ENERGY FOR PURPOSE

Energy Study:

THE WOODLANDS COMMUNITY PRESBYTERIAN CHURCH

THE WOODLANDS, TX

APRIL 25, 2023

Colby May CEM
(512) 971-2364
colby@energyforpurpose.com

Table of Contents

1.0 EXECUTIVE SUMMARY:

This **ASHRAE LEVEL 2 ENERGY AUDIT** is provided to **The Woodlands Community Presbyterian Church** (hereafter known as WCPC) in Partnership with **Energy for Purpose** (hereafter known as EFP).

Our hope through these studies is for WCPC to promote Creation Care and missions through energy efficiency stewardship. The service assists churches, schools and institutions to take basic steps towards energy efficient facility operation and environmental sustainability. Active involvement in the partnership from the entire administration and staff within the agencies and institutions is critical in developing a customized blueprint for energy efficiency for their facilities.

In April 2023, **EFP** was retained by WCPC, for the performance of an ASHRAE Level 2 Energy Audit. This report is intended to provide support for WCPC as it determines the most appropriate path for facility energy practices and renovation, especially as it pertains to the energy consuming systems around the facility. It is our opinion that decreases in annual energy costs, as well as major maintenance cost reductions, can be achieved through the efficiency recommendations provided herein. The report will focus on assisting WCPC in building upon their existing energy management program that will address maintenance and operation recommendations.

This study has focused on energy efficiency, behavior and systems operations. To that end, an analysis of the utility usage and costs for **WCPC** was completed by **EFP** to determine the annual energy cost index (ECI) and energy use index (EUI) for the facility. A complete listing of the Base Year Utility Costs and Consumption is provided in Section 3.0 of this report.

Following the utility analysis and a preliminary consultation with the facility team a walk-through energy analysis was conducted throughout the campus. Specific findings of this survey and the resulting recommendations for both operation and maintenance procedures and cost-effective energy retrofit installations are identified in Section 5.0 of this report.

We estimate that as much as **$18,670 (29% savings)** may be saved annually if all recommended projects are implemented. The estimated installed cost of these projects should total approximately **$208,880** yielding an average simple payback of **11.2 Years**. These numbers do not take into effect maintenance savings, rebates or utility tax credits.

We would like to thank Cinda Hitchcock, Mark Seefeldt and team for their support during the site survey, and the valuable explanations of existing equipment and operations. We appreciate the fact that the staff went above and beyond in assisting us in the energy audit. Their knowledge of the systems is extensive, and the findings/recommendations herein would not have been possible without their assistance.

ECRM	PROJECT	Summary	COST	SAVINGS	PAYBACK (Years)
1 & 2	Controls & Scheduling	Change Sequence of Operations	$30,000	$5,000	6.00
3	HVAC	Replace Older Units	$168,000	$11,200	15.00
4	Lighting Project	Retrofit LED bulbs campus wide	$5,880	$1,470	4.00
5	Low Cost Opportunities	Domestic Hotwater, Lighting, Plug Load, Water	$5,000	$1,000	5.00
TOTAL			**$208,880**	**$18,670**	**11.19**
Total Energy Cost			**$63,594**		
Total Project Savings					**$18,670**
% Savings					**29.36%**

Table 1: Summary of Recommended Energy Cost Reduction Measures (ECRMs)

These savings only account for Energy cost and do not include maintenance savings. Also, these projects only account for the immediate capital expense projects. Low-Cost recommendations mentioned in the report could increase savings. Our final "summary" comment is that **EFP** views the completion and presentation of this report as a beginning, rather than an end, of our relationship with **WCPC**. We hope to be ongoing partners in assisting you to implement the recommendations listed in this report. Please call us if you have further questions or comments regarding your Energy Management Issues

*EFP Consultants. Colby May, CEM (512) 971-2364

2.0 ENERGY ASSESSMENT PROCEDURE:

This analysis serves as the springboard to form a "partnership" between the client and the consultant for the purposes of energy costs and consumption reduction within owned and operated facilities. An initial visit was conducted by **EFP** to review the program elements and to select the elements, which could best benefit WCPC. A summary of the **WCPC's** most recent twelve months of utility bills was provided to the consultant for the assessment of the Energy Performance Indicators.

Key components of future analyses should include:

1. Designing and monitoring customized procedures to control the run times of energy consuming systems.
2. Analyze systems for code and standard compliance in areas such as cooling system refrigerants used, outside air quantity, and lighting illumination levels.
3. Develop an accurate definition of system and equipment replacement projects along with installation cost estimates, estimated energy and cost savings and analyses for each recommended project.
4. Develop a prioritized schedule for replacement projects.
5. Developing and drafting an overall Energy Management Policy.
6. Assist in the development of guidelines for efficiency levels of future equipment purchases.

COVID- STATEMENT:

Although the SARS-CoV-2 virus, which causes the COVID-19 disease, can be distributed through air distribution systems. In an effort to assist in the control of the virus, ASHRAE (the primary air conditioning standards agency in America) has produced a set of recommendations that should provide beneficial results toward reduction of the spread of the virus.

These recommendations can be broken down into four parts: Dilute, Exhaust, Contain, and Clean. Of these categories, the HVAC system is primarily concerned with the first two:

"Dilute & Exhaust" – Multiple options are offered by ASHRAE that would affect positive results within the indoor environment. Many of these recommendations, though effective, are not possible in most commercial buildings. For example, operating a building with 100% outside air at all times would certainly decrease the level of contamination within the building, but very few HVAC systems are designed to handle the greatly increased loads this would place on the conditioning equipment, and the result in humid areas of the country would likely be an increase of indoor mold and mildew, and would produce a detrimental effect on many musical and humidity sensitive instruments.

As a result, we cannot offer any advice that will produce a 100% disease-free facility. However, our experience with church facilities has led us to the following conclusions:

- *Older facilities were not constructed as tightly as today's newer buildings and as a result, they have constant uncontrolled infiltration and/or exfiltration (i.e., exhaust). Although this is a detriment during normal times, it serves to dilute and exhaust indoor air 24 hours per day*
- *Pre- and Post-Occupancy "Flushing" of the building (i.e., running the air distribution system with 100% outside air) to provide 3 total air-changes (combined pre- and post-total air exchanges) each day is sufficient to minimize contamination levels in most facilities during periods of no/low occupancy.*
- *Most HVAC systems within churches were not designed to handle 100% outside air loads, with some of the smaller systems having no outside air intakes at all. Thus, the attempt to significantly increase the %OA in most systems would invite humidity related issues such as mold, mildew and discomfort.*
- *During all hours of the week when the facility is minimally occupied (e.g., 50% or less), it is suggested that the pre- and post-flush should be sufficient to dilute indoor air.*
- *During full occupancy hours, adding some additional percentage of OA to the pre- and post-flush is advised, but the actual percentage will vary in each building depending upon ambient conditions and building exterior wall integrity.*

SUMMARY:
The COVID-19 virus is not a disease to be dismissed or taken lightly, but each facility director must determine the balance point between 0% and 100% outside air that continues to provide comfort while also diluting contaminants within the indoor air.

3.0 ENERGY PERFORMANCE INDICATORS:

In order to easily assess WCPC energy utilization and current level of efficiency, there are two key "Energy Performance Indicators" calculated within this report.

1. Energy Utilization Index

The Energy Utilization Index (EUI) depicts the total annual energy consumption per square foot of building space and is expressed in "British Thermal Units" (BTUs).

To calculate the EUI, the consumption of electricity and gas are first converted to equivalent BTU consumption via the following formulas:

ELECTRICITY Usage

[Total KWH /yr] x [3413 BTUs/KWH] = _____ BTUs / yr

NATURAL GAS Usage

[Total Therms/yr] x [100,000 BTUs/Therms] = _____ BTUs / yr

After adding the BTU consumption of each fuel, the total BTUs are then divided

by the building area.

EUI = [Electricity BTUs + Gas BTUs] divided by [Total square feet]

2. Energy Cost Index

The Energy Cost Index (ECI) depicts the total annual energy cost per square foot of building space.

To calculate the ECI, the annual costs of electricity and gas are totaled and divided by the total square footage of the facility:

ECI = [Electricity Cost + Gas Cost] divided by [Total square feet]

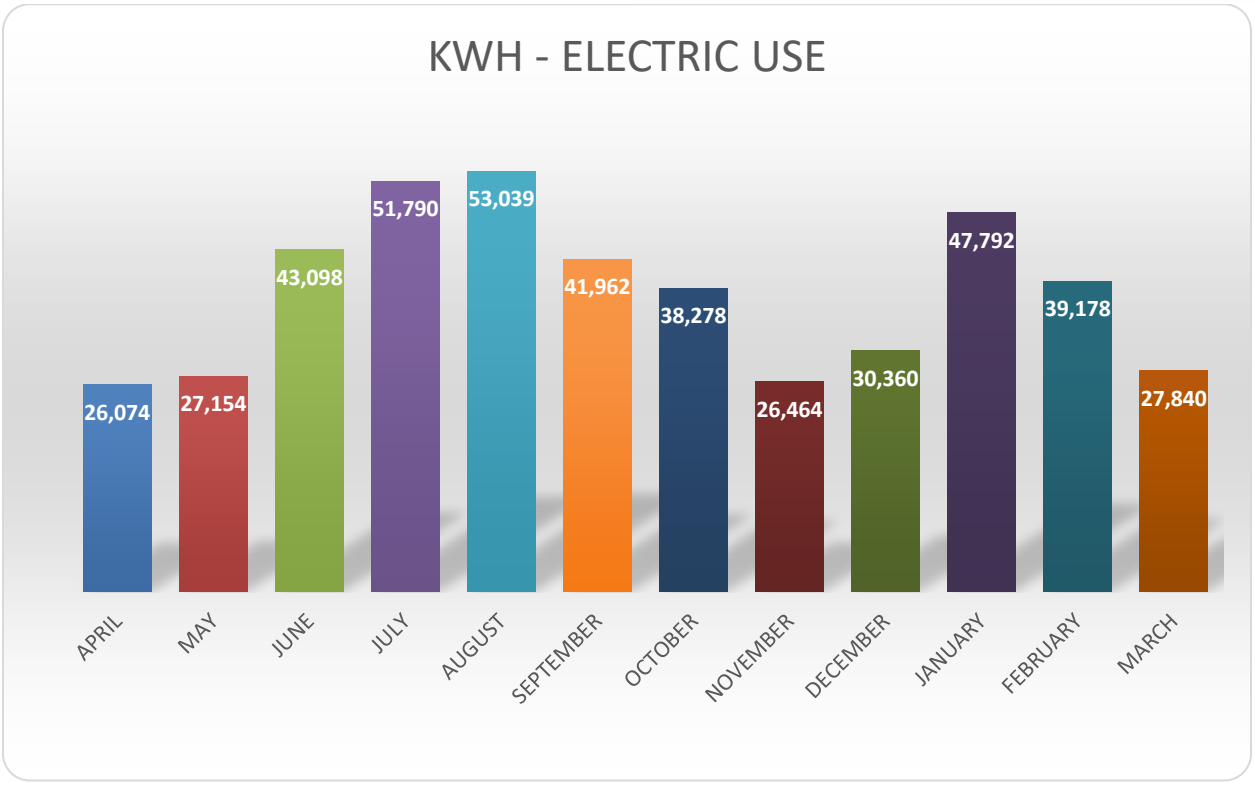
These indicators may be used to compare the facility's current cost and usage to past years, or to other similar facilities in the area. Although the comparisons will not provide specific reasons for unusual operation, they serve as indicators that problems may exist within the energy consuming systems.

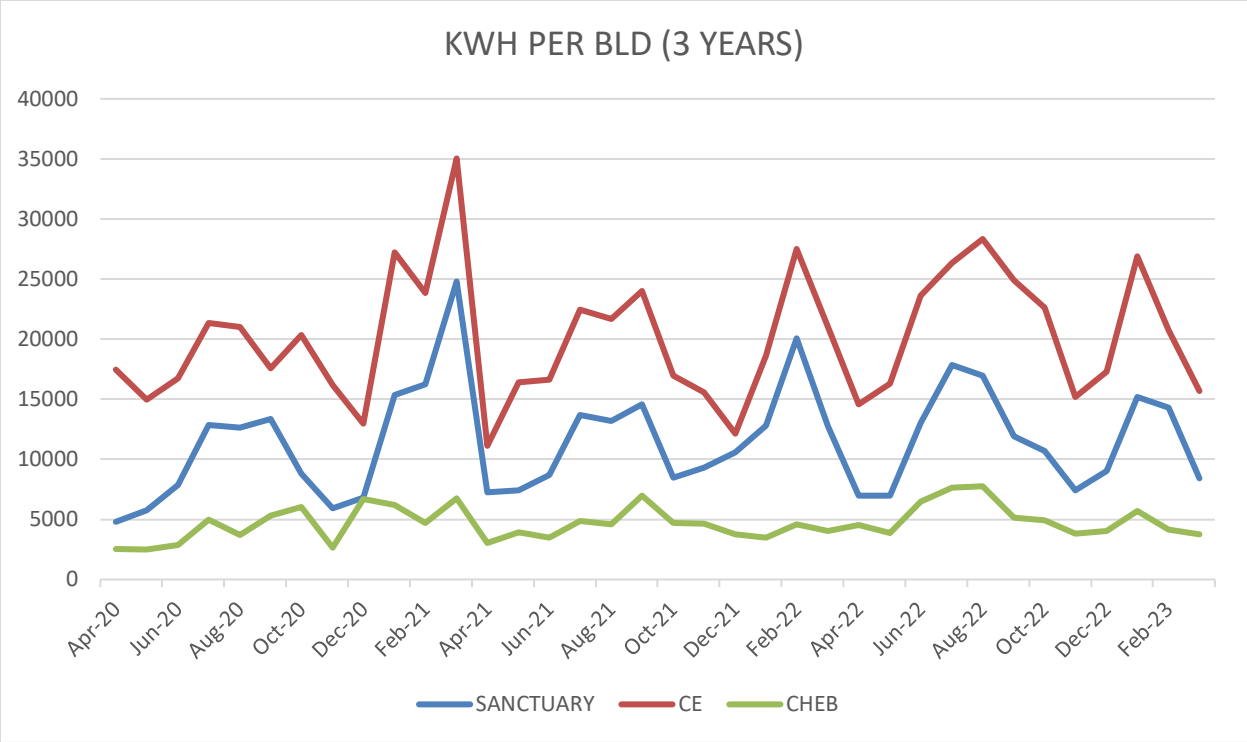
OWNER: THE WOODLANDS COMMUNITY PRESBYTERIAN CHURCH

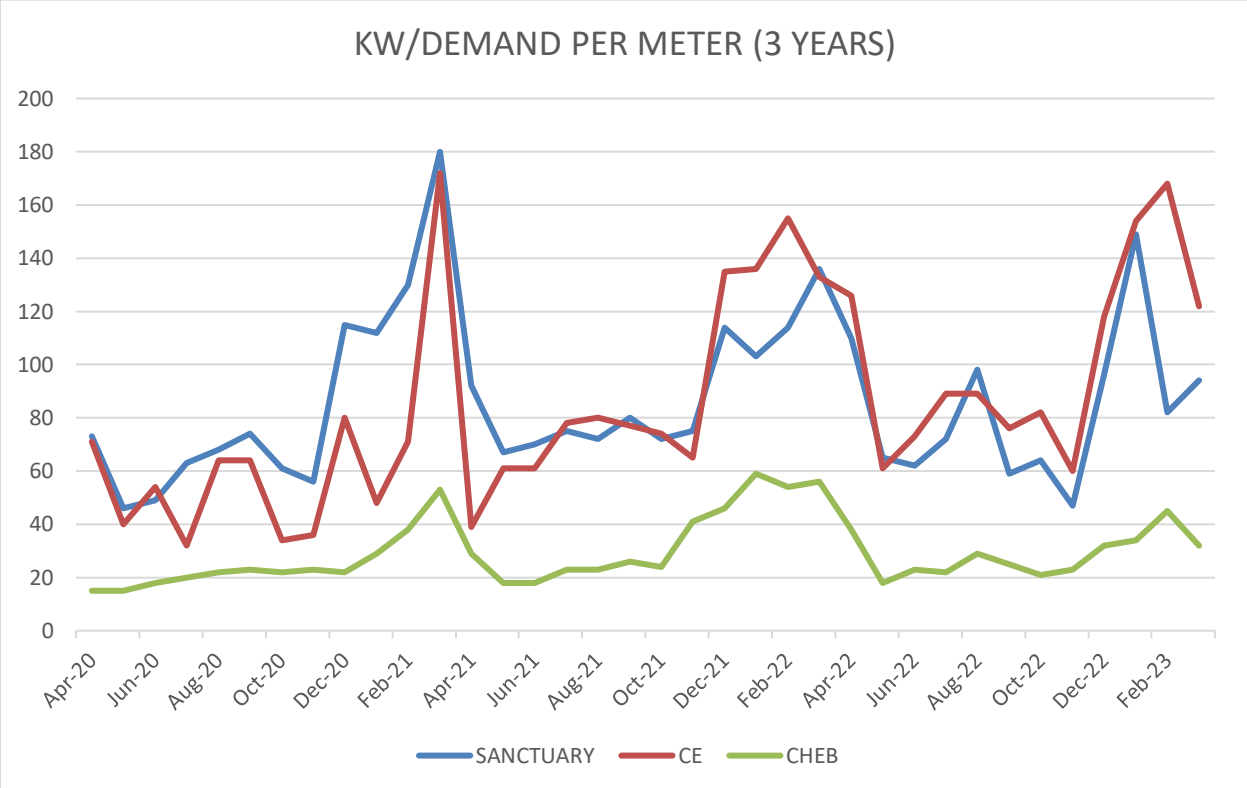
MONTH / YEAR		ELECTRIC					GAS	
			DEMAND					
MONTH / YEAR	YEAR	CONSUMPTION kWh	LOAD FACTOR %	BILLED kW	COST OF DEMAND	TOTAL ELECTRIC COSTS $	USAGE CCF	GAS COST
APRIL	2022	26,074	13%	274	2,028	4,824	1	28
MAY	2022	27,154	26%	144	1,066	3,555	2	28
JUNE	2022	43,098	38%	158	1,169	4,788	2	28
JULY	2022	51,790	39%	183	1,354	5,652	1	28
AUGUST	2022	53,039	34%	216	1,598	5,849	2	28
SEPTEMBER	2022	41,962	36%	160	1,184	5,399	1	28
OCTOBER	2022	38,278	32%	167	1,236	5,190	0	28
NOVEMBER	2022	26,464	28%	130	962	3,791	2	28
DECEMBER	2023	30,360	17%	246	1,820	5,405	5	28
JANUARY	2022	47,792	20%	337	2,494	7,871	1	28
FEBRUARY	2023	39,178	18%	295	2,183	6,612	4	28
MARCH	2023	27,840	16%	248	1,835	4,322	2	28
TOTAL		453,029	62%	1,010	$18,929	$63,258	23	$336

Annual Total Energy Cost =	$63,594	Per Year	
Total KWH x 0.003413 =	1,546.19	x 106	
Total CCF x 0.103 =	2.37	x 106	
Total Other x ____		x 106	
Total Site BTU's/yr	1,548.56	x 106	
Floor area:	37,000	s.f.	

Energy Use Index:		
Total Site BTU's/yr	41,853	BTU/s.f.yr
Total Area (sq.ft.)		
Energy Cost Index:		
Total Energy Cost/yr	$1.72	$/s.f. yr
Total Area (sq.ft.)		
Cost per KWH (All in)	$0.140	




KWH PER BLD (3 YEARS)
40000
35000
30000
25000
20000
15000
10000
5000
0
Apr-20
Jun-20
Aug-20
Oct-20
Dec-20
Feb-21
Apr-21
Jun-21
Aug-21
Oct-21
Dec-21
Feb-22
Apr-22
Jun-22
Aug-22
Oct-22
Dec-22
Feb-23
SANCTUARY
CE
CHEB


KW/DEMAND PER METER (3 YEARS)
200
180
160
140
120
100
80
60
40
20
0
Apr-20
Jun-20
Aug-20
Oct-20
Dec-20
Feb-21
Apr-21
Jun-21
Aug-21
Oct-21
Dec-21
Feb-22
Apr-22
Jun-22
Aug-22
Oct-22
Dec-22
Feb-23
SANCTUARY
CE
CHEB

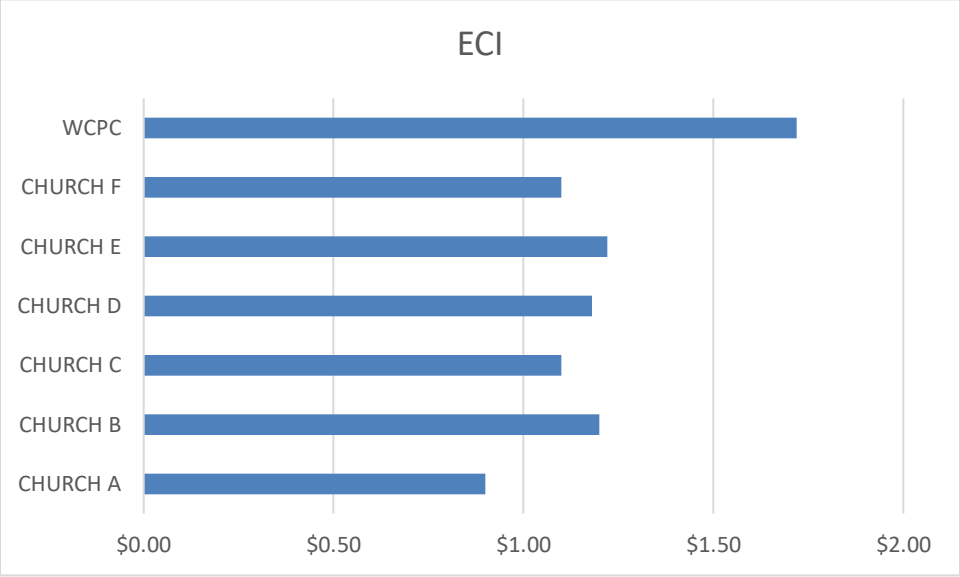
GENERAL COMMENTS:

While viewing these Base Year tabulations, a few items stood out as being out of the ordinary and we address them at this point for your consideration:

A. Demand for kW is extremely high during colder months (February), which is irregular even with electric heat. This practice is common in all 3 meters for the past 3 years. Demand is the measurement of kWh over a 15-minute period. Whatever the highest 15-minute period during the month is what the church is charged. The rate at which we use kW is vital to energy management. Demand typically peaks during the hotter summer months. We believe there is simultaneous heating and cooling during the colder months. Houston is a humid climate and heat use in Houston, even electric heat, is typically minimal in comparison.

B. KWh (like Demand) also seems very high during colder months, which is irregular. We believe the high kW and kWh are due to the simultaneous heating and cooling we identified during our assessment.

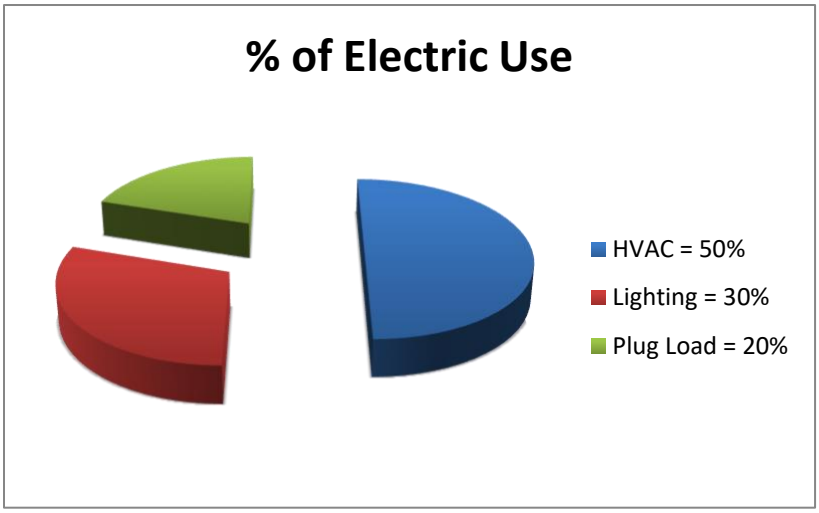
C. The cost per square foot for WCPC is a $1.72, this is very high for the region, we believe a big part of this cost is related to electric use during colder months. When compared to similar sized churches that have similar rate schedules WCPC shows to be much higher. The good news is we believe this cost can be brought lower at no/low cost.



4.0 ENERGY MANAGEMENT GOALS:

A typical building energy use model is broken down as follows:

1. **HVAC = 50% (as high as 70% in humid areas) of building electric use.**
2. **Lighting = 30% of building electric use.**
3. **Plug Load = 20% of building electric use.**



There are different influencers that can affect energy use:

1. Building Envelope – Ceiling insulation, windows, roof, doors and more.
2. Thermostats – How does a facility control the HVAC?
3. Building Occupants – The higher the number of occupants the higher the energy use.
4. Weather – Cooling Degree Days or Heating Degree Days
5. Behavior – The way we operate lighting, HVAC, building envelope and more.

Our goal is to maintain occupant comfort as much as possible while minimizing usage and reducing cost during unoccupied hours. We highly recommend WCPC begin to establish energy reduction goals and to benchmark energy use. Benchmarking your energy use on a monthly basis allows you to compare current use with historical use. An excellent and free program (already funded through tax dollars) is EPA's Portfolio Manager. Portfolio Manager will allow the facility to benchmark all energy use per account per month, which will then allow WCPC to set and establish energy reduction goals. https://portfoliomanager.energystar.gov

5.0 ENERGY RECOMMENDATIONS:

Recommendations:

Although energy cost savings for individual buildings is an important part of these reports, the *more important goal* is to discover and report on savings opportunities that can be duplicated around WCPC. Our energy recommendations are separated into 7 different sections:

1. CONTROLS
2. HVAC
3. LIGHTING
4. PLUG LOAD
5. BUILDING ENVELOPE
6. WATER
7. BEHAVIOR

As you read through the report, please look at all recommendations carefully, as HVAC and Lighting are typically capital expense projects. The low cost or no cost items are addressed in this section as well as the Maintenance and Operations Section.

We understand WCPC does not necessarily want to pursue all capital expense projects, however as a part of the audit scope we have included all items for WCPC to consider for future budgeting purposes. Also keep in mind that many of these recommendations have rebates and incentives offered through your utility company.

Control Opportunities:

ECRM #1: SEQUENCE OF OPERATIONS

The overarching energy reduction opportunities are no/low cost, load shifting opportunities, or behavior change. According to the EPA 30% of the energy we use is wasted, which means the energy waste can be recaptured through no cost behavior change.

TTHERMOSTAT (SAMPLE)	EXISTING TEMP	RECOMMENDED
AHU 3	72C 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
PASTOR	72C 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
AHU 4/KITCHEN	64H/74C 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
FELLOWSHIP	70H 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
PARLOR	68H 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
NARTHEX	65H 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
SANCT x2	65H/74C 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
HENDRIX x4	72C 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
CE (all)	69C 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
YOUTH	71C 24/7	OCC 68H or 73C, UNOCC 55H/85C, ONLY CONDITION WHEN OCCUPIED
H=HEAT C=COOL		**OCC=OCCUPIED UNOCC=UNOCCUPIED**

No Cost Opportunities.

1. *Leverage Zone capability* –The church has numerous HVAC zones located throughout the buildings; this is an excellent design to have as it allows the building to zone based on occupancy. We highly recommend always taking advantage of this system. For example, if WCPC only occupies zone 1 from 8am-3pm, yet zones 2-3 are unoccupied, we will recommend adapting a zone strategy by keeping zones off or in setback mode in the unoccupied zones.

2. Scheduling –We understand the church has busy schedules, and requirements. However, we do believe the church would benefit from tightening schedules and promoting zone strategies. Note: the church has done a great job overall on thermostat control.

$31,628.83	Elec
$319.20	Gas
$31,948.03	Total
15	Hours per day
5310	Hours per Year
$6.02	Energy Cost per Hour
$28,548.66	If decreased by two hours
$3,399.37	**Savings**

For Example:

A. Tighten schedules – Even a 2-hour time change between all zones could save the church nearly $3,399 annually.
B. Promote zone strategies – We highly encourage the church to only condition occupied zones. We understand this is hard for the church to always determine, given the varied schedules, but if we can organize and schedule zone use this will go a long way regarding conservation. We believe the church could easily save an additional 10%, $2,855.
C. Many zones are occupied by very large units. It is much more cost efficient to use a zone conditioned by a 2.5-ton mini-split versus a 25-ton unit. Strategies should include minimizing use of larger units as much as possible. This strategy would need to be approved by the pastor (top-down approach).

D. Keep outside air damper to 0% during unoccupied times or minimally occupied, many were left 100% open. The ASHRAE code states that outside air should be set to 700 parts per million above ambient. Ambient is usually around 300-400 in TX, meaning the outside air should not come on until PPM is around 1,000-1,100 PPM. Churches historically allow too much outside air into the building. Please note we are not saying close outside air dampers, as they are required when the building is occupied, we are simply saying do not allow too much outside air into the building.
    a. There are currently louvers open to the outside (2 and 1'). These should only be open on Sundays or when zone is fully occupied.
E. Sanctuary is one of the more expensive zones to condition, minimize use as much as possible.
F. Keep occupied temperatures 72-76° for cooling, or 66-70° for heating.
G. Unoccupied temperatures – 55° for heating and 85° cooling.
H. Use already conditioned zones, the cost of conditioning an unoccupied zone could be more expensive opposed to using an already conditioned zone.
I. Be careful of simultaneous heating or dead band. Keep temperature deltas at 6°, for example, 67H and 73C. A 4° delta or less could cause heating and cooling to fight against itself. We believe this is more common in colder months.
J. Some supply fans on many units were running 24 hours. We recommend putting supply fans to auto verses constant.
K. Be careful with simultaneous heating and cooling in thermostats that condition common zones.

3. Schedule – Per the above schedule of thermostats and identified zones, most units are on constantly, we highly recommend closing outside air dampers, and adopting an occupied unoccupied schedule unique to each respective zone.

4. Bathroom exhaust – Be careful not to use allow bathroom exhaust fans to run 24/7, keep them tied to a motion sensor or controls. This practice pumps conditioned air outside of the building.

5. Filters – We did not identify dirty filters during assessment but encourage church to keep clean. A dirty filter can quickly cause a dust build up, system failure and indoor air quality issues. We recommend installing Merv-13 filters per ASHRAE COVID related recommendations.

6. We identified a number of thermostats that had long runtimes, either 24 hour a day or extended periods. If not done already we recommend installing WIFI Stats (More identified in ECRM 2) and adopting a strong occupied unoccupied schedule.

7. We were unable to verify the cooling temperature set points in many locations. As a rule of thumb, we highly recommend leveraging aggressive zone scheduling to match occupied periods.
    a. Cooling Occupied Set point = 74-78°
    b. Cooling Unoccupied Set Point = Off or 85°
    c. Heating Occupied Set point = 66-70°
    d. Heating Unoccupied Set point – Off or 50°.
    e. Zones = Off or in setback when unoccupied, and on only when occupied. If Zones 1-3 are occupied, yet Zones 4-6 are unoccupied the temperatures should match schedule.
    f. Outside Air – Per ASHRAE standard buildings must have outside air coming into the building when building is occupied, however when unoccupied or in minimum occupancy the outside air should be closed. Given the humid conditions, dehumidifying outside air is expensive. We recommend staff checking outside air dampers on the air handlers.

8. Please see http://energy.gov/energysaver/articles/thermostats for EPA recommendations regarding setback, scheduling, zoning and more.

Estimated Cost: 0	Estimated Savings: $6,000	Estimated Payback: instant
Savings partnered with ECRM 2		

ECRM #2: WIFI-ENABLED THERMOSTATS

We encourage the church to change the 10 thermostats over to WIFI-Enabled thermostats. WIFI-stats will centralize the existing controls and allow staff to set temperatures and schedule much easier. It was stated the existing thermostats could be WIFI, the church did not know. We recommend reaching out to church contractor to further investigate, and if appropriate connect to WIFI programming.

We also encourage staff to add a control system when the new chiller is installed at the CE Building. The system may require new control points, updated wiring and more to partner with the control chiller.

Estimated Cost: $30,000	Estimated Savings: $6,000	Estimated Payback: 5 Years
Savings partnered with ECRM 2		

ECRM #3: HVAC

During our assessment we identified split systems, furnaces, packaged units, chillers, boilers, pumps, and air handlers that provide heating and cooling throughout the church. Typically, units have a 15-20-year life span before a significant amount of maintenance is needed, assuming 8-10 run time hours per day. However, we believe many of the units are operating 12+ hours a day, which depreciates life expectancy.

Many units are in good shape; and but many are passed their life expectancy. We recommend replacing the aging chiller (serving CE) and three older units (identified in red below) with newer more efficient units as soon as convenient. The upgraded chiller will require updated air handling units, and potential piping. There are rebates available from the utility company, we HIGHLY encourage church to reach out prior to any project. The cost today is closer to $3,000 per ton but we believe buying in bulk would allow for discounted rates.

We also encourage staff to add a control system (Spelled out in ECRM 2) to help control the chiller. Currently the church has a number of aging air handling units, time clocks and minimal control over the CE building.

Estimated Cost: $168,000	Estimated Savings: $11,200	Estimated Payback: 15 Years

- Savings will overlap with ECRM 1
- There are rebates available through the utility provider that can offset cost by 20-30%.
- Keep coils clean. If a coil is damaged by as little as 10% the unit can lose up to 30% of the efficiency of the unit. We recommend having the facility manager purchase an HVAC fin-comb in order to comb back the coils and regain the efficiency. On all future units we highly recommend purchasing hail guards.

- Our costs and savings do not include maintenance savings or utility energy rebates.
- Add ambient sensors to any forced hot water boilers or furnaces, this will allow setpoints to vary based on ambient temperature as opposed to running 24/7.

ZONE	NUMBER OF UNITS	YEAR	TONS	REPLACE	COST
CE	1	2007	45	2023	$135,000
FH	1	2001	7.5	2023	$22,500
FH	1	2006	2	2023	$6,000
FH	1	2017	4	2037	$12,000
FH	1	2009	50	2024	$150,000
FH	1	2017	15	2032	$45,000
CHOIR	1	2011	7.5	2026	$22,500
CHOIR	1	2016	5	2031	$15,000
CHOIR	1	1996	15	2011	$4,500
CHOIR	1	2016	30	2031	$75,000
SANCTUARY	1	2008	7	2025	$17,500
SANCTUARY	1	2008	14	2025	$35,000
SANCTUARY	1	2008	4	2025	$10,000
SANCTUARY	1	2008	30	2025	$75,000
CHEB	1	2012	20	2027	$50,000
CHEB	1	2012	20	2027	$50,000
CHEB	1	2012	20	2027	$60,000
TOTAL	**17**		**296**		**$785,000**
TOTAL TO REPLACE	**4**		**69.5**		**$168,000**

ECRM #4: LIGHTING RETROFIT:

The church is a majority LED, however during our assessment we identified several Linear Fluorescents, CFL and Incandescent bulbs. We do recommend replacing all existing lamps with LED equivalent bulbs. LEDs are cost effective, great technology, last 5-times longer and much more efficient when compared to the average bulb.

We highly recommend reaching out to your utility provider prior to installation, as there are incentives that could offset a large portion of the lighting cost.

Savings will vary based on lighting runtime hours.

Estimated Cost: $5,880 Estimated Savings: $1,470 Estimated Payback: 4 Years

HENDRIX EXISTING LIGHTING			REPLACE WITH:			COST
# of fixtures	**# of Lamps**	**Lamp Type**	**# of fixtures**	**# of Lamps**	**Lamp Type**	
6	2	32-Watt CFL	6	1	8-watt LED Equivalent	$60
10	2	32-watt T8	10	2	13-watt LED Equivalent	$600
87	3	32-watt T8	87	2	13-watt LED Equivalent	$5,220
					TOTAL	**$5,880**

ECRM #5: LOW-COST OPPORTUNITIES:

1. **Lighting:**

There are several opportunities for WCPC to reduce lighting load through no cost behavior change. The same rule that applies to HVAC applies for lighting. Lighting makes up 20% of a building electrical load. A 10% reduction in lighting can impact the electric bill by 2%.

WATTS	BULBS	HOURS PER WEEK	WEEKS PER YEAR	TOTAL WATTS	UNIT COST	SAVINGS
32	87	40	52	5790720	0.139632695	$808.57

- De-Lamping – If the church de-lamped every 3 or 4 lamp fixtures by 1-lamp the church could save over $800. This is assuming 40-hour a week runtime. This number would also disappear if the church installed LED.
- Daylighting – There are some opportunities to optimize daylighting. There were fixtures on by large windows that made no impact on task level lighting, exterior lights on during daylight hours, and more.
- Cove Lighting – We encourage church to keep minimize COVE or up-shining lighting off as much as possible, given cove lighting minimally impact foot candles.
- Decrease Light runtime –It is believed that many of the lights within the facility are left on longer than required (in areas) or after staff leave. Many offices and corridors stay on longer than needed. We highly encourage the staff to engage security lighting during unoccupied periods. It is hard to estimate savings due to unknown runtime.
- Behavior –We encourage all employees to turn off lights if gone longer than 23 seconds. Another option could be to install motion sensors; however, this defeats the purpose of teaching staff. Promoting behavior practices at the office, such as turning off lights, allows staff to take the information/practices to their homes.

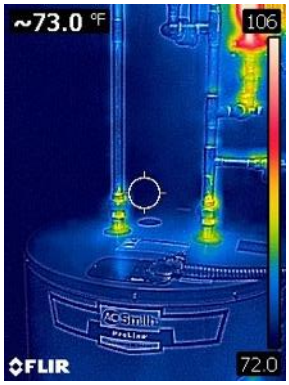
2. Domestic Hot Water:

We identified a 2 electric domestic hot water tanks that provide hot water throughout the inspected buildings (although there may be more). We recommend replacing these units with a gas-fired on demand unit (tankless), as soon as convenient. We estimate cost to be $4,000 installed.

DOMESTIC HOTWATER	GALLONS	AGE	REPLACE
9 KW	65	1988	2023
3 KW	20	1996	2023

As a rule of thumb:

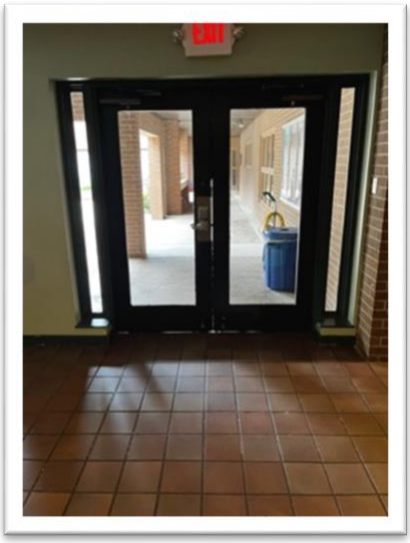
- Keep piping insulation to the first 3 feet of pipe– Most of the heat is lost through the pipes. Adding pipe insulation will not only retain the heat, but also allow the return water temperature to remain constant, thus allowing the tank to work less. Most of the units had strong insulation, however two need to be upgraded.
- Reduce temperature – We identified the domestic hot water tanks set hot water supply temperature at 140° however, per code that maximum recommended temperature is 120°. We recommend setting temperature at 110-120° and increase the heat as needed. For every 10° you lower your water temperature, you will save 3-5% on your tank.



- Add Timeclock – The current tanks currently heat the water 24 hours a day 365 days a year in order to maintain the 130-140°. We recommend adding time clocks to the electric tanks that would allow the unit to turn off during unoccupied hours of 5pm-7am.

3. Building Envelope:

During our assessment we identified 5 doors that lack weather-stripping and compromise building envelope, causing HVAC to work that much harder to maintain setpoint. We recommend upgrading weatherstripping on all doors.



4. Plug Load:

Plug Load makes up about 15-20% of the average church's electric use. There are several ways to reduce plug and phantom load. Phantom load is the continual use of energy for plug load items (microwave, computers, TV's, coffee pots) even when the items are turned off. As a matter of fact, Up to 75% of plug load energy is used when an item is off. The church could reduce plug load by buying newer Energy Star rated units, unplugging devices, sleep mode, minimizing use, or by the installation of plug load adapters/smart strips. Plug load adapters cut the use of phantom load after a unit is turned off or no longer in use, as opposed to standard adapters which continue to draw energy. We recommend the church pursue a BETA program in the administration building. We recommend the purchase and installation of 5 adapters. The respective office would plug in all or highest consuming plug load items into the plug load adapters. Typical cost is around $20 per adapter.

Sleep is Good Program – We estimate WCPC have approximately 15+ computers/laptops in the campus. We recommend implementing a sleep program which will allow the computers to go into sleep mode after 5 minutes of inactivity. This practice could save $20 per year per computer. It is also worth noting that laptops use 80% less energy when compared to desktops.

5. Water:

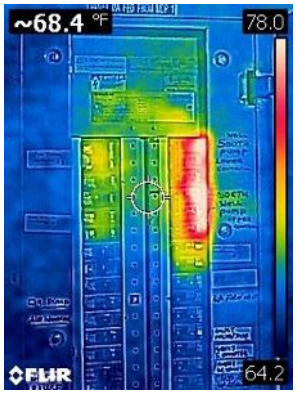
During the assessment we documented several opportunities for water.

1. Faucets that lacked 0.5 low flow aerators. We recommend buying or working with the Township to obtain free aerators. The average flow rate of a kitchen or bathroom faucet is around 2.2 gallons per minute; the aerators will minimize that to 0.5 GPM. If faucets used an average of 2,200 gallons per month, the new aerator equivalent would be 500 gallons. Keep in mind this affects both usage and sewage rates, cutting usage by more than 60%.
2. Commodes – We encourage staff purchase low-flow urinals and commodes on older bathrooms when it's time to replace.
3. When purchasing showerheads, make sure the label says "Water Sense"
4. Rain-Catch System – We encourage church to consider adding a rain catch system as part of their rain gutter for irrigation purposes.
5. Refrigerators – The church has a few refrigerators. We encourage church to change all refrigerator and freezer settings to efficient mode. This will impact both water and energy use. If a refrigerator is empty, we would recommend keeping it off and unplugging.
6. Vending Machine – We encourage staff to add Vending controls to any vending machines as it will cut the use of the compressors by 50%.
7. Water Fountains – We recommend keeping water foundation compressors off as much as possible, given they stay on 24 hours a day.

6. Education:

To provide ongoing education and networking, we would recommend the facility manager or representative join a national association of likeminded individuals to grow in the trade, build relationships, grow in knowledge and more. There are several opportunities for education, networking and more. One such example is the National Association of Church Facility Managers or NACFM.com

7. Thermal Scan:



We performed a thermal scan on all electric sub panels and identified a few hotter than normal breakers. We do not know the reason for the breakers) damaged or overloaded) but encourage church to ask their certified electrician to further investigate.

ELEC PANEL	BREAKER
CE - PB	38,40,42
CE - DPA	30,31,33,35

Estimated (Total) Cost: $5,000 Estimated Savings: $1,000 Estimated Payback: 5 Years

ECRM #6: REBATES/INCENTIVES

As stated throughout the report Entergy offers several rebates that could offset a portion of the cost on many of the recommendations above. Before purchasing any related equipment reach out to your representative for rebate opportunities. Utilities offer incentives in the following areas:

Incentive Rates

HVAC	$250 per kW	$0.02 per kWh
Lighting	$165 per kW	$0.01 per kWh
Refrigeration	$275 per kW	$0.02 per kWh
Roofing	$250 per kW	$0.02 per kWh
Custom / Other	$165 per kW	$0.02 per kWh

- https://entergytxsolutions.com/customers/
- Heating, Ventilation and Air Conditioning
- Lighting
- Smart Thermostats
- Appliances – Refrigerators, washer/dryers, fans
- Building Envelope (Roofs, windows, insulation, etc)

6.0 MAINTENANCE & OPERATION RECOMMENDATIONS:

HVAC	Keep electric cooling off or at a higher setpoint during peak electrical load conditions if possible (2-5pm June-Sept). Adopt strong unoccupied/occupied schedules (85c/55h) Careful where you locate thermostats (direct sunlight, behind shelf) Add timeclocks to domestic hotwater tanks Verify Domestic HW Temp, should not be above 120
Lighting	•Keep upshinging lighting disengaged •Turn off all light fixtures not required during daytime •Leverage daylighting when possible •Delamp Multi-bulb fixtures where possible •Turn Lights off if gone longer than 23 seconds.
Controls	Creation of an Energy Policy (Example in appendix) Verify Kitchen hoods and exhausts remain off Buy Energy Star Kitchen Appliances. Most refrigerators/freezers were set to highest settings, recommend decreasing to normal range or lower. Purchase Vending controls for vending machines
Envelope	•Keep Doors and windows closed as much as possible. •There were a few doors and windows with poor or no weatherstripping. •Make sure attic insulation is sufficient.

Maintenance and Operation procedures are strategies that can offer significant energy savings potential yet require little or no capital investment by WCPC to implement. Exact paybacks are at times difficult to calculate but are typically always less than one year. The difficulties with payback calculation are often related to the fact that the investigation required to make the payback calculation, for example measuring the air gap between exterior doors and missing or damaged weather-stripping so that exact air losses may be determined, is time and cost prohibitive when the benefits of renovating door and weather weather-stripping are well documented and universally accepted.

7.0 REFERENCES

Below is a list of references that can assist the facility in energy management:

1. Benchmarking - Energy Star Portfolio Manager, https://portfoliomanager.energystar.gov
2. Education:
    a. National Association of Church Facility Managers, www.nacfm.com
    b. Conference for Catholic Facility Managers, www.ccfm.net
    c. Texas Energy Managers Association, www.texasema.org
3. Energy Related Rebates – www.dsireusa.org
4. EPA recommendations:
    a. Smart power strips, reducing phantom load, https://www.energy.gov/energysaver/articles/save-energy-your-household-smart-power-strip
    b. Sleep is good, https://www.energystar.gov/products/low_carbon_it_campaign/put_your_computers_sleep
5. Energy for Mission – www.energyformission.org

8.0 GENERAL COMMENTS

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted engineering practices. All estimations provided in this report were based upon information provided to EFP by WCPC and their respective utility providers. While costs saving estimates have been provided, they are not intended to be considered a guarantee of cost savings. No guarantees or warranties, expressed or implied, are intended or made. Changes in energy usage or utility pricing from those provided will impact the overall calculations of estimated savings and could result in different or longer payback periods.

EXAMPLE OF AN ENERGY POLICY

Energy Policy
XYZ is committed to minimizing our impact on the environment as far as possible, in order to preserve our environment for the benefit of present and future generations. We will strive to lead by example to meet the highest energy management standards and be at the forefront of sustainable development as a standard bearer for good environmental and resource management.
We aim to deliver on this commitment by:

- Promoting the concept of energy efficiency at all levels in the organization amongst students, academics, support staff and contractors.
- Identifying improved energy efficiency technologies and deploying them where practical.
- Implementing a program of continuous improvement of energy efficiency. This program will address the activities which most significantly impact energy usage.
- Developing energy conservation action plans and regularly assessing whether the objectives and targets are being met.
- Providing our staff with the necessary awareness, education, and training to implement this policy.
- Ensuring that adequate resources are deployed to enable the energy policy to be implemented where practical.
- Complying with all relevant energy legislation, legal and other requirements, that relate to the energy use consumption and efficiency.
- Incorporating an energy efficiency evaluation dimension to the decision-making process relating to all future capital investments and facility upgrades
- Communicating this Energy Policy at all levels within the organization

Other Examples:

- People should expect temperatures, which are regularly between 68 degrees Fahrenheit and 78 degrees Fahrenheit and dress accordingly.

- Personnel working or teaching in rooms which are regularly colder than 68 degrees Fahrenheit, hotter than 78 degrees Fahrenheit, or who have chronic problems with drafts or stagnant air should report it, in writing, to Physical Plant. Physical Plant will attempt to adjust the air conditioning or make other modifications to correct the problem.

- No space heaters, whether state-owned or personal property, will be authorized for campus use unless a statement, approved by Physical Plant, is on file in the Physical Plant Office indicating that such equipment is necessary to maintain a temperature of 68 degrees Fahrenheit.

- In accordance with Department of Energy Regulations, heating and air conditioning systems must be turned off while buildings are unoccupied. This is normally between the hours of 10 p.m. and 7 a.m., Monday through Friday and all hours of Saturday, Sunday and holidays. Exceptions to these regulations should be requested, in writing, by the cognizant

administrator and forwarded to the Director of Physical Plant.

- All windows in buildings that are air-conditioned will remain closed and as secure as possible to prevent loss of conditioned air.

- Use of refrigerators for non-instructional purposes should be consistent with good energy management practices. In order to discourage proliferation of personal refrigerators, approval for operation of such must be obtained from the Director of Physical Plant.

- Exemptions to this policy include, but are not limited to, maintaining laboratory plants or animal life; operation of data processing or other equipment which is temperature sensitive, storage of food or other perishables; and preservation of archives, books, art works or specimen. The cognizant administrator should send written request for exemptions to the Director of Physical Plant.

- We realize that implementation of the attached building temperature control policy will change environmental and physical comfort conditions in many, if not all, of the buildings on campus. Physical Plant will respond as quickly as possible to adjust air conditioning and heating systems which are not providing temperatures within the 68-degree Fahrenheit to 78 degrees Fahrenheit restrictions mandated by the Federal Department of Energy Regulations. In most buildings heating, ventilation and air conditioning systems were not designed to accommodate these temperature restrictions. This is further complicated by numerous changes in building space and room usage over the years, making it almost impossible to maintain original design conditions. We hope all members of the campus community will cooperate as together we endeavor to achieve and maintain the goals of the Federal Building Temperatures Regulations.

Lighting Control Policy

- Artificial lighting is to be used only when natural light is insufficient to perform required function, or where the safety of the campus community is compromised.

- When artificial lighting is required, the following standard guidelines are to be followed:

    - Use the minimum amount of light required to perform the required tasks comfortably. The attached table indicates the desired level of illuminance [*sic*] that the Facility will attempt to provide. Physical Plant will consult with facility users in the adjustment of lighting levels.

    - Purely decorative lighting will be eliminated. Lighting for special events will be approved on an event-by-event basis.

    - Artificial lighting will be used only when areas are occupied. Whenever a room is unoccupied, the lights are to be switched off. This practice should be followed even if

the room is unoccupied only for a few minutes.

- When specifying new light fixtures and lamps, care will be taken to order the most energy efficient light source appropriate for the intended application.

- It should be noted that energy efficient lighting should not detract from the esthetic value currently provided by lighting throughout the Facility. In most instances, it will be possible to provide more energy efficient lighting that also provides better quality illumination.

Recommendations for Illuminance [*sic*]

Type of Activity	Lighting Levels Footcandles
• Classrooms & General Offices	50 +/- 20%
• Specialized Labs, Data Processing	75 +/- 20%
• Drafting	100 +/- 20%
• Work areas infrequently used (e.g., storage)	15 +/- 20%
• Public Areas (e.g., hallways, etc.)	5 +/- 20%
• Parking	1 +/- 20%