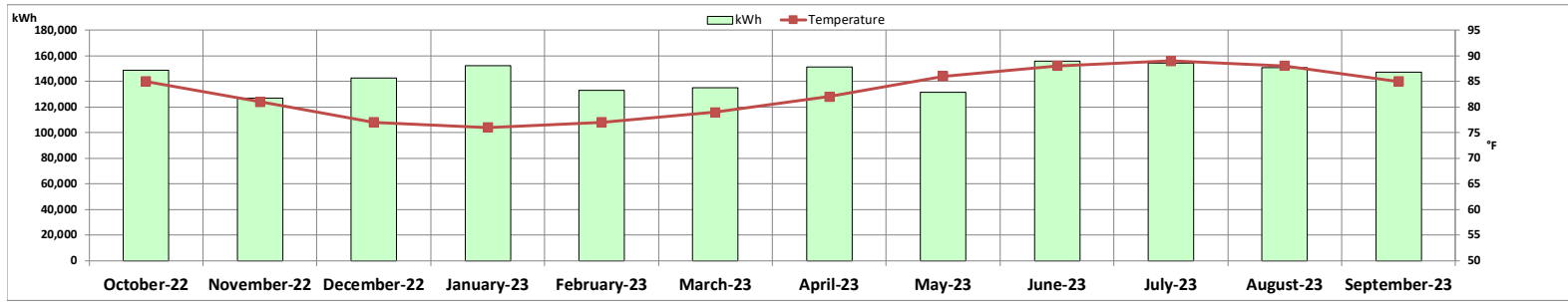
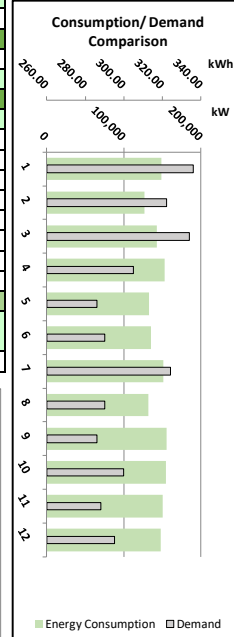
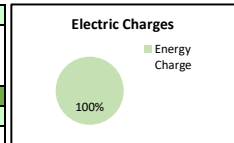
## **SUMMARY OF BILLS**



# Summary of Electricity Bills

**Energy Rate \$0.068 /kWh**  
**Demand Rate \$12.369 /kW**

Electric Bill Summary (October 2022 - September 2023)													GSD-1 KV81156
	October-22	November-22	December-22	January-23	February-23	March-23	April-23	May-23	June-23	July-23	August-23	September-23	Total
Service Days	9/1/2022	10/3/2022	11/1/2022	12/1/2022	1/3/2023	2/1/2023	3/2/2023	4/3/2023	5/1/2023	6/1/2023	7/3/2023	8/2/2023	335
Days	32	29	30	33	29	29	32	28	31	32	30	30	
Total Consumption kWh	148,560	126,720	142,800	152,400	132,960	134,880	151,200	131,520	155,520	154,320	150,480	147,360	1,728,720.00
Energy Charge	\$3,905.64	\$3,331.47	\$3,754.21	\$4,255.01	\$3,712.24	\$3,765.85	\$5,242.11	\$4,559.80	\$5,391.88	\$5,350.27	\$5,217.14	\$5,108.97	\$3,594.60
Energy (Non-Fuel) \$/kWh	\$0.026290	\$0.026290	\$0.026290	\$0.027920	\$0.027920	\$0.027920	\$0.034670	\$0.034670	\$0.034670	\$0.034670	\$0.034670	\$0.034670	
Fuel Charge	\$5,654.19	\$4,822.96	\$5,434.97	\$6,167.63	\$5,380.89	\$5,458.59	\$5,999.62	\$4,650.55	\$5,499.19	\$4,862.62	\$4,741.62	\$4,643.31	63,316.15
Fuel \$/kWh	\$0.038060	\$0.038060	\$0.038060	\$0.040470	\$0.040470	\$0.040470	\$0.039680	\$0.035360	\$0.035360	\$0.031510	\$0.031510	\$0.031510	
Total kWh Cost Non Demand \$	\$9,559.84	\$8,154.43	\$9,189.18	\$10,422.64	\$9,093.13	\$9,224.44	\$11,241.73	\$9,210.35	\$10,891.07	\$10,212.90	\$9,958.77	\$9,752.28	\$116,910.75
Demand \$/kW	\$11.93	\$11.93	\$11.93	\$11.28	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65	\$12.65	
Demand	295.00	288.00	300.00	286.00	290.00	324.00	290.00	286.00	305.00	334.00	322.00	336.00	3,656.00
Total kW Cost Demand \$	\$3,519.35	\$3,435.84	\$3,579.00	\$3,226.08	\$3,668.50	\$4,098.60	\$3,668.50	\$3,617.90	\$3,858.25	\$4,225.10	\$4,073.30	\$4,250.40	\$45,220.82
Total Energy Cost	\$13,079.19	\$11,590.27	\$12,768.18	\$13,648.72	\$12,761.63	\$13,323.04	\$14,910.23	\$12,828.25	\$14,749.32	\$14,438.00	\$14,032.07	\$14,002.68	\$162,131.57
Base Charge	\$28.17	\$28.17	\$28.17	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	\$29.98	354.33
Gross Receipts Tax	\$345.77	\$306.49	\$337.57	\$351.00	\$328.23	\$342.64	\$383.37	\$329.94	\$379.24	\$371.25	\$360.83	\$360.08	4,196.41
Franchise Charge	\$843.51	\$747.69	\$823.50	\$879.66	\$822.61	\$858.72	\$960.79	\$826.90	\$950.44	\$930.42	\$876.91	\$875.08	10,396.23
Utility Tax													0.00
Florida Sales Tax													0.00
Late Fee Charge			\$151.31	\$151.31	\$294.28								596.90
Discretionary Sales Surtax											\$140.25		140.25
Regulatory fee (State fee)				\$10.74	\$10.26	\$10.49	\$11.73	\$10.10	\$11.61	\$11.36	\$11.12	\$11.00	98.41
Total Services and Taxes	\$1,217.45	\$1,082.35	\$1,340.55	\$1,422.69	\$1,485.36	\$1,241.83	\$1,385.87	\$1,196.92	\$1,371.27	\$1,343.01	\$1,419.09	\$1,276.14	\$15,782.53
Total Charges	\$14,296.64	\$12,672.62	\$14,108.73	\$15,071.41	\$14,246.99	\$14,564.87	\$16,296.10	\$14,025.17	\$16,120.59	\$15,781.00	\$15,451.15	\$15,278.82	\$177,914.10
Total amount per Qtr		\$41,077.99			\$43,883.27			\$46,441.85			\$46,510.97		
Percent of Each quarter		23.09%			24.67%			26.10%			26.14%		100.00%



	October-22	November-22	December-22	January-23	February-23	March-23	April-23	May-23	June-23	July-23	August-23	September-23
Temperature min	74	69	65	62	63	66	70	74	77	78	78	77
Temperature max	85	81	77	76	77	79	82	86	88	89	88	85
Temperature average	79.5	75	71	69	70	72.5	76	80	82.5	83.5	83	81

# APPENDIX B

---

## ELECTRICAL DATA LOGGING





---

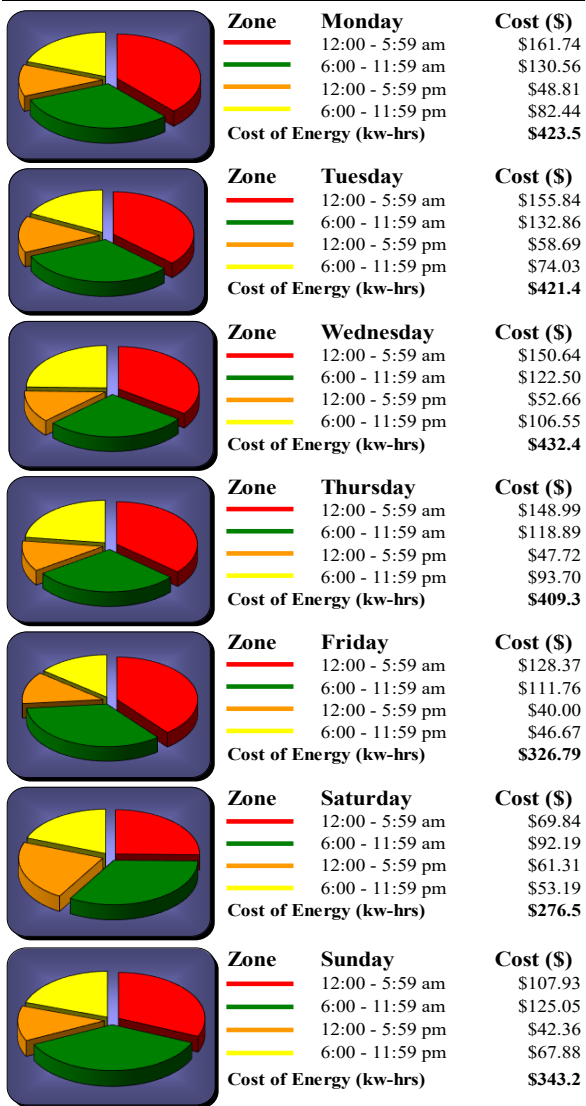
## Data Logging Table of Contents

---

Appendix B: Data Logging Summary	Page
MDC07 Air Unit #1	2
MDC07 Air Unit #2	6

## MDC07 Air Unit #1

### The Week in Review: Cost of Energy



### Profiling: Cost of Energy; Air Unit 1

The figures and graphs depicted on this page reflect the cost of energy consumption (kilowatt-hours) in accordance with the billing rate schedule's On-peak Charges of \$0 .068 and off-peak charges of \$0 .068 as shown on your monthly customer statement. Charges for demand (\$ 12.369) are discussed in another section of this report. A multiplier of 1 has been applied.

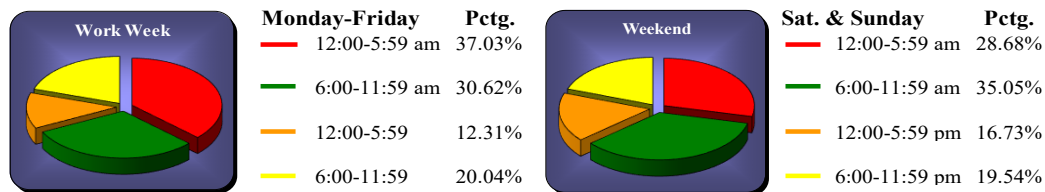


Figure 1A Cost of Energy: Monday-through-Sunday; Per Hour Per Day

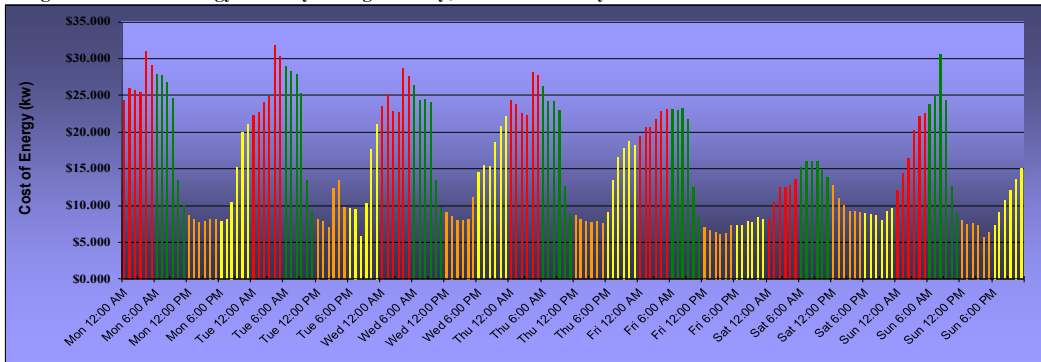
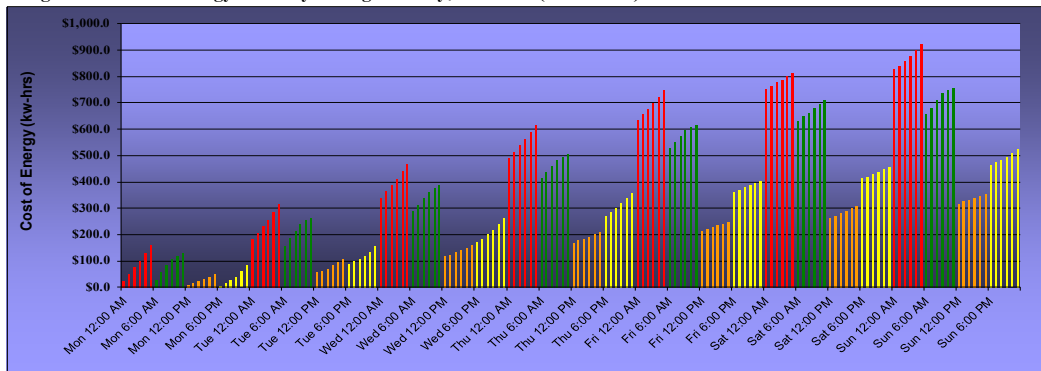


Figure 1B Cost of Energy: Monday-through-Sunday; Per Zone (cumulative)



**Table 1 Vertical Cross Analysis**

		Vertical Cross Analysis			
#	Day	Cost (\$)	Kw-Hrs	Pctg	Cumu %
1-	Monday	\$423.5	6228.4	16.08%	16.08%
2-	Tuesday	\$421.4	6197.4	16.00%	32.09%
3-	Wednesday	\$432.4	6358.2	16.42%	48.51%
4-	Thursday	\$409.3	6019.0	15.54%	64.05%
5-	Friday	\$326.8	4805.8	12.41%	76.46%
6-	Saturday	\$276.5	4066.8	10.50%	86.97%
7-	Sunday	\$343.2	5047.4	13.03%	100%
8-	Work Week	\$2,013.4	29608.8	76.5%	76.5%
9-	Week End	\$619.8	9114.2	23.5%	100%
10-	Total Week	\$2,633	38723.0	100%	100%

**Table 2 Cost of Energy; Per Time Zone Per Day**

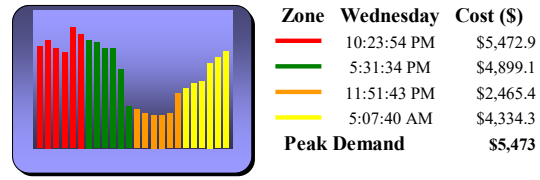
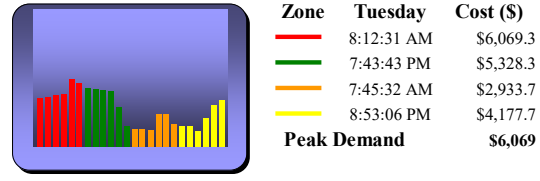
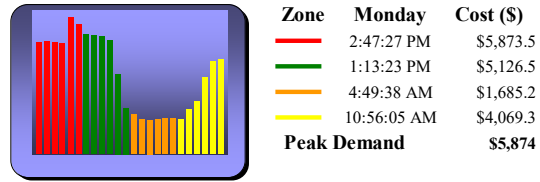
Day	Ghost Power: 12:00 To 05:59 AM				Gate Power: 06:00 To 11:59 AM				Stretch Power: 12:00 To 05:59 PM				Phantom Power: 06:00 To 11:59 PM			
	Cost (\$)	Kw-Hrs	V-Pctg	H-Pctg	Cost (\$)	Kw-Hrs	V-Pctg	H-Pctg	Cost (\$)	Kw-Hrs	V-Pctg	H-Pctg	Cost (\$)	Kw-Hrs	V-Pctg	H-Pctg
Monday	\$161.74	2378.46	17.52%	38.19%	\$130.56	1919.93	15.66%	30.83%	\$48.81	717.74	13.88%	11.52%	\$82.44	1212.31	15.72%	19.46%
Tuesday	\$155.84	2291.70	16.88%	36.98%	\$132.86	1953.87	15.93%	31.53%	\$58.69	863.07	16.69%	13.93%	\$74.03	1088.74	14.12%	17.57%
Wednesday	\$150.64	2215.35	16.32%	34.84%	\$122.50	1801.53	14.69%	28.33%	\$52.66	774.43	14.98%	12.18%	\$106.55	1566.89	20.32%	24.64%
Thursday	\$148.99	2190.96	16.14%	36.40%	\$118.89	1748.38	14.26%	29.05%	\$47.72	701.72	13.57%	11.66%	\$93.70	1377.97	17.87%	22.89%
Friday	\$128.37	1887.72	13.90%	39.28%	\$111.76	1643.54	13.40%	34.20%	\$40.00	588.25	11.38%	12.24%	\$46.67	686.27	8.90%	14.28%
Saturday	\$69.84	1027.03	7.56%	25.25%	\$92.19	1355.80	11.06%	33.34%	\$61.31	901.69	17.44%	22.17%	\$53.19	782.26	10.14%	19.24%
Sunday	\$107.93	1587.23	11.69%	31.45%	\$125.05	1839.04	15.00%	36.44%	\$42.36	622.90	12.05%	12.34%	\$67.88	998.24	12.94%	19.78%
Work Week	\$746	10964	80.7%	37.0%	\$617	9067	73.9%	30.6%	\$248	3645	70.5%	12.3%	\$403	5932	76.9%	20.0%
Week End	\$178	2614	19.3%	29%	\$217	3195	26.1%	35%	\$104	1525	29.5%	17%	\$121	1780	23.1%	20%
Total Week	\$923	13578.5	100%	35.07%	\$834	12262.1	100%	31.67%	\$352	5169.8	100%	13.35%	\$524	7712.7	100%	19.92%

**Table 3 Cost of Energy; Per Hour Per Day For Seven Days**

		1200 AM	100 AM	200 AM	300 AM	400 AM	500 AM	600 AM	700 AM	800 AM	900 AM	1000 AM	1100 AM	1200 PM	100 PM	200 PM	300 PM	400 PM	500 PM	600 PM	700 PM	800 PM	900 PM	1000 PM	1100 PM
		Monday	Cost (\$)	\$24.419	\$25.904	\$25.773	\$25.426	\$31.070	\$29.143	\$27.902	\$27.801	\$26.842	\$24.596	\$13.396	\$10.018	\$8.700	\$8.119	\$7.704	\$7.837	\$8.227	\$8.221	\$7.813	\$8.106	\$10.469	\$15.164
Monday	Kw-Hrs	359.11	380.94	379.02	373.92	456.91	428.57	410.33	408.83	394.73	361.71	197.00	147.33	127.95	119.39	113.29	115.24	120.98	120.89	114.89	119.20	153.96	223.01	292.11	309.15
Monday	%	5.77%	6.12%	6.09%	6.00%	7.34%	6.88%	6.59%	6.56%	6.34%	5.81%	3.16%	2.37%	2.05%	1.92%	1.82%	1.85%	1.94%	1.94%	1.91%	1.91%	2.47%	3.58%	4.69%	4.96%
Monday	Cumu %	5.77%	11.88%	17.97%	23.97%	31.31%	38.19%	44.78%	51.34%	57.68%	63.48%	66.65%	69.01%	71.07%	72.98%	74.80%	76.65%	78.59%	80.54%	82.38%	84.29%	86.77%	90.35%	95.04%	100%
Tuesday	Cost (\$)	\$22.277	\$22.703	\$23.992	\$24.825	\$31.724	\$30.315	\$28.961	\$28.252	\$27.852	\$25.267	\$13.405	\$9.126	\$8.224	\$7.875	\$7.059	\$12.358	\$13.353	\$9.820	\$9.628	\$9.572	\$5.766	\$10.265	\$17.636	\$21.167
Tuesday	Kw-Hrs	327.60	333.87	352.82	365.07	466.53	445.81	425.89	415.48	409.59	371.58	197.13	134.20	120.94	115.80	103.81	181.73	196.36	144.42	141.59	140.76	84.79	150.96	259.36	311.27
Tuesday	%	5.29%	5.39%	5.69%	5.89%	7.53%	7.19%	6.87%	6.70%	6.61%	6.00%	3.18%	2.17%	1.95%	1.87%	1.68%	2.93%	3.17%	2.33%	2.27%	1.37%	2.44%	4.18%	5.02%	
Tuesday	Cumu %	5.29%	10.67%	16.37%	22.26%	29.79%	36.98%	43.85%	50.55%	57.16%	63.16%	66.34%	68.51%	70.46%	72.33%	74.00%	76.93%	80.10%	82.43%	84.72%	86.99%	88.36%	90.79%	94.98%	100%
Wednesday	Cost (\$)	\$23.583	\$25.155	\$22.861	\$22.715	\$28.708	\$27.622	\$26.486	\$24.337	\$24.453	\$24.003	\$13.442	\$9.783	\$9.004	\$8.536	\$7.991	\$7.911	\$8.180	\$11.040	\$14.439	\$15.434	\$15.284	\$18.576	\$20.758	\$22.059
Wednesday	Kw-Hrs	346.81	369.93	336.19	334.04	422.17	406.20	389.50	357.89	359.60	352.99	197.68	143.87	132.42	125.52	117.51	116.34	120.29	162.35	212.34	226.96	224.77	273.18	305.26	324.39
Wednesday	%	5.45%	5.82%	5.29%	5.25%	6.64%	6.39%	6.13%	5.63%	5.66%	5.55%	3.11%	2.26%	2.08%	1.97%	1.85%	1.83%	1.89%	2.55%	3.34%	3.57%	3.54%	4.30%	4.80%	5.10%
Wednesday	Cumu %	5.45%	11.27%	16.56%	21.81%	28.45%	34.84%	40.97%	46.60%	52.25%	57.80%	60.91%	63.18%	65.26%	67.23%	69.08%	70.91%	72.80%	75.36%	78.70%	82.27%	85.80%	90.10%	94.90%	100%
Thursday	Cost (\$)	\$24.419	\$23.760	\$22.563	\$22.299	\$28.155	\$27.788	\$26.233	\$24.134	\$24.139	\$22.951	\$12.682	\$8.751	\$8.738	\$8.026	\$7.811	\$7.690	\$7.829	\$7.622	\$9.001	\$13.344	\$16.594	\$17.829	\$18.698	\$18.236
Thursday	Kw-Hrs	359.11	349.41	331.81	327.93	414.05	408.65	385.78	354.91	354.98	337.51	186.51	128.69	128.50	118.04	114.87	113.09	115.14	112.09	132.37	196.23	244.03	262.18	274.97	268.18
Thursday	%	5.97%	5.81%	5.51%	5.45%	6.88%	6.79%	6.41%	5.90%	5.90%	5.61%	3.10%	2.14%	2.13%	1.96%	1.91%	1.88%	1.91%	1.86%	2.20%	3.26%	4.05%	4.36%	4.57%	4.46%
Thursday	Cumu %	5.97%	11.77%	17.28%	22.73%	29.61%	36.40%	42.81%	48.71%	54.60%	60.21%	63.31%	65.45%	67.58%	69.54%	71.45%	73.33%	75.24%	77.11%	79.31%	82.57%	86.62%	90.98%	95.54%	100%
Friday	Cost (\$)	\$19.392	\$20.691	\$20.598	\$21.779	\$22.822	\$23.084	\$23.081	\$22.903	\$23.197	\$21.671	\$12.519	\$8.389	\$7.150	\$6.688	\$6.367	\$6.148	\$6.305	\$7.344	\$7.331	\$7.306	\$7.792	\$7.660	\$8.440	\$8.136
Friday	Kw-Hrs	285.17	304.28	302.91	320.28	335.62	339.46	339.43	336.82	341.13	318.69	184.10	123.37	105.14	98.35	93.63	90.42	92.71	107.99	107.81	107.45	114.58	112.65	124.12	119.65
Friday	%	5.93%	6.33%	6.30%	6.66%	6.98%	7.06%	7.06%	7.01%	7.10%	6.63%	3.83%	2.57%	2.19%	2.05%	1.95%	1.88%	1.93%	2.25%	2.24%	2.24%	2.38%	2.34%	2.58%	2.49%
Friday	Cumu %	5.93%	12.27%	18.57%	25.23%	32.22%	39.28%	46.34%	53.35%	60.45%	67.08%	70.91%	73.48%	75.67%	77.71%	79.66%	81.54%	83.47%	85.72%	87.96%	90.20%	92.58%	94.93%	97.51%	100%
Saturday	Cost (\$)	\$8.071	\$10.542	\$12.376	\$12.382	\$12.798	\$13.668	\$15.231	\$16.039	\$16.110	\$16.047	\$14.883	\$13.885	\$12.749	\$11.022	\$9.998	\$9.264	\$9.188	\$9.094	\$8.901	\$8.799	\$8.677	\$7.985	\$9.223	\$9.609
Saturday	Kw-Hrs	118.70	155.03	182.00	182.09	188.21	201.01	223.98	235.87	236.91	235.98	218.86	204.19	187.49	162.08	147.03	136.23	135.12	133.74	130.89	129.40	127.61	117.42	135.63	141.31
Saturday	%	2.92%	3.81%	4.48%	4.48%	4.63%	4.94%	5.51%	5.80%	5.83%	5.80%	5.38%	5.02%	4.61%	3.99%	3.62%	3.35%	3.32%	3.29%	3.22%	3.18%	2.89%	3.14%	2.89%	3.47%
Saturday	Cumu %	2.92%	6.73%	11.21%	15.68%	20.31%	25.25%	30.76%	36.56%	42.39%	48.19%	53.57%	58.59%	63.20%	67.19%	70.80%	74.15%	77.48%	80.76%	83.98%	87.16%	90.30%	93.19%	96.53%	100%
Sunday	Cost (\$)	\$12.118	\$14.420	\$16.429	\$20.248	\$22.171	\$22.546	\$23.730	\$24.900	\$30.489	\$24.313	\$12.677	\$8.946	\$7.903	\$7.532	\$7.544	\$7.405	\$5.626	\$6.348	\$7.382	\$9.094	\$10.728	\$12.012	\$13.628	\$15.037
Sunday	Kw-Hrs	178.20	212.06	241.60	297.76	326.04	331.56	348.97	366.18	448.37	357.55	186.42	131.56	116.22	110.76	110.93	108.90	82.73	93.35	108.55	133.74	157.76	176.64	200.41	221.14
Sunday	%	3.53%	4.20%	4.79%	5.90%	6.46%	6.57%	6.91%	7.25%	8.88%	7.08%	3.69%	2.61%	2.30%	2.19%	2.20%	2.16%	1.64%	1.85%	2.15%	2.65%	3.13%	3.50%	3.97%	4.38%
Sunday	Cumu %	3.53%	7.73%	12.52%	18.42%	24.88%	31.45%	38.36%	45.61%	54.50%	61.58%	65.28%	67.88%	70.18%	72.38%	74.58%	76.73%	78.37%	80.22%	82.37%	85.02%	88.15%	91.65%	95.62%	100%

Summary		Ghost Power: 12:00 To 05:59 AM					Gate Power: 06:00 To 11:59 AM					Stretch Power: 12:00 To 05:59 PM					Phantom Power: 06:00 To 11:59 PM								
		Cost (\$)	Kw-Hrs	%	Cumu %		Cost (\$)	Kw-Hrs	%	Cumu %		Cost (\$)	Kw-Hrs	%	Cumu %		Cost (\$)	Kw-Hrs	%	Cumu %					
	Cost (\$)	\$134.279	\$143.176	\$144.592	\$149.673	\$177.449	\$174.165	\$171.623	\$168.366	\$173.082	\$158.848	\$93.004	\$68.898	\$62.468	\$57.796	\$54.473	\$58.613	\$58.707	\$59.488	\$64.495	\$71.654	\$75.310	\$89.490	\$108.246	\$115.267
	Kw-Hrs	1,974.7	2,105.5	2,126.4	2,201.1	2,609.5	2,561.3	2,523.9	2,476.0	2,545.3	2,336.0	1,367.7	1,013.2	918.											

**The Week in Review: Peak Demand**



**Profiling: Cost of Energy; Air Unit 1**

Data Collection: Peak demand is the kw (kilowatt) to the nearest whole kw as determined from the company's time of use metering equipment for the Customer's greatest use for the designated on-peak periods during the month adjusted for power factor. The figures and graphs depicted on this page reflect the peak demand cost of energy (kilowatts) in accordance with the billing rate schedule (\$ 12.369/peak-kilowatt demand) and applicable taxes as shown on your monthly customer statement. for a detailed breakdown of peak demand costs per hour per day, please refer to the accompanying tables following this page. A multiplier of 1 has been applied.

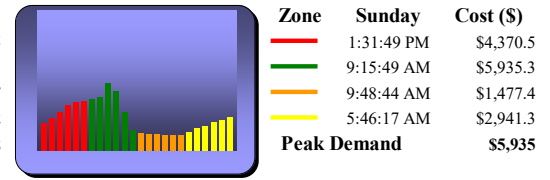
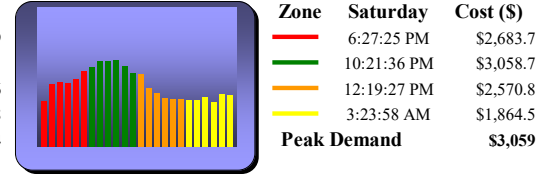
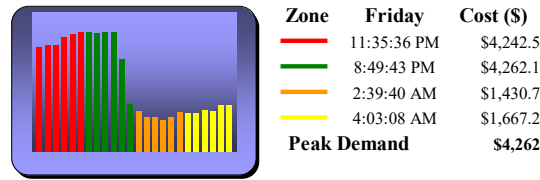
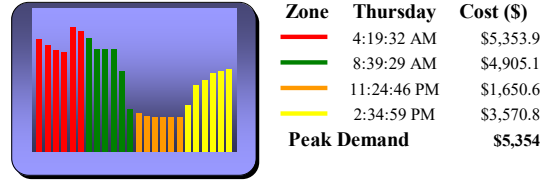
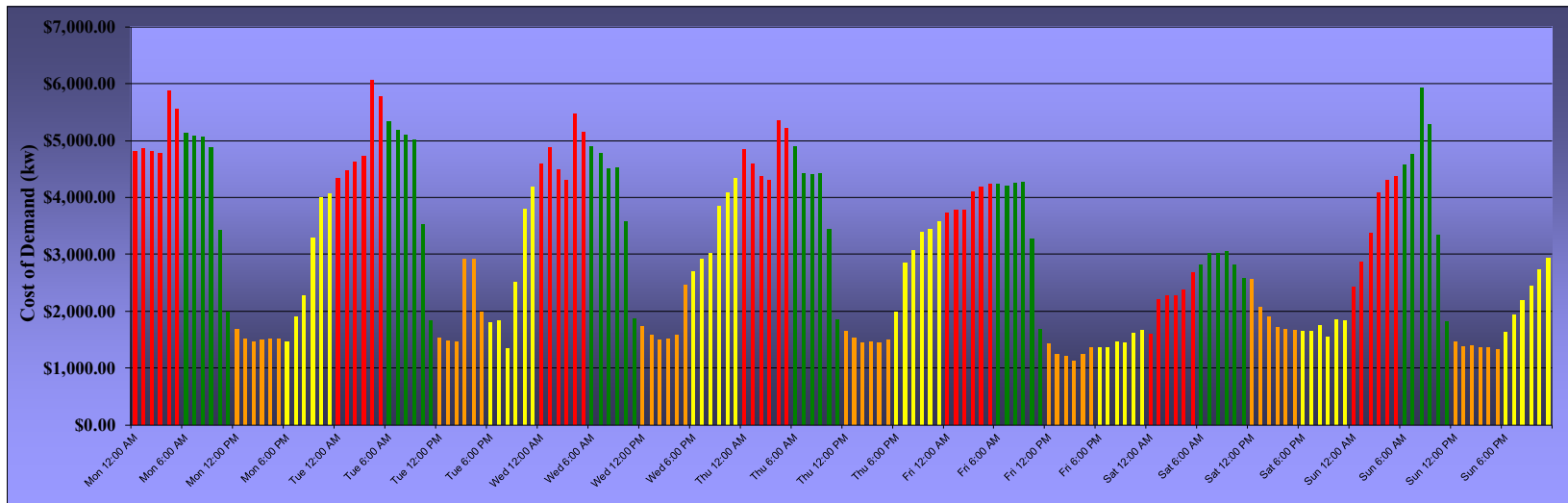


Figure 1A Cost of Energy: Monday-through-Sunday; Per Hour Per Day



**Profiling: Cost of Energy; Air Unit 1**

**Data Collection:** The team implements a data logging session aimed to capture the company's lump sum cost of energy-peak demand (kilowatt, kw) and consumption (kilowatt hours, kw-hrs). The data collection strategy consist of the installation of a minimum of 18 and up to a maximum of 500 data loggers for seven consecutive days. Each logger is preset to capture electrical demand inputs according to the preset configuration. For example, if the data loggers are set to capture data every 15 seconds, then the total number of points captured by one logger is equal to 40,320 data points. The tables shown below reflect the cost of energy- peak demand (kilowatt). All calculations reflect the billing rate schedule shown on the company's customer monthly billing statement.

**The Week in Review: Peak Demand Profile; Highest 15-second interval Kilowatt Demand, Time of Day Recorded, and Cost of Peak**

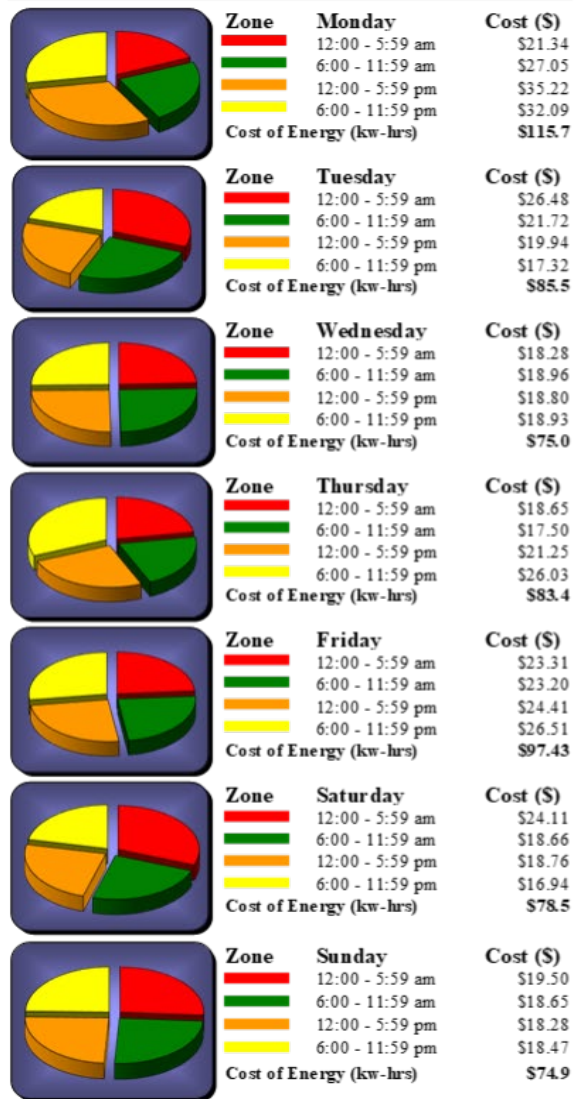
	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	
<b>Mon</b>	Cost (\$)	\$4,817.8	\$4,856.9	\$4,810.2	\$4,783.1	\$5,873.5	\$5,561.8	\$5,126.5	\$5,084.3	\$5,069.3	\$4,891.6	\$3,429.2	\$1,984.9	\$1,685.2	\$1,509.0	\$1,459.3	\$1,494.0	\$1,518.1	\$1,518.1	\$1,478.9	\$1,900.6	\$2,278.6	\$3,284.6	\$4,006.0	\$4,069.3
	Kwd	389.5	392.7	388.9	386.7	474.9	449.7	414.5	411.1	409.8	395.5	277.2	160.5	136.2	122.0	118.0	120.8	122.7	122.7	119.6	153.7	184.2	265.6	323.9	329.0
	Time	12:43 AM	1:29 AM	2:29 AM	3:00 AM	4:19 AM	5:00 AM	6:00 AM	7:55 AM	8:00 AM	9:01 AM	10:00 AM	11:14 AM	12:00 PM	1:07 PM	2:01 PM	3:57 PM	4:08 PM	5:26 PM	6:00 PM	7:59 PM	8:59 PM	9:59 PM	10:56 PM	11:34 PM
<b>Tue</b>	Cost (\$)	\$4,332.8	\$4,483.4	\$4,632.5	\$4,727.4	\$6,069.3	\$5,775.6	\$5,328.3	\$5,191.3	\$5,103.9	\$5,018.1	\$3,533.1	\$1,834.3	\$1,528.6	\$1,486.4	\$1,459.3	\$2,933.7	\$2,927.7	\$1,986.4	\$1,802.7	\$1,828.3	\$1,343.4	\$2,515.1	\$3,784.6	\$4,177.7
	Kwd	350.3	362.5	374.5	382.2	490.7	466.9	430.8	419.7	412.6	405.7	285.6	148.3	123.6	120.2	118.0	237.2	236.7	160.6	145.7	147.8	108.6	203.3	306.0	337.8
	Time	12:49 AM	1:59 AM	2:40 AM	3:36 AM	4:25 AM	5:00 AM	6:01 AM	7:00 AM	8:03 AM	9:01 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:59 PM	3:55 PM	4:00 PM	5:00 PM	6:58 PM	7:27 PM	8:04 PM	9:59 PM	10:59 PM	11:38 PM
<b>Wed</b>	Cost (\$)	\$4,593.4	\$4,882.5	\$4,501.5	\$4,313.3	\$5,472.9	\$5,143.1	\$4,899.1	\$4,789.2	\$4,507.5	\$4,522.6	\$3,567.8	\$1,870.5	\$1,725.9	\$1,585.9	\$1,507.5	\$1,509.0	\$1,585.9	\$2,465.4	\$2,701.8	\$2,908.1	\$3,012.1	\$3,853.9	\$4,081.3	\$4,334.3
	Kwd	371.4	394.7	363.9	348.7	442.5	415.8	396.1	387.2	364.4	365.6	288.4	151.2	139.5	128.2	121.9	122.0	128.2	199.3	218.4	235.1	243.5	311.6	330.0	350.4
	Time	12:45 AM	1:13 AM	2:04 AM	3:47 AM	4:17 AM	5:00 AM	6:00 AM	7:00 AM	8:59 AM	9:15 AM	10:00 AM	11:19 AM	12:01 PM	1:00 PM	2:00 PM	3:57 PM	4:24 PM	5:59 PM	6:59 PM	7:59 PM	8:36 PM	9:57 PM	10:47 PM	11:59 PM
<b>Thu</b>	Cost (\$)	\$4,838.9	\$4,597.9	\$4,384.0	\$4,313.3	\$5,353.9	\$5,216.9	\$4,905.1	\$4,418.7	\$4,417.2	\$4,420.2	\$3,447.3	\$1,843.4	\$1,650.6	\$1,527.1	\$1,442.8	\$1,451.8	\$1,447.3	\$1,498.5	\$1,997.0	\$2,859.9	\$3,067.8	\$3,394.6	\$3,438.3	\$3,570.8
	Kwd	391.2	371.7	354.4	348.7	432.9	421.8	396.6	357.2	357.1	357.4	278.7	149.0	133.4	123.5	116.6	117.4	117.0	121.1	161.5	231.2	248.0	274.4	278.0	288.7
	Time	12:48 AM	1:27 AM	2:20 AM	3:42 AM	4:24 AM	5:00 AM	6:00 AM	7:00 AM	8:59 AM	9:00 AM	10:00 AM	11:00 AM	12:06 PM	1:00 PM	2:05 PM	3:57 PM	4:05 PM	5:37 PM	6:59 PM	7:59 PM	8:59 PM	9:59 PM	10:58 PM	11:34 PM
<b>Fri</b>	Cost (\$)	\$3,734.9	\$3,783.1	\$3,775.6	\$4,109.9	\$4,188.3	\$4,242.5	\$4,235.0	\$4,215.4	\$4,250.0	\$4,262.1	\$3,278.6	\$1,682.2	\$1,430.7	\$1,236.4	\$1,218.4	\$1,128.0	\$1,242.5	\$1,373.5	\$1,361.4	\$1,364.5	\$1,469.9	\$1,444.3	\$1,620.5	\$1,667.2
	Kwd	302.0	305.9	305.2	332.3	338.6	343.0	342.4	340.8	343.6	344.6	265.1	136.0	115.7	100.0	98.5	91.2	100.5	111.0	110.1	110.3	118.8	116.8	131.0	134.8
	Time	12:59 AM	1:50 AM	2:00 AM	3:50 AM	4:39 AM	5:52 AM	6:01 AM	7:58 AM	8:57 AM	9:03 AM	10:00 AM	11:00 AM	12:01 PM	1:00 PM	2:05 PM	3:42 PM	4:59 PM	5:29 PM	6:09 PM	7:58 PM	8:56 PM	9:59 PM	10:59 PM	11:33 PM
<b>Sat</b>	Cost (\$)	\$1,605.4	\$2,207.8	\$2,283.1	\$2,272.6	\$2,378.0	\$2,683.7	\$2,819.3	\$3,012.1	\$3,010.6	\$3,058.7	\$2,831.3	\$2,584.3	\$2,570.8	\$2,073.8	\$1,908.1	\$1,713.9	\$1,680.7	\$1,677.7	\$1,641.6	\$1,659.6	\$1,754.5	\$1,555.7	\$1,864.5	\$1,834.3
	Kwd	129.8	178.5	184.6	183.7	192.3	217.0	227.9	243.5	243.4	247.3	228.9	208.9	207.8	167.7	154.3	138.6	135.9	135.6	132.7	134.2	141.8	125.8	150.7	148.3
	Time	12:59 AM	1:59 AM	2:27 AM	3:57 AM	4:57 AM	5:59 AM	6:59 AM	7:59 AM	8:01 AM	9:08 AM	10:00 AM	11:55 AM	12:00 PM	1:00 PM	2:00 PM	3:06 PM	4:17 PM	5:06 PM	6:22 PM	7:59 PM	8:34 PM	9:59 PM	10:22 PM	11:59 PM
<b>Sun</b>	Cost (\$)	\$2,423.2	\$2,873.5	\$3,373.5	\$4,096.4	\$4,307.2	\$4,370.5	\$4,572.3	\$4,777.1	\$5,935.3	\$5,283.1	\$3,347.9	\$1,823.8	\$1,477.4	\$1,390.1	\$1,402.1	\$1,361.4	\$1,366.0	\$1,325.3	\$1,625.0	\$1,935.2	\$2,188.3	\$2,453.3	\$2,725.9	\$2,941.3
	Kwd	195.9	232.3	272.7	331.2	348.2	353.3	369.7	386.2	479.8	427.1	270.7	147.4	119.4	112.4	113.4	110.1	110.4	107.1	131.4	156.5	176.9	198.3	220.4	237.8
	Time	12:59 AM	1:36 AM	2:59 AM	3:59 AM	4:46 AM	5:43 AM	6:18 AM	7:58 AM	8:17 AM	9:00 AM	10:00 AM	11:01 AM	12:14 PM	1:14 PM	2:08 PM	3:39 PM	4:04 PM	5:58 PM	6:59 PM	7:59 PM	8:59 PM	9:59 PM	10:59 PM	11:59 PM

**Figure 1A Peak Demand Profile (KW): Monday-through-Sunday; Per Hour Per Day**



## MDC07 Air Unit #2

### The Week in Review: Cost of Energy



### Profiling: Cost of Energy;

The figures and graphs depicted on this page reflect the cost of energy consumption (kilowatt-hours) in accordance with the billing rate schedule's On-peak Charges of \$0 .068 and off-peak charges of \$0 .068 as shown on your monthly customer statement. Charges for demand (\$ 12.369) are discussed in another section of this report. A multiplier of 1 has been applied.

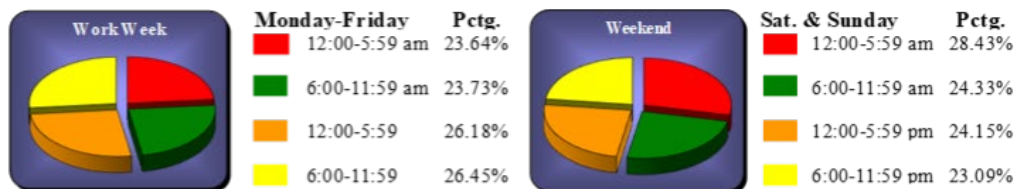


Figure 1A Cost of Energy: Monday-through-Sunday; Per Hour Per Day

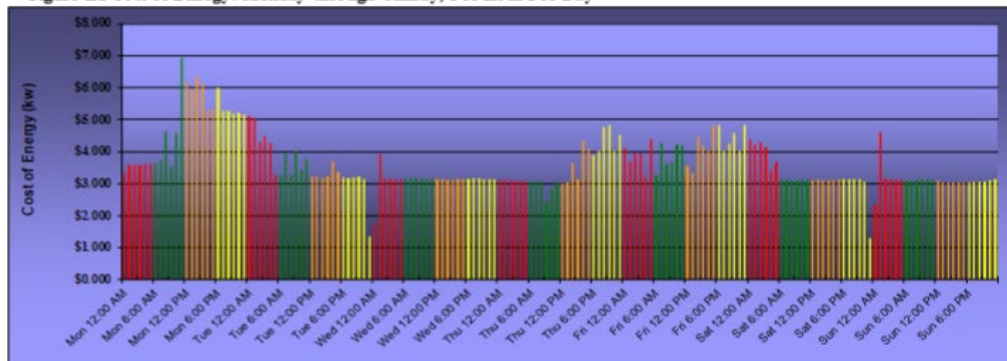
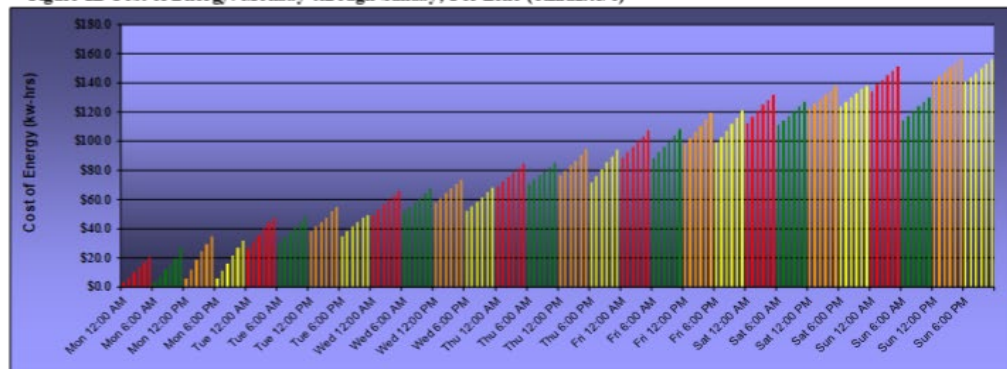


Figure 1B Cost of Energy: Monday-through-Sunday; Per Zone (cumulative)



**Table 1 Vertical Cross Analysis**

#	Day	Vertical Cross Analysis			
		Cost (\$)	Kw-Hrs	Pctg	Cumu %
1-	Monday	\$115.7	1701.6	18.96%	18.96%
2-	Tuesday	\$85.5	1256.7	14.00%	32.96%
3-	Wednesday	\$75.0	1102.4	12.28%	45.24%
4-	Thursday	\$83.4	1226.9	13.67%	58.91%
5-	Friday	\$97.4	1432.7	15.96%	74.87%
6-	Saturday	\$78.5	1153.9	12.86%	87.73%
7-	Sunday	\$74.9	1101.5	12.27%	100%
8-	Work Week	\$457.0	6720.3	74.9%	74.9%
9-	Week End	\$153.4	2255.4	25.1%	100%
10-	Total Week	\$610	8975.7	100%	100%

**Table 2 Cost of Energy: Per Time Zone Per Day**

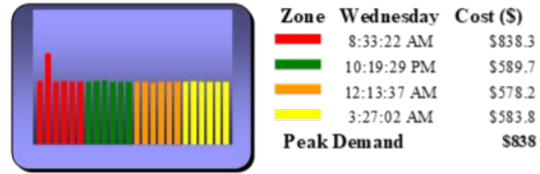
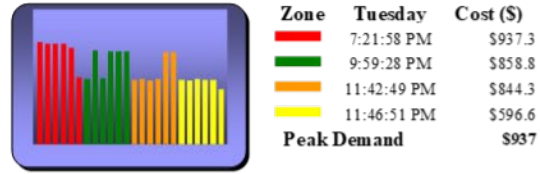
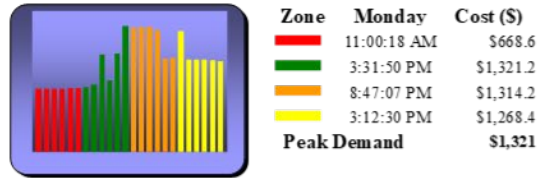
Day	Ghost Power: 12:00 To 05:59 AM				Gate Power: 06:00 To 11:59 AM				Stretch Power: 12:00 To 05:59 PM				Phantom Power: 06:00 To 11:59 PM			
	Cost (\$)	Kw-Hrs	V-Pctg	H-Pctg	Cost (\$)	Kw-Hrs	V-Pctg	H-Pctg	Cost (\$)	Kw-Hrs	V-Pctg	H-Pctg	Cost (\$)	Kw-Hrs	V-Pctg	H-Pctg
Monday	\$21.34	313.89	14.07%	18.45%	\$27.05	397.76	18.56%	23.38%	\$35.22	517.98	22.48%	30.44%	\$32.09	471.93	20.53%	27.74%
Tuesday	\$26.48	389.39	17.46%	30.98%	\$21.72	319.42	14.90%	25.42%	\$19.94	293.23	12.73%	23.33%	\$17.32	254.69	11.08%	20.27%
Wednesday	\$18.28	268.77	12.05%	24.38%	\$18.96	278.78	13.01%	25.29%	\$18.80	276.41	12.00%	25.07%	\$18.93	278.44	12.11%	25.26%
Thursday	\$18.65	274.21	12.30%	22.35%	\$17.50	257.39	12.01%	20.98%	\$21.25	312.43	13.56%	25.47%	\$26.03	382.84	16.66%	31.20%
Friday	\$23.31	342.72	15.37%	23.92%	\$23.20	341.20	15.92%	23.81%	\$24.41	359.00	15.58%	25.06%	\$26.51	389.81	16.96%	27.21%
Saturday	\$24.11	354.56	15.90%	30.73%	\$18.66	274.42	12.80%	23.78%	\$18.76	275.88	11.98%	23.91%	\$16.94	249.05	10.84%	21.58%
Sunday	\$19.50	286.71	12.86%	26.03%	\$18.65	274.31	12.80%	24.90%	\$18.28	268.80	11.67%	24.40%	\$18.47	271.64	11.82%	24.66%
Work Week	\$108	1589	71.2%	23.6%	\$108	1595	74.4%	23.7%	\$120	1759	76.4%	26.2%	\$121	1778	77.3%	26.5%
Week End	\$44	641	28.8%	28%	\$37	549	25.6%	24%	\$37	545	23.6%	24%	\$35	521	22.7%	23%
Total Week	\$152	2230.2	100%	24.85%	\$146	2143.3	100%	23.88%	\$157	2303.7	100%	25.67%	\$156	2298.4	100%	25.61%

**Table 3 Cost of Energy: Per Hour Per Day For Seven Days**

		12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
		Monday	Cost (\$)	\$3.337	\$3.588	\$3.583	\$3.597	\$3.618	\$3.620	\$3.655	\$3.731	\$4.639	\$3.528	\$4.568	\$6.927	\$6.160	\$5.973	\$6.332	\$6.120	\$5.303	\$5.315	\$5.997	\$5.274	\$5.283	\$5.183
	Kw-Hrs	49.08	52.77	52.69	52.89	53.21	53.24	53.75	54.86	68.22	51.89	67.17	101.87	90.59	87.84	93.41	90.00	77.98	78.16	88.19	77.56	77.70	76.23	76.53	75.72
	%	2.88%	3.10%	3.10%	3.11%	3.13%	3.13%	3.16%	3.22%	4.01%	3.05%	3.95%	5.99%	5.32%	5.16%	5.29%	4.58%	4.59%	5.18%	4.56%	4.57%	4.48%	4.48%	4.50%	4.45%
	Cumu %	2.88%	5.99%	9.08%	12.19%	15.32%	18.45%	21.61%	24.83%	28.84%	31.89%	35.84%	41.82%	47.15%	52.31%	57.80%	63.09%	67.67%	72.26%	77.45%	82.01%	86.57%	91.05%	95.55%	100%
Tuesday	Cost (\$)	\$5.098	\$5.047	\$4.293	\$4.495	\$4.263	\$3.282	\$3.259	\$3.965	\$3.283	\$4.033	\$3.416	\$3.765	\$3.236	\$3.231	\$3.179	\$3.229	\$3.687	\$3.378	\$3.207	\$3.183	\$3.206	\$3.225	\$3.147	\$1.350
	Kw-Hrs	74.98	74.23	63.13	66.11	62.69	48.27	47.92	58.31	48.27	59.31	50.24	55.37	47.59	47.51	46.75	47.48	54.22	49.68	47.17	46.81	47.15	47.43	46.28	19.85
	%	5.97%	5.91%	5.02%	5.26%	4.99%	3.84%	3.81%	4.64%	3.84%	4.72%	4.00%	4.41%	3.79%	3.78%	3.72%	3.78%	4.31%	3.95%	3.75%	3.72%	3.75%	3.77%	3.68%	1.58%
	Cumu %	5.97%	11.87%	16.90%	22.16%	27.14%	30.98%	34.80%	39.44%	43.28%	48.00%	52.00%	56.40%	60.19%	63.97%	67.69%	71.47%	75.78%	79.73%	83.49%	87.21%	90.96%	94.74%	98.42%	100%
Wednesday	Cost (\$)	\$1.764	\$3.906	\$3.159	\$3.153	\$3.155	\$3.138	\$3.153	\$3.180	\$3.196	\$3.145	\$3.134	\$3.149	\$3.144	\$3.137	\$3.110	\$3.125	\$3.138	\$3.143	\$3.138	\$3.184	\$3.164	\$3.148	\$3.152	\$3.148
	Kw-Hrs	25.95	57.45	46.46	46.37	46.39	46.15	46.36	46.77	47.00	46.26	46.09	46.31	46.24	46.13	45.73	45.95	46.15	46.22	46.15	46.83	46.53	46.29	46.35	46.29
	%	2.35%	5.21%	4.21%	4.21%	4.21%	4.19%	4.21%	4.24%	4.26%	4.20%	4.18%	4.20%	4.19%	4.18%	4.15%	4.17%	4.19%	4.19%	4.19%	4.25%	4.22%	4.20%	4.20%	4.20%
	Cumu %	2.35%	7.56%	11.78%	15.99%	20.19%	24.38%	28.59%	32.83%	37.09%	41.29%	45.47%	49.67%	53.86%	58.05%	62.20%	66.36%	70.55%	74.74%	78.93%	83.18%	87.40%	91.60%	95.80%	100%
Thursday	Cost (\$)	\$3.130	\$3.130	\$3.127	\$3.101	\$3.089	\$3.068	\$3.074	\$3.063	\$3.088	\$2.436	\$2.847	\$2.995	\$3.005	\$3.022	\$3.649	\$3.157	\$4.335	\$4.077	\$3.888	\$4.023	\$4.765	\$4.823	\$4.016	\$4.520
	Kw-Hrs	46.03	46.03	45.99	45.61	45.43	45.12	45.20	45.04	45.41	35.82	41.87	44.05	44.20	44.44	53.67	46.42	63.75	59.96	57.18	59.16	70.05	70.92	59.06	66.47
	%	3.75%	3.75%	3.75%	3.72%	3.70%	3.68%	3.68%	3.67%	3.70%	2.92%	3.41%	3.59%	3.60%	3.62%	4.37%	3.78%	5.20%	4.89%	4.66%	4.82%	5.71%	5.78%	4.81%	5.42%
	Cumu %	3.75%	7.50%	11.25%	14.97%	18.67%	22.35%	26.04%	29.71%	33.41%	36.33%	39.74%	43.33%	46.93%	50.55%	54.93%	58.71%	63.91%	68.80%	73.46%	78.28%	83.99%	89.77%	94.58%	100%
Friday	Cost (\$)	\$4.099	\$3.709	\$3.975	\$3.933	\$3.206	\$4.384	\$3.254	\$4.264	\$3.611	\$3.657	\$4.233	\$4.184	\$3.565	\$3.336	\$4.459	\$4.180	\$4.033	\$4.839	\$4.827	\$4.024	\$4.237	\$4.569	\$4.027	\$4.823
	Kw-Hrs	60.28	54.54	58.46	57.83	47.15	64.47	47.85	62.70	53.10	53.78	62.25	61.53	52.43	49.06	65.57	61.47	59.31	71.16	70.99	59.18	62.30	67.18	59.22	70.93
	%	4.21%	3.81%	4.08%	4.04%	3.29%	4.50%	3.34%	4.38%	3.71%	3.75%	4.34%	4.29%	3.66%	3.42%	4.58%	4.29%	4.14%	4.97%	4.95%	4.13%	4.35%	4.69%	4.13%	4.95%
	Cumu %	4.21%	8.01%	12.09%	16.13%	19.42%	23.92%	27.26%	31.64%	35.34%	39.10%	43.44%	47.74%	51.39%	54.82%	59.40%	63.69%	67.83%	72.79%	77.75%	81.88%	86.23%	90.92%	95.05%	100%
Saturday	Cost (\$)	\$4.393	\$4.227	\$4.303	\$4.131	\$3.394	\$3.662	\$3.145	\$3.112	\$3.080	\$3.090	\$3.120	\$3.114	\$3.122	\$3.149	\$3.122	\$3.118	\$3.114	\$3.134	\$3.134	\$3.138	\$3.144	\$3.144	\$3.071	\$3.304
	Kw-Hrs	64.61	62.16	63.28	60.75	49.91	53.85	46.24	45.77	45.29	45.44	45.88	45.80	45.92	46.31	45.91	45.86	45.79	46.09	46.09	46.15	46.23	46.23	45.16	19.18
	%	5.60%	5.39%	5.48%	5.26%	4.33%	4.67%	4.01%	3.97%	3.93%	3.94%	3.98%	3.97%	3.98%	4.01%	3.98%	3.97%	3.99%	3.99%	3.99%	4.00%	4.01%	4.01%	3.91%	1.66%
	Cumu %	5.60%	10.99%	16.47%	21.73%	26.06%	30.73%	34.73%	38.70%	42.63%	46.56%	50.54%	54.51%	58.49%	62.50%	66.48%	70.45%	74.42%	78.42%	82.41%	86.41%	90.42%	94.42%	98.34%	100%
Sunday	Cost (\$)	\$2.313	\$4.607	\$3.151	\$3.157	\$3.126	\$3.142	\$3.080	\$3.079	\$3.105	\$3.135	\$3.132	\$3.124	\$3.081	\$3.032	\$3.044	\$3.040	\$3.036	\$3.046	\$3.044	\$3.048	\$3.059	\$3.057	\$3.124	\$3.140
	Kw-Hrs	34.01	67.75	46.34	46.43	45.97	46.20	45.29	45.28	45.66	46.10	46.05	45.94	45.31	44.59	44.76	44.70	44.65	44.79	44.76	44.82	44.99	44.95	45.94	46.17
	%	3.09%	6.15%	4.21%	4.22%	4.17%	4.19%	4.11%	4.11%	4.15%	4.19%	4.18%	4.17%	4.11%	4.05%	4.06%	4.06%	4.05%	4.07%	4.06%	4.07%	4.08%	4.08%	4.17%	4.19%
	Cumu %	3.09%	9.24%	13.45%	17.66%	21.83%	26.03%	30.14%	34.25%	38.40%	42.58%	46.76%	50.93%	55.05%	59.10%	63.16%	67.22%	71.27%	75.34%	79.40%	83.47%	87.56%	91.64%	95.81%	100%

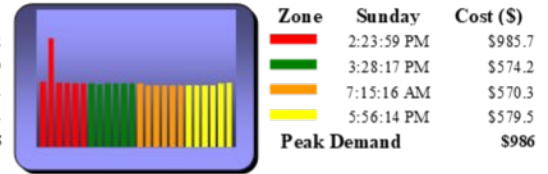
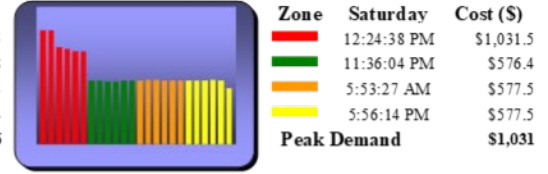
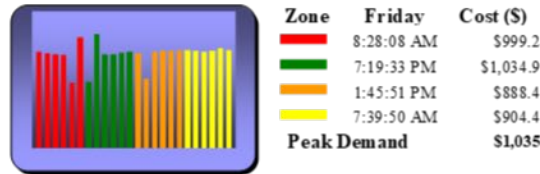
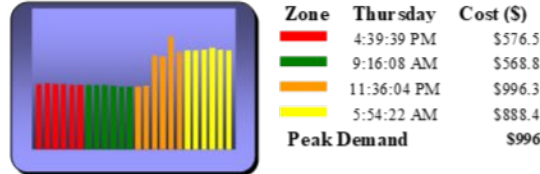
Summary	Cost (\$)	Ghost Power: 12:00 To 05:59 AM				Gate Power: 06:00 To 11:59 AM				Stretch Power: 12:00 To 05:59 PM				Phantom Power: 06:00 To 11:59 PM											
		\$24.135	\$28.215	\$25.592	\$25.567	\$23.852	\$24.296	\$22.618	\$24.393	\$24.000	\$23.024	\$24.449	\$27.259	\$25.314	\$24.879	\$26.914	\$25.968	\$26.645	\$26.932	\$27.236	\$25.875	\$26.856	\$27.148	\$25.741	\$23.434
	Kw-Hrs	354.9	414.9	376.4	376.0	350.8	357.3	332.6	358.7	352.9	338.6	359.5	400.9	372.3	365.9	395.8	381.9	391.8	396.1	400.5	380.5	394.9	399.2	378.5	344.6
	%	15.91%	18.60%	16.88%	16.86%	15.73%	16.02%	15.52%	16.74%	16.47%	15.80%	16.78%	18.70%	16.16%	15.88%	17.18%	16.58%	17.01%	17.19%	17.43%	16.56%	17.18%	17.37%	16.47%	14.99%
	Cumu %	15.91%	34.52%	51.39%	68.25%	83.98%	100%	15.52%	32.26%	48.72%	64.52%	81.30%	100%	16.16%	32.04%	49.22%	65.80%	82.81%	100%	17.43%	33.98%	51.17%	68.54%	85.01%	100%

**The Week in Review: Peak Demand**



**Profiling: Cost of Energy;**

Data Collection: Peak demand is the kw (kilowatt) to the nearest whole kw as determined from the company's time of use metering equipment for the Customer's greatest use for the designated on-peak periods during the month adjusted for power factor. The figures and graphs depicted on this page reflect the peak demand cost of energy (kilowatts) in accordance with the billing rate schedule (\$ 12.369/peak-kilowatt demand) and applicable taxes as shown on your monthly customer statement. for a detailed breakdown of peak demand costs per hour per day, please refer to the accompanying tables following this page. A multiplier of 1 has been applied.



**Figure 1A Cost of Energy: Monday-through-Sunday; Per Hour Per Day**



**Profiling: Cost of Energy;**

**Data Collection:** The team implements a data logging session aimed to capture the company's lump sum cost of energy-peak demand (kilowatt, kw) and consumption (kilowatt hours, kw-hrs). The data collection strategy consist of the installation of a minimum of 18 and up to a maximum of 500 data loggers for seven consecutive days. Each logger is preset to capture electrical demand inputs according to the preset configuration. For example, if the data loggers are set to capture data every 15 seconds, then the total number of points captured by one logger is equal to 40,320 data points. The tables shown below reflect the cost of energy-peak demand (kilowatt). All calculations reflect the billing rate schedule shown on the company's customer monthly billing statement.

**The Week in Review: Peak Demand Profile; Highest 15-second interval Kilowatt Demand, Time of Day Recorded, and Cost of Peak**

		12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Mon	Cost (\$)	\$856.2	\$861.0	\$857.3	\$860.7	\$868.6	\$866.1	\$874.8	\$701.7	\$1,019.0	\$747.6	\$1,028.9	\$1,321.2	\$1,307.4	\$1,311.5	\$1,314.2	\$1,275.8	\$977.6	\$981.7	\$1,268.4	\$971.3	\$970.3	\$964.8	\$960.1	\$949.3
	Kwd	53.1	53.4	53.1	53.4	54.1	53.9	54.6	56.7	82.4	60.4	83.2	106.8	105.7	106.0	106.2	103.1	79.0	79.4	102.5	78.5	78.4	78.0	77.6	76.8
	Time	11:59 AM	12:13 PM	12:32 PM	12:47 PM	1:01 PM	1:19 PM	1:36 PM	1:52 PM	1:57 PM	2:22 PM	2:36 PM	2:44 PM	3:03 PM	3:09 PM	3:24 PM	3:49 PM	4:06 PM	4:08 PM	4:32 PM	4:48 PM	4:55 PM	5:07 PM	5:30 PM	5:46 PM
Tue	Cost (\$)	\$937.3	\$925.5	\$923.9	\$924.7	\$887.3	\$815.9	\$599.7	\$858.8	\$606.5	\$856.3	\$852.5	\$857.4	\$592.8	\$597.0	\$585.6	\$598.7	\$842.9	\$844.3	\$593.1	\$584.5	\$596.6	\$589.7	\$592.1	\$507.3
	Kwd	75.8	74.8	74.7	74.8	71.7	49.8	48.5	69.4	49.0	69.2	68.9	69.3	47.9	48.3	47.3	48.4	68.1	68.3	48.0	47.3	48.2	47.7	47.9	41.0
	Time	5:56 PM	6:14 PM	6:23 PM	6:39 PM	6:59 PM	7:08 PM	7:36 PM	7:45 PM	8:06 PM	8:18 PM	8:36 PM	8:38 PM	9:06 PM	9:17 PM	9:25 PM	9:51 PM	10:07 PM	10:08 PM	10:22 PM	10:44 PM	10:52 PM	11:15 PM	11:27 PM	11:38 PM
Wed	Cost (\$)	\$581.9	\$838.3	\$878.5	\$580.3	\$577.6	\$574.7	\$575.8	\$583.2	\$589.7	\$576.6	\$574.0	\$576.4	\$576.8	\$578.2	\$572.0	\$575.2	\$575.6	\$577.1	\$574.3	\$583.8	\$579.6	\$575.7	\$577.1	\$577.2
	Kwd	47.0	67.8	46.8	46.9	46.7	46.5	46.6	47.1	47.7	46.6	46.4	46.6	46.6	46.7	46.2	46.5	46.5	46.7	46.4	47.2	46.9	46.5	46.7	46.7
	Time	12:07 AM	12:17 AM	12:22 AM	12:41 AM	12:58 AM	1:09 AM	1:34 AM	1:51 AM	1:59 AM	2:13 AM	2:28 AM	2:44 AM	3:06 AM	3:12 AM	3:33 AM	3:50 AM	3:53 AM	4:19 AM	4:37 AM	4:44 AM	5:05 AM	5:21 AM	5:33 AM	5:38 AM
Thur	Cost (\$)	\$573.9	\$876.5	\$573.7	\$569.1	\$567.9	\$562.7	\$564.9	\$564.6	\$568.8	\$559.3	\$547.4	\$548.4	\$552.1	\$555.6	\$823.3	\$819.0	\$996.3	\$852.4	\$867.8	\$870.6	\$888.4	\$877.6	\$877.1	\$866.2
	Kwd	46.4	46.6	46.4	46.0	45.9	45.5	45.7	45.6	46.0	45.2	44.3	44.3	44.6	44.9	66.6	66.2	80.5	68.9	70.2	70.4	71.0	71.8	70.8	70.0
	Time	5:56 AM	6:08 AM	6:30 AM	6:38 AM	6:53 AM	7:19 AM	7:36 AM	7:52 AM	8:08 AM	8:30 AM	8:47 AM	9:04 AM	9:14 AM	9:36 AM	9:38 AM	9:59 AM	10:13 AM	10:35 AM	10:40 AM	11:07 AM	11:15 AM	11:26 AM	11:41 AM	
Fri	Cost (\$)	\$871.4	\$852.2	\$851.6	\$841.0	\$858.1	\$999.2	\$598.8	\$1,034.9	\$849.4	\$848.1	\$861.3	\$870.2	\$859.9	\$826.4	\$871.7	\$877.3	\$877.6	\$888.4	\$888.4	\$877.5	\$873.9	\$877.6	\$904.4	\$884.7
	Kwd	70.5	69.4	68.9	68.0	47.5	80.8	48.4	83.7	68.7	68.6	69.6	70.4	69.5	50.6	70.5	70.9	71.0	71.8	71.8	70.9	70.6	71.0	73.1	71.5
	Time	12:02 PM	12:08 PM	12:22 PM	12:45 PM	1:07 PM	1:13 PM	1:32 PM	1:38 PM	2:05 PM	2:07 PM	2:34 PM	2:44 PM	2:54 PM	3:13 PM	3:34 PM	3:52 PM	4:07 PM	4:21 PM	4:29 PM	4:37 PM	4:53 PM	5:12 PM	5:36 PM	5:51 PM
Sat	Cost (\$)	\$1,029.7	\$1,031.5	\$878.3	\$858.0	\$836.3	\$837.1	\$576.4	\$573.2	\$565.8	\$568.7	\$571.8	\$569.8	\$575.8	\$577.2	\$577.5	\$571.9	\$569.5	\$573.4	\$574.5	\$574.7	\$576.7	\$577.5	\$574.2	\$566.7
	Kwd	83.2	83.4	71.0	69.4	67.6	67.7	46.6	46.3	45.7	46.0	46.2	46.1	46.6	46.7	46.7	46.2	46.0	46.4	46.4	46.5	46.6	46.7	46.4	41.0
	Time	6:06 PM	6:07 PM	6:30 PM	6:43 PM	7:07 PM	7:07 PM	7:28 PM	7:38 PM	7:54 PM	8:22 PM	8:31 PM	8:38 PM	9:06 PM	9:09 PM	9:25 PM	9:41 PM	10:06 PM	10:14 PM	10:24 PM	10:52 PM	11:07 PM	11:15 PM	11:33 PM	11:38 PM
Sun	Cost (\$)	\$585.4	\$985.7	\$577.3	\$578.3	\$573.5	\$575.6	\$574.2	\$564.9	\$571.5	\$573.2	\$573.3	\$574.0	\$570.3	\$555.1	\$559.5	\$556.9	\$556.9	\$556.1	\$556.1	\$557.3	\$561.1	\$559.1	\$574.4	\$579.5
	Kwd	47.3	79.7	46.7	46.8	46.4	46.5	46.4	45.7	46.2	46.3	46.3	46.4	46.1	44.9	45.2	45.0	45.0	45.1	46.0	45.1	45.4	45.2	46.4	46.9
	Time	12:07 AM	12:16 AM	12:36 AM	12:40 AM	1:06 AM	1:07 AM	1:26 AM	1:43 AM	2:07 AM	2:15 AM	2:36 AM	2:43 AM	2:59 AM	3:12 AM	3:31 AM	3:46 AM	3:56 AM	4:17 AM	4:24 AM	4:50 AM	5:03 AM	5:13 AM	5:37 AM	5:38 AM

**Figure 1A Peak Demand Profile (KW): Monday-through-Sunday; Per Hour Per Day**

