MASSACHUSETTS
Interfaith Power & Light

ENVIRONMENTAL STEWARDSHIP ASSESSMENT

Parish of the Epiphany

Winchester, Massachusetts

April 2022

This *Environmental Stewardship Assessment* is based upon information provided by the congregation, observations of the visible and apparent conditions of the property and the components evaluated on the date of assessment. Care has been taken in the performance of this assessment. This report is made only in the best exercise of our ability and judgment. However, Massachusetts Interfaith Power & Light (and or its representatives) makes no representations regarding latent or concealed defects that may exist, and no warranty or guarantee is expressed or implied. Conclusions in this report are based on systems attributes, estimates of the age and normal working life of various items of equipment and appliances. Predictions of life expectancy and the balance of useful life are necessarily based on industry and/or statistical comparisons and observed conditions. It is essential to understand that actual and future conditions can alter the useful life of any item. The previous use/misuse, irregularity of servicing, faulty manufacture, unfavorable conditions, acts of God and unforeseen circumstances make it impossible to state precisely when each item will require replacement and/or what the actual savings in use and cost will be. The Member herein should be aware that certain components with the above referenced property may function consistent with their purpose at the time of the assessment, but due to their nature are subject to deterioration without notice. Unless otherwise noted, all building components are assumed to have met the building code requirements in force at the time of construction. Conclusions reached in this report assume responsible ownership and competent management of the property. Information provided to us by others is believed to be reliable. However, we assume no responsibility for the accuracy of such information.

This *Environmental Stewardship Assessment* is based on a site visit to Parish of the Epiphany on March 4, 2022, by Jim Nail and Bill Schroeder for Massachusetts Interfaith Power & Light (MassIPL). The report provides a summary of conditions and "To Do" table, followed by findings that will help guide you as you make the recommended improvements. It can easily be shared with other members of your congregation, in print or electronic format.

Also review the ***Everyday Environmental Stewardship Briefs*** and ***Success Stories*** which are sent separately and are available at the MassIPL web site.

http://www.massipl.org/everyday-environmental-stewardship

These provide detailed guidance on the actions possible at your HOW, and at all the places we occupy as we live, work, study, and play. ***Case studies*** of interest are also presented. It helps to know what others with similar circumstances have done.

Remember also that the observations for this House Of Worship apply as well
to the houses in which we live, work, learn and play.
Be active in caring for them all.

If We Don't, Who Will?

SUMMARY

This summarizes the energy use, environmental and financial impact, and the rating of Parish of the Epiphany for its environmental stewardship. Photos showing the buildings are on pages 8 & 13, below. Pages 9-12 also has a floor plan of the areas.

Energy Use Intensity: Above Average

Energy use intensity (EUI) measures the amount of energy used annually per square foot of building space. It is a standard measure used in the energy efficiency field. The Energy Information Administration reports that the average House Of Worship (HOW) has an EUI of 43. It also reports that HOWs are the **worst** building types for energy use. Thus just being "average" as a HOW is not a good rating for environmental stewardship. Your church has an EUI of 99, indicating significant potential to become more efficient.

Carbon Emissions: Above Average

Different types of energy emit different amounts of carbon, with heating oil emitting the most. Gas and the fuels used to generate electricity also emit carbon so reducing all energy use is important. The Next Generation Roadmap for MA Climate Policy legislation calls for Massachusetts to reduce carbon dioxide emissions by 50% by 2030 and be net zero by 2050 (versus a 1990 baseline), in line with scientists' recommendations to avoid the worst effects of climate change. Because your church is above average, there is significant potential to decrease your carbon footprint in each of the four areas this report examines: Behavior, Electricity, Building Envelope, and Heating/Cooling/Hot Water.

Financial impact: Below Average

Parish of the Epiphany spent $41,948 in 2018 for all its energy use. MassIPL sees a range of 2% - 20% of total budget spent on energy – and you are near 4%. Green grows two ways – one of which you take to the bank! By implementing the recommendations in this report you can reduce this cost further and reinvest the savings in additional energy efficiency measures caring for creation, which is a key element of your mission. MassIPL sees savings in a range of 10% for the "low-hanging fruit" to over 50% for the major work. All actions have continuing benefits, for decades or more.

Your 24 Questions Score **2 YES; 4 YES & NO; 18 NO**

The following page presents the answers to the **24 Questions** on environmental stewardship at your HOW; based on our site visit we revised several of the answers submitted by Church of the Epiphany. A perfect score would be answering all 24 questions YES. Currently Parish of the Epiphany can only answer 2 questions YES. However these NO answers reveal the most important opportunities to decrease energy use, save money and improve your environmental stewardship.

Parish of the Epiphany, Winchester MA

Question	*Answer*	*Comments*
BEHAVIOR		
Do you track your Utility Use and Cost (UU&C) monthly?	Yes	We keep a log and use it when questions arise. However we are not proactively monitoring it on a regular basis.
Have you created energy awareness among staff and members?	No	We haven't emphasized it. There are few opportunitys to control energy at individual units.
Do you have an evironmental stewardship team? A designated "energy manager"?	Yes and No	We have a Creation Care team. But no energy manager. Our office Admin will track energy usage monthly.
Do thermostat settings match times of use?	No	We have clock thermostats. But we don't have zones to control heating in each room.
Do you have a plan to cut your carbon emissions 50% by 2030?	No	A roadmap to Zero emissions is a desired outcome of this assessment. It should include percent targets by decade.
Do you have a budget line for Energy Efficiency investments?	No	Not that we're aware of
ELECTRICITY		
Do you make best use of natural and artificial light?	No	Looking for input from assessment.
Do all your fixtures have LED bulbs?	No	To use LED lights in sanctuary, we would have to update our control panel. In the rest of the church, we have used some fluorescent bulbs.
Do you have occupancy sensing switches in all appropriate spaces?	No	We should look at this.
Are all your refrigerators and freezers highly efficient and efficiently used?	No	Standard commercial, fairly new unit (since 10 years). Always used.
Are all other office equipment and appliances Energy Star top-rated?	No	Unlikely
Have you evaluated your HOW for solar panels?	Yes	We did an assessment and it showed issues because of trees south-facing and slate roof (expense). We are already using 100% fossil free electiricty at a fixed rate not much more

Question	*Answer*	*Comments*
BUILDING ENVELOPE		
Are your walls, ceilings, floors insulated to current standards?	No	
Have you sealed areas of air infiltration?	No	
Do you have high efficiency windows? Interior storms? Sun screens?	Yes and No	
Are all doors insulated and tight-fitting?	No	The assessment should determine this.
Do windows and doors have effective weatherstripping?	No	A big opportunity for improvement.
HEATING COOLING WATER		
Do heating and cooling zones match use patterns?	No	Heating is on timers. We don't have zones.
Do controls and distribution optimize energy efficiency of HVAC equipment?	No	
Are heat/AC/hot water pipes and ducts insulated?	Yes and No	Steam pipes are insulated.
Is your air conditioning SEER 14+?	No	Unlikely, newest minisplits are 10 years old.
Have you evaluated your HOW for heat pumps?	No	See above, but need further evaluation.
Is your hot water heater 95%+ efficient?	No	All electric; hot water booster for dishwasher. Hot water heater is new in past 10 years. Don't know efficiancy.
Do you have water-efficient faucets and toilets?	Yes and No	Some toilets have been updated in the past 10 years. Maybe a few newer ones are.

Summary To Do List

There are a number of steps you can take over the next year or two, both to save some money in the upcoming heating season and to prepare for larger projects described in the Net Zero Plan:

- Recruit additional members of the Environmental Stewardship/Green Team, Property Committee (see p. 18)
- Convert Sanctuary lighting to LED (pp 24- 25)
- Convert classroom lighting to LED (pp 24 – 25)
- Remove and recycle the Kenmore standing freezer; don't replace it unless absolutely necessary (see p. 26)
- Consider removing and recycling the smaller beverage fridge in the basement (see p. 26)
- Caulk windows, especially in the offices (see p. 33)
- Buy additional window inserts for the offices (see p. 35)
- Build window inserts to fit the arched windows along the corridor and in the Upper Parish Hall (see pp 34 – 35)
- Replace doors: Upper Parish Hall, Garret, Rector's office back door, Music director back door, Woodland Garden doors (see pp 35 – 36)
- Insulate hot water heat pipes (see p. 43)
- Upgrade existing heat pumps to cold-climate models that provide both heating and cooling; extend this to the second floor offices (pp 44 – 45)

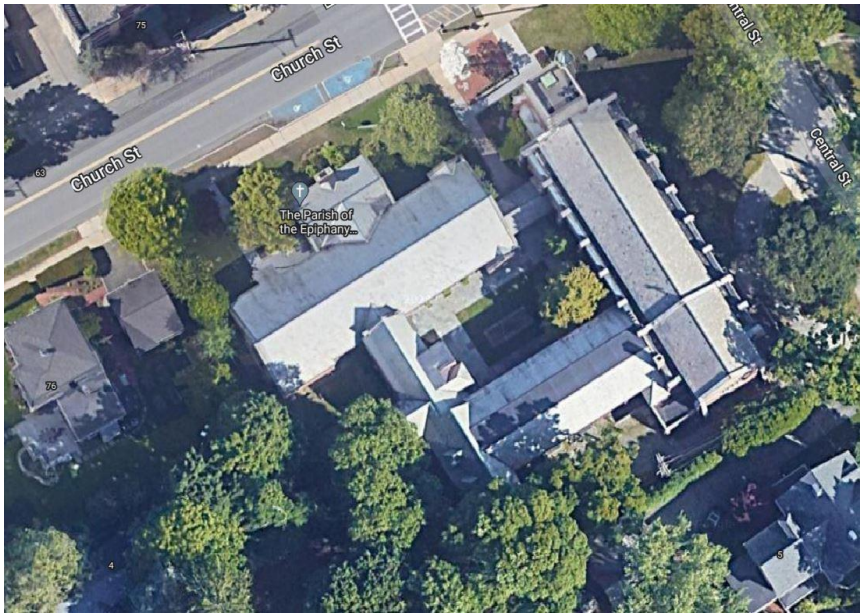
Net Zero Plan

In the 2021 Next Generation Roadmap for Massachusetts Climate Policy law, the Commonwealth sets goals to decrease carbon emissions 50% by 2030 (compared to a 1990 baseline) and be net zero carbon emissions by 2050. As these goals relate to buildings, the general approach is to decrease the building energy use as much as possible then switch to electric heating and cooling, either air source or ground source heat pumps.

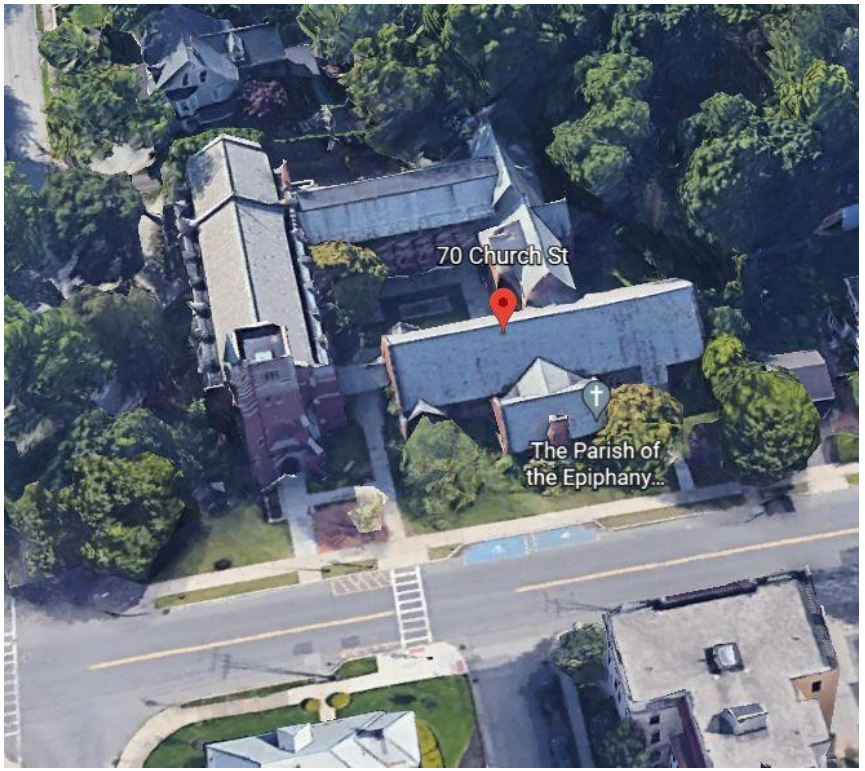
It would be challenging to find data to calculate your 1990 energy consumption and carbon emissions, so MassIPL recommends you use the 2018 energy consumption documented in this report as your baseline.

The centerpiece of Church of the Epiphany's Net Zero plan is to retire the steam heating system and to the maximum extent possible replace it with heat pumps. As mentioned on page 42 we propose a phased approach to this. Some other projects should be tackled along with the heating system and we suggest you think about the overall project in 5 work streams, in this priority order:

1. Hadley Hall: interior roof insulation and conversion to heat pump heating/cooling (p 32)
2. Basement classrooms: investigate and remediate (if necessary) the source of water that causes the high humidity levels (p. 42). Replace windows (p. 35). Replace the air handler and install a heat pump (with a dehumidification system) to take this area off the steam boiler (p. 43).
3. Replace the Sanctuary heating system: explore alternatives to forced air through the undercroft tunnels, ideally generated by heat pumps. If heat pumps are impractical for this space, use 95% (or higher) efficiency gas unit (pp. 45- 46).
4. Renovation of Upper Parish Hall: insulate ceiling, replace windows and exterior doors (p.32)
5. Hadley Hall and/or Sanctuary roof solar panels (pp. 28 – 29)

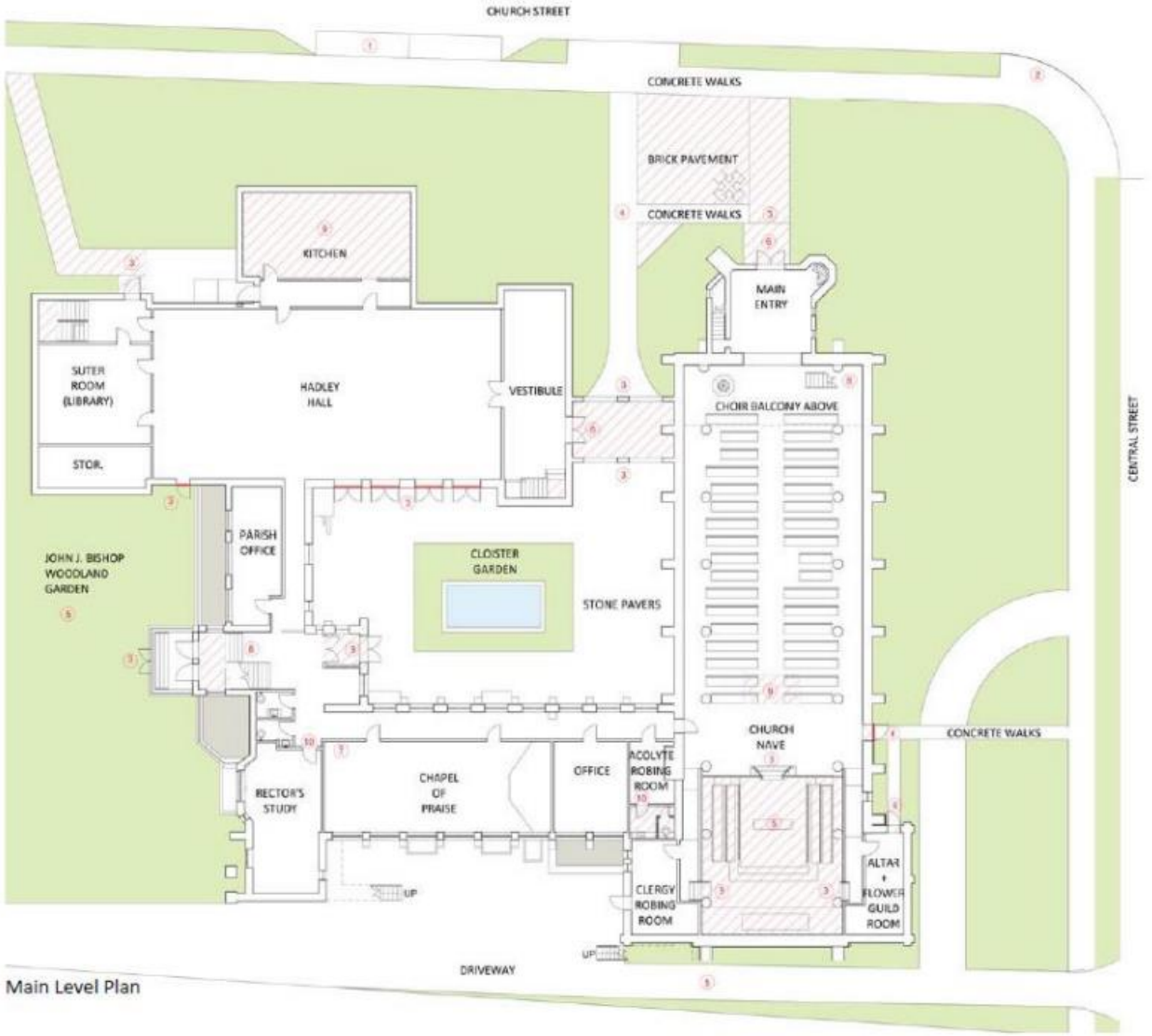


Satellite view of Parish of the Epiphany. North is at the top.

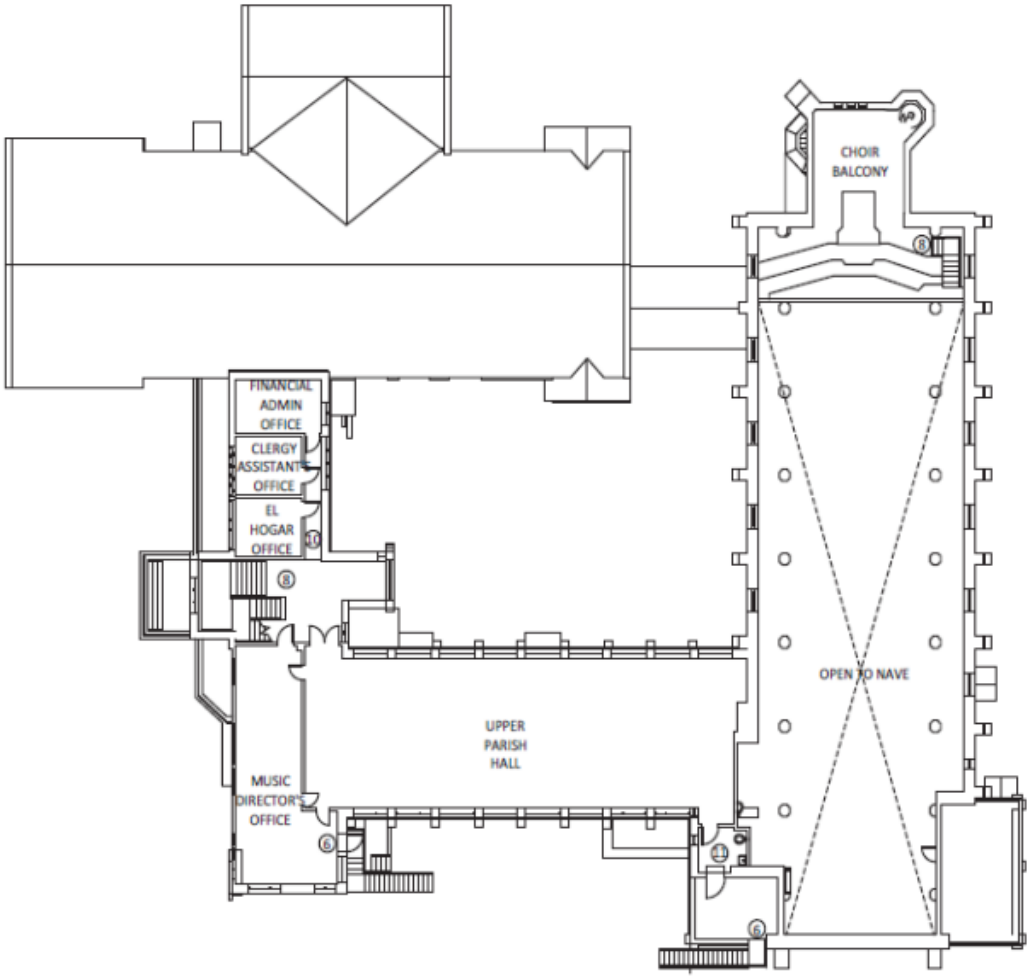


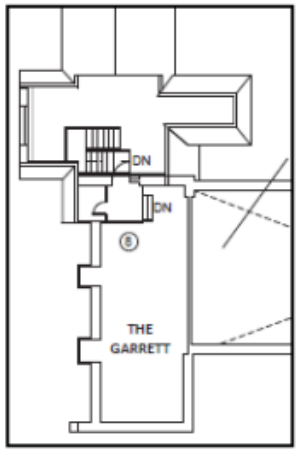
Aerial view of Parish of the Epiphany. Looking south.

Parish of the Epiphany First Floor Plan



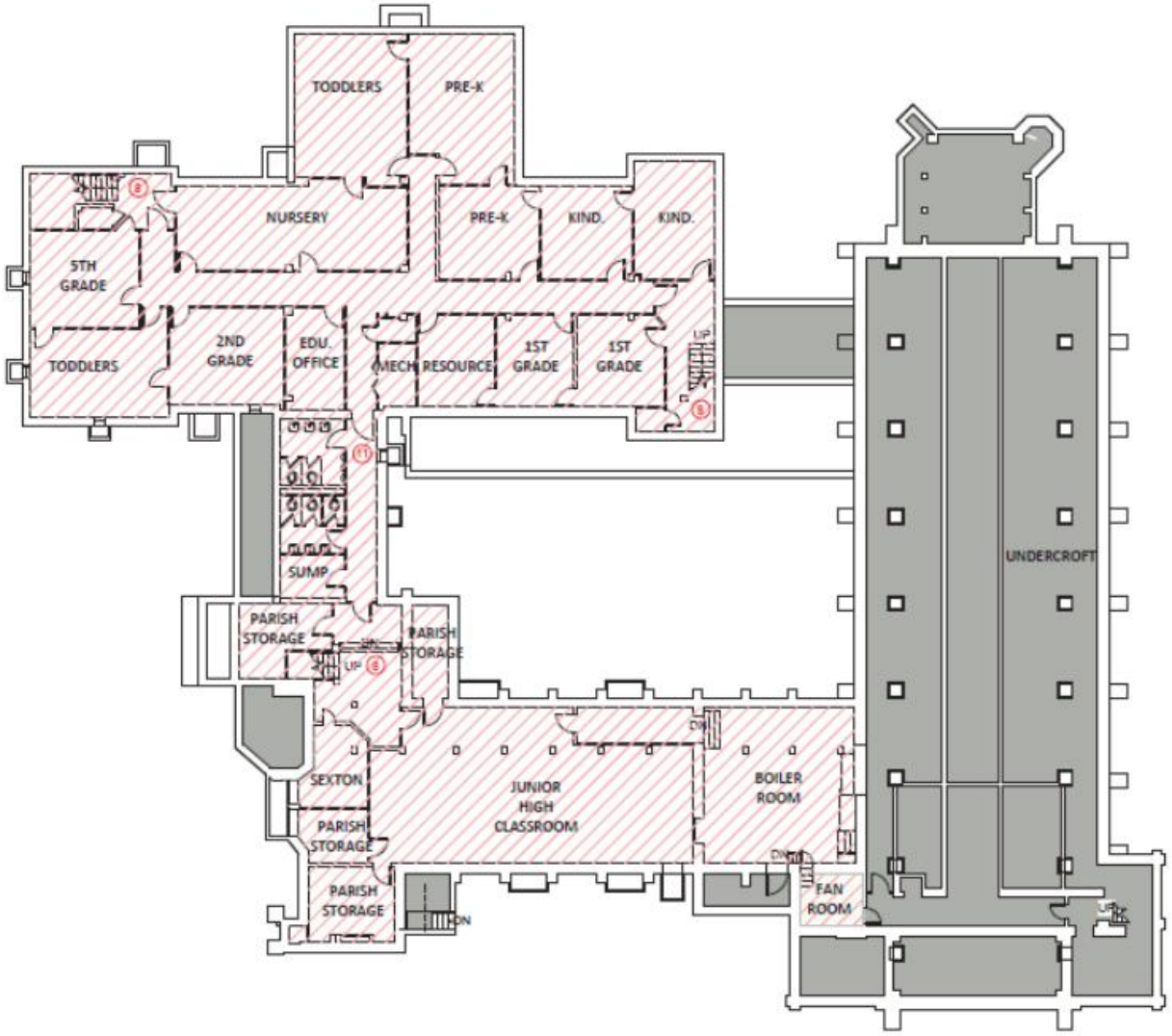
Parish of the Epiphany Second Floor Plan



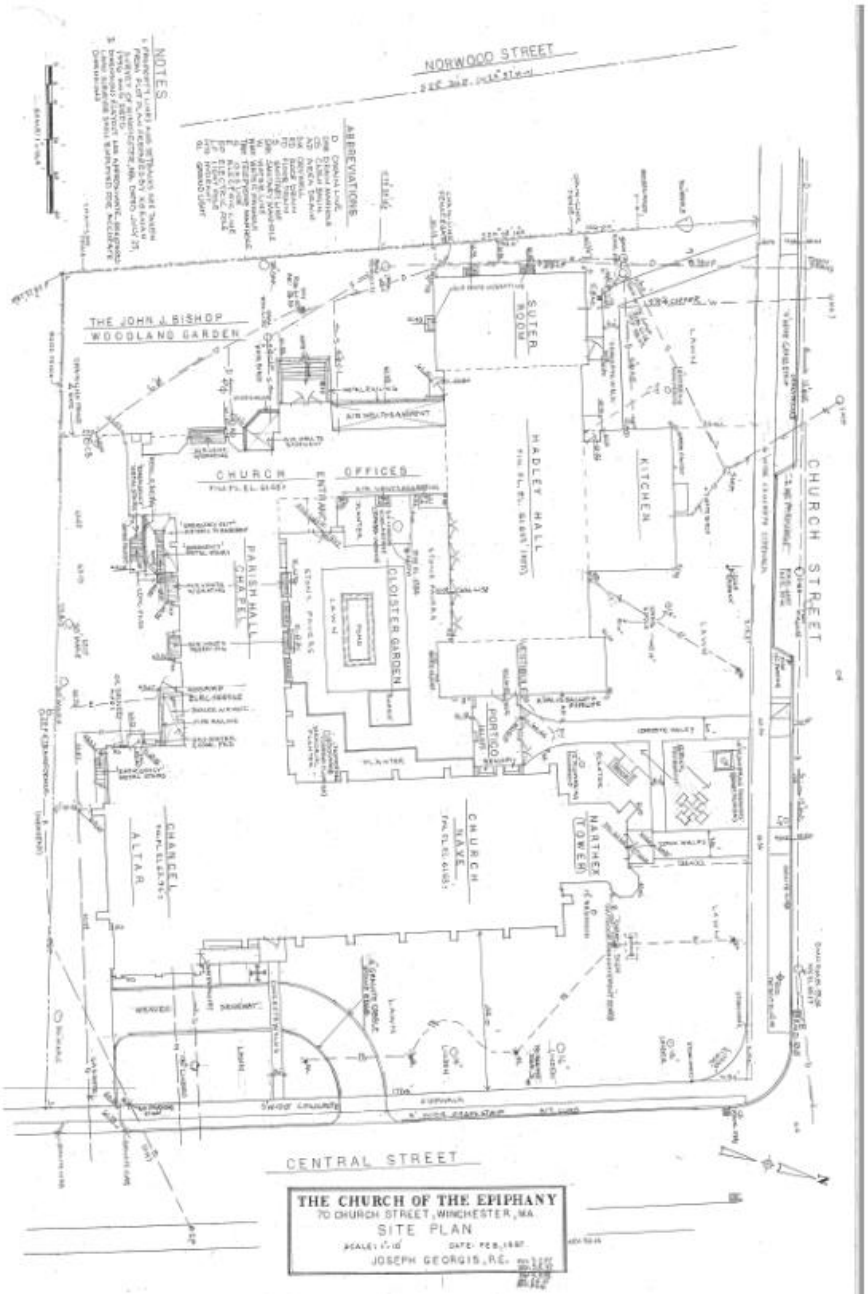


Loft Floor - The Garrett Floor Plan

Parish of the Epiphany Basement Floor Plan

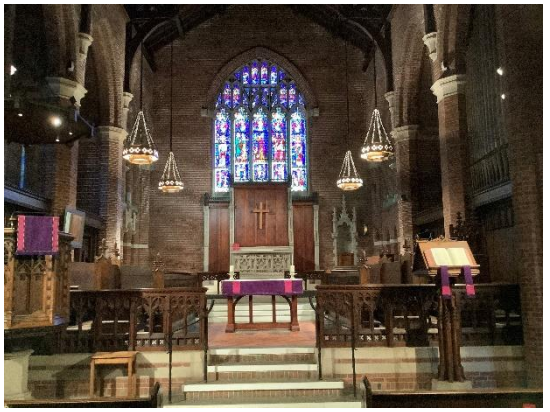


Parish of the Epiphany
Exterior Site Plan



Sanctuary exterior from northeast corner

Sanctuary cornerstone



Sanctuary interior

Hadley Hall exterior

Hallway exterior. Upper Parish Hall is on second floor.

Parish office entrance

DETAILED FINDINGS

BEHAVIOR

We generally take energy for granted. If we do think about energy, it is usually when we get a big bill! But cost is the result of how we use energy, and **use** reflects our behavior. Behavior is volitional. We can change it and thus lower the cost (in $s and environmental impact) of our energy use. Follow the low cost/no cost ways to reduce energy use in this section and you may save up to 15%.

Do you track your utility use and cost monthly? **Yes**

You have begun, now be sure to update the UU&C spreadsheet monthly and review it regularly to identify unusual patterns that can indicate attention is needed. Using the MassIPL *Utility Use & Cost* spreadsheet for all utilities is an effective way to know the impacts and cost (in $s and pollution) of one's behavior, as a congregation or an individual.

Though we usually just focus on the financial cost for utilities, it is imperative that we are also aware of the environmental and health impacts. The spreadsheet calculates the carbon footprint of your HOW as a first step in your environmental stewardship journey.

The summary of Utility Use and Cost information for Parish of the Epiphany is below. Cost for utility use is financial, but also and importantly environmental, including health impacts. The volume and cost of utility use is fertile grounds for improved environmental stewardship. For more information, see MassIPL's *EES Brief* on *UU&C*. There are dollar savings to be achieved (in the 10% range) simply by using *PowerOptions* to "bulk-buy" gas and electricity. See information in Appendix C on both.

SUMMARY OF UTILITY USE & COST

21,000 *square feet*

YEAR	TOTAL	ELECTRICITY $s	ELECTRICITY KWH	Cooling Degree Days	GAS $s	GAS THERMS	Heating Degree Days	WATER & SEWER $s	WATER & SEWER VOLUME
2018	**$36,495**	$16,267	66,720	1,538	$17,719	18,554	4,864	$2,509	388
CO 2 lbs	*264,453*		*47,371*			*217,082*			
kBTU per SF	**99.2**								
% prior year	**114.3%**	117.7%	102.8%	121.4%	104.1%	112.8%	102.2%	232.4%	225.6%
2019	**$29,942**	$16,909	69,080	1,413	$11,623	9,574	4,690	$1,410	236
CO 2 lbs	*161,063*		*49,047*			*112,016*			
kBTU per SF	**56.8**								
% prior year	**82.0%**	103.9%	103.5%	91.9%	65.6%	51.6%	96.4%	56.2%	60.8%
2020	**$37,640**	$11,942	47,560	1,655	$24,177	22,147	4,040	$1,522	192
CO 2 lbs	*292,888*		*33,768*			*259,120*			
kBTU per SF	**113.2**	$0.57	2		$1.15	1		$0.07	0.0
% prior year	**125.7%**	70.6%	68.8%	117.1%	208.0%	231.3%	86.1%	107.9%	81.4%
2021	**$32,377**	$12,267	46,320	1,542	$19,347	16,341	4,081	$763	92
CO 2 lbs	*224,077*		*32,887*			*191,190*			
kBTU per SF	**85.3**	$0.58	2		$0.92	1		$0.04	0.0
% prior year	**86.0%**	102.7%	97.4%	93.2%	80.0%	73.8%	101.0%	50.1%	47.9%

CO_2 lbs 2018	**264,453**	**47,371** **217,082**
kBTU per SF for 2018	**99.2**	**The US Energy Information Administration calculates that the average house of worship in cold/very cold climate zones uses 42.6 kBTU per square foot per year. Is your house of worship better or worse than average?**

Use Patterns

Use for heating should vary in direct relation to heating *Degree Days*. The % change by the congregation at the end of the year should be about the same as *Degree Days*. If the use % is higher, it indicates increasing inefficiency by the congregation. Monthly tracking and comparison with the same month in prior years (adjusting for Degree Days) is also an important indicator in understanding your HOW use patterns.

To learn more about how to use the Utility Cost & Use spreadsheet to lower your energy costs, read the MassIPL's *Everyday Environmental Stewardship Brief* on *UU&C*.

Evaluation
You noted that although you do record expenses monthly "we are not proactively monitoring" the data. So you are halfway there but now need an "energy manager" to review the data and take action, which we discuss in a later section.

The fact that your primary heat is an old steam system with ineffective controls are a major cause of your high Energy Use Intensity. You began evaluating how to replace this system a few years ago and now is the time to act. A modern system will dramatically reduce you EUI and carbon emissions and we discuss this in detail in a later section.

The amount of carbon emissions in 2018 was 132 tons; the average of 2020 and 2021 was about 2% lower, due to the lower electricity use as a result of Covid. The carbon footprint due to gas use actually increased slightly, suggesting the heat wasn't turned down during 2020 and 2021.

Your recorded gas use in 2019 is only half the use in 2018. In 2020 and 2021 it popped back up again. You told us there was a problem with the gas meter in 2019, and you believe it simply didn't record a lot of the gas that was actually used. That's the most likely explanation. As a result, 2019 is not representative of your actual gas use, and that's why we have taken 2018 as the baseline year.

The electricity use for 2018-2021 was, in round numbers, 67, 69, 48 and 46 MWh respectively. The sharp drop in 2020 and 2021 was most likely caused by reduced use of the building in 2020 and 2021 due to the Covid-19 pandemic. No significant change in electrical equipment was reported. Therefore, we believe that 68,000 kWh per year would be your normal electricity use going forward.

The water use patterns are unusual. For 2018-2021 the annual totals were 388, 236, 192 and 92 units (ccf, probably). The large drop from 2018 to 2019 is unexplained. The additional decrease in 2021 is partially due to the fact only three bills were recorded instead of the usual four. The dollar amount of these bills is a small part of your total utility expense. But water is a precious resource, and some investigation of erratic use would be warranted. There may be some running toilets or leaky faucets which should be attended to.

Have you created energy awareness among staff and members? **No**

Nothing can change if nobody is paying attention. A life of faithful behavior needs help, which of course is one of the reasons we gather as religious communities, to talk, share and worship. Energy awareness prompts faithful behavior. Start with the congregation by including carbon footprint and energy use reports at meetings of the governing body as well as the annual report to the congregation. Encourage members to save energy when they are in the building (turn off the lights, close the doors, etc.) and to report problems to someone to be fixed. Every member can be part of the solution! Then recognize that the actions discussed in this report can also be done at home, business, and school, all the places we go in our lives.

Include discussion of energy at least twice a year in staff meetings: in the spring at the switch from the heating season to the spring/summer cooling season and in the fall at the beginning of the heating season. Remind staff to be aware of closing doors between zones, how to adjust thermostats temporarily when necessary, without affecting the programmed times, and encourage them to report cases where rooms seem warmer than necessary. Review staff schedule and schedule of outside groups using the space to be sure the thermostat programming is kept in synch with building usage.

Evaluation

First, discuss with your staff the winter and summer temperature settings and ask them to give energy saving settings a try. For winter the US Energy Department recommends 68 degrees and reports that for every 1 degree lower setting for 8 hours you can save 1% of the energy cost. For air conditioning, where you have it, the Energy Department recommends 78 degrees. Of course, the staff's comfort, health, and productivity are most important so if these temperatures don't work for them, be open to adjusting them. Let them know that by trying these different temperatures, they are helping ensure the budget is spent on your programs and mission!

Similarly, overnight temperatures should be 7 – 10 degrees lower in the winter and higher in the summer and be scheduled to return to begin to bring temperatures to desired levels 2 – 3 hours before people come to the building. On extremely hot or cold days, the space may not reach the desired temperature until slightly later, so ask them to be patient rather than adjusting the thermostat.

Also ask them to be proactive and inform you of schedule changes in their hours or programs so thermostat setting can be adjusted accordingly.

Do you have an environmental stewardship team? A designated "energy manager"? Yes & No

Awareness moves to action when responsibility is clear. Just as a church has committees for finance, social justice, and other ministries so should it have an *environmental stewardship* team. Simply put, the team consists of a group of people who share concern for Creation Care and environmental justice who serve to identify, plan, and execute environmental stewardship activities. They support each other and convey the stewardship actions to the congregation.

The *energy manager* for your HOW should do several things: update the Utility Use & Cost sheet every month, look for unusual spikes in energy use and, if found, investigate the cause; share findings with committees including the environmental stewardship/green team, finance, property, and the lay leadership; update the Space Use sheet at least twice a year (October and March) and use the information to update programmable thermostat settings. Finally, the energy manager should ensure that energy-using equipment (especially boilers, furnaces, and air conditioners) receive regular routine maintenance to operate as efficiently as possible. The energy manager could be any member of the congregation with an interest in saving energy. Now that you have started the UU&C spreadsheet, it only takes a few minutes each month to update it.

Evaluation

You have a Creation Care team which has excellent, experienced leadership. And the team that attended the site visit demonstrated that Creation Care is connected to the Property Committee and Finance and has clergy support. But, tackling all the things we need to do to care properly for God's Creation is a big job! It's important to have a core of 5 or more people who are dedicated to this mission especially as you implement the many recommendations in this report. One or two can burn out. Five or more can share the load and bring different perspectives and creative ideas that will fit your congregation. While MassIPL focuses on energy and carbon reduction, many "green teams" also include recycling, reduction of toxic chemicals, landscaping with native plants, etc. A Creation Care team can have room for all these and many more interests!

You need an *energy manager*. An energy manager does much more than simply track energy use but proactively notices out-of-pattern usage to investigate and correct the cause. He or she needs to be proactive, looking for ways energy use can be reduced, and the congregation can be informed, and the results can be displayed. The energy manager needs support from the congregation to be effective, otherwise he or she may be regarded as just the "thermostat police".

Do thermostat settings match time of use? **No**

One of the benefits of living in a computer age is that thermostats can be programmed and controlled from a distance. A programmable thermostat "remembers" what humans often forget. But all of this relies on knowing the schedule when rooms are typically used, matching thermostat settings to that schedule, and periodically checking to make sure settings are still appropriate and the thermostat's clock is correct. *Programmable thermostats* automatically adjust to the desired temperature for the desired time period. The multiple time settings (typically 4 settings per day) permit scheduling of space conditioning (heat or cool) when and only when needed. With *Wi-Fi* based thermostats, this check can be done remotely, via a *SmartPhone*. This also enables resetting thermostats whenever a significant change to the use of the building occurs, such as a community group beginning/stopping holding meetings, adding a new service, changing times when the office is open, unexpected use or cancelations and so on. *Programmable thermostats* with an ***adaptive recovery*** element anticipate how long it will take to reach the desired temperature and start the system in just the right lead time. See MassIPL's *EES Brief* on *Thermostats*.

Evaluation

The *Space Use* table in Appendix B presents Parish of the Epiphany's current pattern of use and is the starting point for ensuring temperature settings match use time. MassIPL recommends updating this form at least three times per year: in the fall as activity typically increases after the summer, in January when a new year may bring new activity patterns, and in May or June when the summer schedule is known. This then guides checking the thermostat settings which should be changed at least twice a year: in mid- to late- October as the weather cools and the heating season begins and in late April or early May as the days warm and heating is no longer necessary. Where you have air conditioning, you can adjust setting for it at the same times.

Improving controls offers a significant opportunity to cut heating use, cost, and carbon footprint. Existing controls are old, and it is unclear how exactly they work and how to adjust them. Installing more modern controls will give you the ability to be more precise in matching times that spaces are heated to the times they are occupied. But, as noted in the Zero Carbon Plan above, replacing this system is top priority so if this project can be done soon, it won't make sense to invest in new controls. The specifications for the new system should specify modern controls.

An example of this modern control is the new electronic thermostat in the sanctuary, which can be programmed and updated remotely (see Photo B1). But for most or all of the other zones you have mechanical clock timers in the basement (see Photo B3). They require someone to go to the basement to set or adjust them. This may happen seasonally when summer changes to winter. But it's impractical to adjust them to variable use patterns, as may be needed when room schedules change.

There are thermostats in some of the rooms which are heated by steam, such as offices (see Photo B4). It's unclear how they work. For example, if a thermostat in an office calls for heat, but the clock timer in the boiler room is not providing any steam to

the zone, how would you get heat? Does the thermostat override the timer, and bring steam to the zone? If so other rooms on the zone will get heat when they didn't call for it. Perhaps the thermostat controls a local bypass in the room, but that would only work if the zone has steam. In some rooms there is a separate thermostat for an auxiliary heater, such as an electric resistance heater. It's not clear how the thermostats work in every case.

Consider the two thermostats in the chapel, as shown in Photo B5. What do they control? Why are they right beside each other? The thermostat on the right has a barely legible marking: "day". The other has no legible marking but it may be "night". Day is set for 69 degrees, night is set for 55. Somewhere there must be a clock, which switches from one to the other. Where is it, is it working, when does it change? Overall, it seems likely the controls are not coordinated, are not efficient, and maybe even counterproductive in some cases.

Do you have a plan to cut your carbon emissions 50% by 2030? **No**

The Utility Use & Cost spreadsheet calculates your carbon footprint – that is, the amount of carbon your HOW is responsible for adding to the atmosphere. As noted above, Massachusetts has set a goal to reduce carbon emissions by 50% by 2030 and we should all do our part to contribute to meeting this goal. Many houses of worship MassIPL has worked with have successfully met this goal. The first step is to implement the recommendations in this report, beginning with the "low-hanging fruit" actions that require minimal cost and effort. Then plan to implement actions that require more time, effort, and budget, ultimately converting as much of your heating system to heat pumps as possible when your current system reaches the end of its useful life.

In addition to reducing the energy you use, you can reduce your carbon footprint by buying carbon offsets or committing to 100% Green Electricity. Although Green Electricity and carbon offsets add money to your energy budget it will be less than the amount you would spend by taking some energy-saving actions and so is an affordable way to further lower your environmental impact. Appendix D provides information on two ways to buy "green" electricity: MassEnergy Consumer Alliance's program (which offers electricity from New England wind, solar and other renewable energy sources) and Energy Sage's Community Solar Marketplace which helps you find nearby solar farms that you can subscribe to.

Evaluation

This report proposes that Epiphany Church prioritizes replacing its aging steam heating system with a more modern one that uses efficient heat pumps as the primary heating source. This is a significant undertaking but alone will dramatically reduce the church's carbon footprint. There are some opportunities for decreasing energy use through building envelope improvements, but they are more limited and disruptive. Installing solar panels is possible, but also may be quite disruptive. Each of these

projects is described in more detail below. Since 2018 is likely be a more representative year for the "normal" level of activity, the church should consider it as the baseline year to calculate emissions reductions going forward.

Have you created a budget line for energy efficiency investments? **No**

In considering costs (especially for capital actions), recognize that "return" on such investments for the community-of-faith is measured by the standards the kingdom of God, not the kingdom of Wall Street. The decisions being made speak to the care we are called to give to the earth, as stewards of God's creation. The age of the building—dating to 1904 with the "youngest" work over 60 years old—conveys the appropriate time horizon.

At MassIPL we find that often congregations have difficulty finding the money to fund even modest energy efficiency improvements, and so we suggest this "reinvesting the dividends" approach. An *energy efficiency budget* starts by adding a line to the congregation's overall budget for *energy efficiency*. Fund it the first year with a modest amount to pay for some small projects. In subsequent years, the projected savings from line items (electricity, gas, oil, propane, water/sewer) as a result of energy efficiency actions are shown in this line, with the savings invested in additional energy efficiency actions. For example, if programmable thermostats are installed replacing manual thermostats with a savings estimate of 10%, and last year's gas bill was $10,000, then the next budget would show $9,000 for gas and $1,000 for energy efficiency. The $1,000 can then be used in the coming year for other actions, such as the HOW's share of LED bulbs after the electric company rebates. If no actions are taken in the year, the funds are set aside in an *Energy Efficiency Reserve Account* for use in future years. In the sample Efficiency Budget at Appendix E, the percent of the Efficiency line increases over 4 years from 14% to 41%. Setting aside these savings for future investment is a huge help in paying for moderate-cost items (such as the portion of LED upgrades not utility rebate) and also for major work, such as paying a loan for heating system upgrades or replacement. See the MassIPL EES brief *Establish An Energy Efficiency Budget Line*.

An immediate step to start saving is to enroll in a program for **bulk purchase** of gas and use the savings to fund the energy efficiency budget. One such bulk buying program available to Parish of the Epiphany (and other non-profits) is *PowerOptions*. Go to www.PowerOptions.org. Information on each is available at Appendix D. (PowerOptions also offers bulk buying of electricity but since you already buy through the Winchester WinPower program you likely have already achieved these savings. But you could still consider calculating the difference between your WinPower cost and today's utility rates (about $.29/kwh in March of 2022) and contribute that to your energy efficiency budget).

Another way to fund the energy efficiency budget is to adopt your own internal fee on carbon. A fee like this is meant to internalize the cost that carbon pollution and the effects of climate change inflict on others and society at large. Many

corporations use this approach, putting a price on carbon ranging from $15 to $50 per ton. One approach would be to follow Canada's example: they started at $10 per ton of carbon in 2018, increasing by $10 per ton until the price reaches $50 per ton in 2022. Use the fund raised by this mechanism to implement the recommendations in this ESA and establish a reserve fund to save for large projects in the future. See the MassIPL *Everyday Environmental Stewardship Brief* "Establish An Efficiency Budget Line."

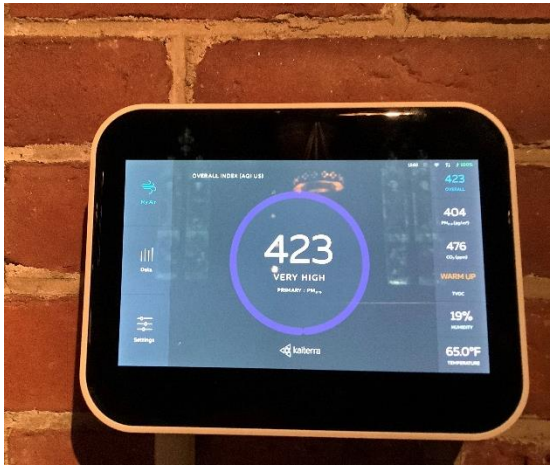
Evaluation

If you do nothing you can expect your energy costs to increase at least at the rate of inflation. For convenience, let's use a 3% annual inflation rate. Thus, the $37,000 spent in 2020 can be expected to be $38,110 in 2021, $39,253 in 2022, etc. Budget for that amount and when you reduce energy use and cost, put the savings into your Energy Efficiency Reserve.

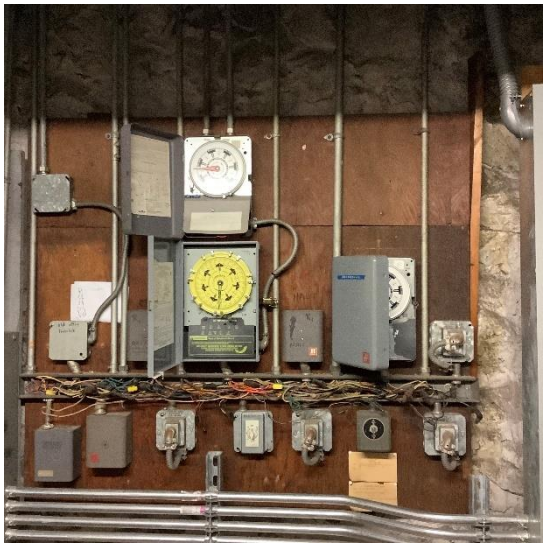
The bulk-buying option is a quick way to begin to fund additional efficiency actions. The regular tracking of savings from the recommendations you implement will show results that you can then use to make further contributions to the Energy Efficiency Reserve.

BEHAVIOR Photos

B1 – Wireless thermostat in Sanctuary provides a more modern control in the existing heating system



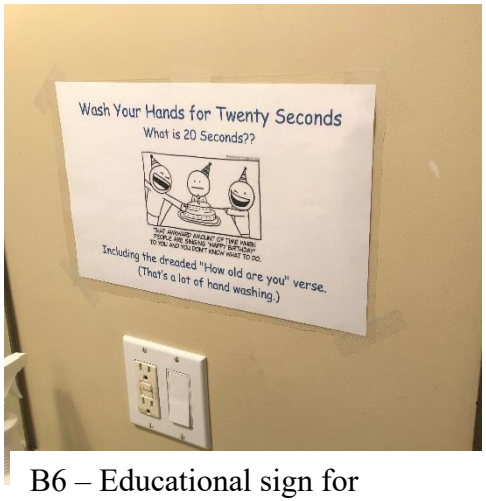
B2 – Ionization control in Sanctuary



B3 – Clock timer controls for steam heat system

B4 – Office thermostat & timer

B5 – Chapel thermostats, apparently one controls the daytime temperature and the other nighttime – but how they are coordinated is unclear.



B6 – Educational sign for handwashing – consider signs to remind people to turn off lights or turn down the heat

ELECTRICITY

Electricity is costly and is a significant cause of environmental pollution. Lighting, office and kitchen equipment, and air conditioning (if used) are key uses of electricity where upgrades in equipment and adoption of more efficient use practices typically are possible.

The building has grounded wiring, with some knob-and-tube (ungrounded) wiring, see photos E1 and E2. Knob-and-tube wiring is a very old type, and potentially a shock and fire hazard. If it is energized, we recommend that it be replaced with modern wiring very soon. If it is disconnected then it is technically not a hazard, but whenever in the future someone encounters it, questions will arise. So, it would be better to remove any visible remnants of it.

Do you make the best use of natural and artificial light? No

Lighting is likely to be one of the largest users of electricity in your church. Depending on the orientation of the building to the sun and the location of rooms, daylight may be sufficient. When there is sufficient daylight, avoid turning on lights. When lights are used, the level should be appropriate for the activity. For example, offices, classrooms, and music rooms need sufficient light so people can read without straining their eyes. Areas such as hallways or entries need lower levels of light but are often overlit. If an area seems too bright, try removing a bulb or two from a fixture or switch bulbs to a lower wattage. You can often reduce electricity use 20% or more in these areas by this simple, no-cost action.

Evaluation

Hadley Hall and the Upper Parish Hall are areas where natural light is excellent and likely minimal additional lighting is needed on many days (see Photos E3 and E4). The offices also have good light so that rather than overhead lights, tasks light could be a more energy efficient choice than overhead lighting. On the other hand, the Sanctuary will require artificial lighting due to the stained glass windows and the basement classrooms don't likely have sufficient natural light, especially for tasks such as reading. The point here is to make use of natural when you can and avoid turning on the electric lights. This can be a challenge because some folks are in the habit of turning on the lights when they enter a room without thinking about whether the natural light is enough. And breaking habits is difficult. You could put reminder signs by the light switches in rooms which have good natural light, to help foster this behavior.

Do all your fixtures have LED bulbs? No

The benefits of efficient lighting are well known. Updating lights is easy and has an immediate impact on your electricity use. LED bulbs are superior to both incandescent and fluorescent lighting in both lower electricity use (50>85%) and longer life

(10>50,000± hours). The longer life also means the time and cost to change bulbs is significantly reduced, an important consideration in hard-to-access locations, such as sanctuaries and other big/high rooms. For more information, see MassIPL's EES Brief on *LEDs*.

Fluorescent tube lighting is common, especially in classrooms, hallways, and large, open rooms. If your fluorescent tubes and/or fixtures are "old" (3+ years), they are candidates for upgrades to LED that can lower their use and cost 40% or more. A related benefit of LED tubes is better brightness. This often means fewer bulbs are needed to achieve desired lighting levels, such as only 2 tubes in a 3-tube fixture. Another benefit is the ability to dim the fixtures, with the proper dimming switch installed.

Evaluation
It was mentioned that converting the Sanctuary lighting to LED had been considered but that would also necessitate replacing the lighting controls. It appears that most of this light is still incandescent and so this is a priority.

The Junior High classroom, see photo E5, is one example of places which are lit by fluorescent tube fixtures recessed in the ceiling. There are many more in the hallways and classrooms. Replacing them with LED fixtures would reduce the electricity use for these areas by about half. Additional advantages of LED lights include better quality light, no flicker, longer life (which reduces maintenance costs) and no mercury waste. Much of the Hadley Hall lighting is also fluorescent tubes and given it frequent use the savings from converting to LED could be significant. We recommend you make an inventory of these lights and a plan to replace them over time.

Do you have sensing switches in all appropriate spaces? **No**

Some spaces are well served by having ***occupancy/vacancy*** sensing switches for lighting control. Restrooms are the prime candidates, with storage rooms and meeting rooms additional places to consider. These spaces have multiple users, with highly variable use patterns. Having a motion sensor switch (typically at the entry) that is also calibrated to typical use time means the use pattern (aka *behavior*) is monitored by technical equipment that ensures efficient on/off of electricity for lighting.

Evaluation
There are multiple opportunities for occupancy sensing switches. One of the best places is restrooms. See photo B6 for a restroom which would benefit from one. They are inexpensive and easy to install by a handy person. Meeting rooms and offices are good candidates for motion sensors. We suggest you take an inventory of places that could benefit from them and install them over a

period of time. When you deploy occupancy sensors widely, you create energy saving awareness. People know you are serious about it.

We suggest all outdoor lights have daylight sensors installed, so they won't be accidentally left on in the daytime. In addition, we suggest motion sensors so lights won't be accidentally left on overnight.

Are all your refrigerators and freezers highly efficient and used efficiently? **No**

Refrigerators and freezers run 24 x 7 so continuously consume electricity but have become far more energy efficient in the past 20 years. A new Energy Star rated refrigerator uses up to 35% less electricity than a 15-year-old model; an easy way to check the efficiency of your current appliance is to use the Energy Star Flip Your Fridge Calculator https://www.energystar.gov/products/appliances/refrigerators/flip-your-fridge Many houses of worship accept donations of refrigerators from members who buy new ones at their home. Before you accept the next donation, check its age and if it is old, politely thank the member but suggest they recycle it! And if there are times when these appliances are not used, turn them off and unplug them.

Evaluation

In the kitchen there is a commercial-type refrigerator and a commercial-type freezer, both made by True Manufacturing Company. They are both Energy Star rated and appear to be relatively new. That's good. See Photos E9 and E10 for the labels.

There is also a small Kenmore freezer in the kitchen (see photos E7, E8, and E8a) that looks to be older; there is no Energy Star Label and no manufacture date. Looking up the serial number on Appliance411.com it appears that it could be as old as 1985 and from its appearance doesn't look like it could be newer than about the year 2000, meaning it is far less efficient than a new model. We even wonder why it is needed: could the contents be placed in the commercial freezer already in the kitchen, and this unit removed? Even if it is relatively efficient, which we doubt, it's using electricity and perhaps needlessly.

Also, in the basement we noticed two small beverage refrigerators. They are both Whirlpool models, made in 2015 or 2016 and Energy Star rated, which is good. But are they both needed? Each one consumes about $50 worth of electricity annually. Consider keeping the larger one (4.3 cubic feet) and removing the smaller one.

Are all your appliances and equipment Energy Star top rated? **No**

Equipment using electricity is found in offices, kitchens, music rooms, and other locations. Computers, printers, copiers, space heaters, dishwashers, humidifiers and dehumidifiers are the most typical sort of such equipment. The ***Energy Star*** program is well known and an excellent guide to finding the most energy efficient equipment to replace older products. But don't just buy any Energy Star product – look for ***Energy Star*** Top Rated. Use the ***Energy Star*** web site to get the best! This ensures both lower electricity use, but likely also longer life for the equipment. Go to

http://www.energystar.gov/certified-products/certified products?c=products.pr_find_es_products

The governing body should adopt a resolution that all new equipment purchased in categories that the Energy Star Program covers should be top-rated, and then apply this policy in all new purchases. For more information, see MassIPL's *EES Brief* on *Appliances.*

Evaluation

We did not see any dehumidifiers in use, but we understand they are used extensively in the basement classroom areas in the summer. Dehumidifiers operate on a refrigeration principle, where warm humid air is passed over a cool coil and the humidity condenses out. As such they consume a fair amount of electricity. Check to see if your dehumidifiers are Energy Star rated. If not, replacing them with top-rated units may pay back in energy savings quickly. The Norian/Siani proposal for replacing the AHU in this space included a ducted dehumidification system and we support this recommendation. It can be sized appropriately for your needs and will likely give you better control and may consume less energy than multiple standalone dehumidifiers – plus the system will remove the water without running hoses across the floor.

We did not examine your office equipment for energy efficiency. Check to see if the energy saving features on your printers, copiers, etc. are set properly. Most such equipment can be set to "sleep" after a few minutes of inactivity. And when it's time to replace any such equipment be sure to choose a top-rated one.

Have you evaluated your HOW for solar panels? **Yes**

Solar energy produces no carbon emissions. In the past few years, the costs to install solar systems have come down dramatically. The cost of a system for a typical HOW is usually in the range of $75,000 - $100,000. The electricity savings plus state incentives will often pay the cost back in under 10 years, and the systems will continue to produce electricity for at least another 10 - 15 years. The HOW also has the benefit of a very visible expression of environmental stewardship, often better than the best welcoming sign.

As costs have come down, purchasing the panels has become the best financial option. Borrow from savings or endowment, then repay it through the electricity savings and the state SMART solar incentive payments. If your church doesn't have cash available, consider a loan from a denominational loan program such as the UCC Cornerstone Fund Ecoloan, the Episcopal Diocese of Massachusetts Green Loan, the Unitarian Universalist Association Building Loan, or the Episcopal Church Building Fund (which loans to other denominations). Check if your denomination has a building loan program. A third option is third-party financing programs such as leases or Power Purchase Agreements. In this model, a third-party financing firm owns the system and your church does not have to pay any money upfront. The monthly payments are at a fixed rate, generally 10% -15% less expensive than paying the electric company for the same amount of electricity. For more information, see MassIPL's EES Brief on *Solar Financing.*

MassIPL has helped 50 HOWs install solar in the last 10 years. MassIPL has 3 partners for solar panels:

- 621 Energy (http://www.621energy.com/) has been MIPL's solar partner for 2 years and offers a power purchase agreement to make solar affordable for HOWs. Contact Bob Clarke clarker@621energy.com
- Resonant Energy (http://www.resonant.energy/) offers a range of programs to help HOWs install solar, including its Interfaith Community Solar program. Contact Madeleine Barr madeleine@resonant.energy
- Energy Sage (www.energysage.com/mipl) is an online site where you post the HOW's address and some information about its energy use, then multiple solar companies will evaluate and provide proposals.

When you install solar panels using one of these partners, they make a donation to support MassIPL. MassIPL can assist you in this process.

Evaluation

Congratulations on using fossil free electricity. The Winchester community aggregation program, Winpower 100, is an excellent program that offsets the carbon emissions of the electricity it sources by purchasing Massachusetts Class 1 renewable energy credits (RECs) which helps encourage building additional renewable energy sources for the Massachusetts grid. These are the highest quality RECs available. In addition, community aggregation offers excellent pricing and price stability, so they are a good choice for you.

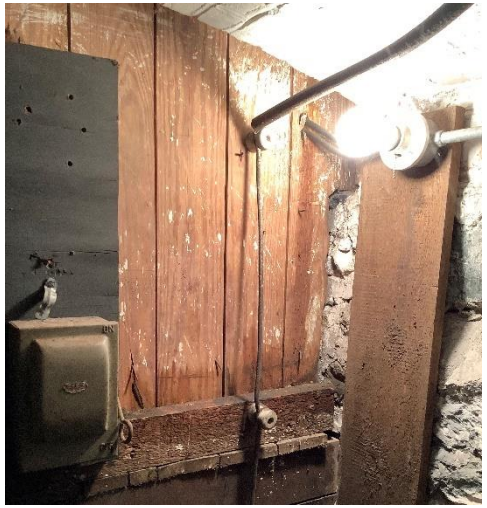
So why consider installing solar if you already have fossil-fuel-free electricity? Because the grid still needs more renewable electricity sources and your installation would add net new renewable energy to the grid without taking up land that a solar or wind farm occupies.

You said you "did a solar panel assessment and it showed issues because of trees south-facing and slate roof (expense). (We) are already using 100% fossil free electricity". (We'd be happy to take a look at this evaluation and provide our point of view). In addition to the expense of slate, we don't know of any solar installers who will install on a slate roof at this time; one approach to try would be to ask your current slate roof contractor if they would be willing to work with a solar installer to attach the racks to the roof so the solar company then only has to attach the panels to the racks and connect the wiring. Your best option may be to consider removing the slate and installing new roofing such as a simulated slate product that, when the roof is covered with solar panels, would be minimally visible and thus any contrast with the real slate might not be noticeable.

You have two very good locations to consider: the roof on the courtyard side of Hadley Hall, which we estimate has room for a system that would generate about 30,000 kwh, almost half of your usage. While Hadley Hall may get some shade, especially in winter, it appears to be minor from a Google Earth view. The west-facing roof of the sanctuary has room for a system that would generate about 37,000 kwh; it would be more difficult for the installers to access and when they evaluate the roof structure, they may find it would also be difficult to attach the racks holding the panels.

ELECTRICITY Photos

E1- Knob-and-tube wiring Example 1



E2- Knob-and-tube wiring Example 2

E3- Hadley Hall – good natural light

E4- Upper Parish Hall – good natural light

E5- Jr High classroom- fluorescent light fixtures

E6-Kitchen range – gas pilot flames always on

E7- Kitchen, small freezer

E8- Kitchen, small freezer label

Brand: Kenmore
Type: Freezer
Country: USA
Model: 1068241512
Serial: S52831115

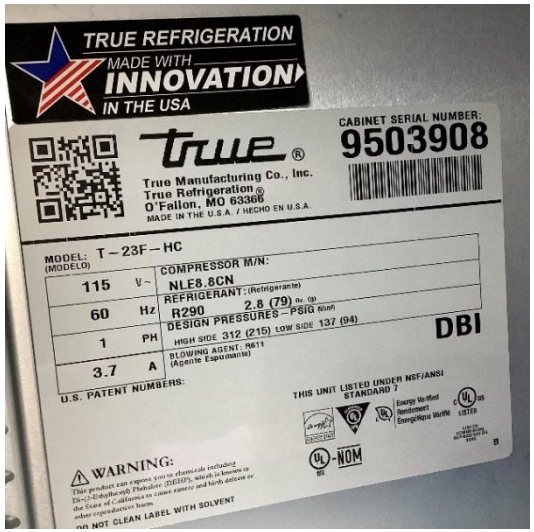
This product could have been manufactured on multiple dates. Personal assistance may be needed to date the product more accurately.

According to the serial number this product may have been manufactured in Ft. Smith, AR, **July of 1975** or **1985** or **2015**.

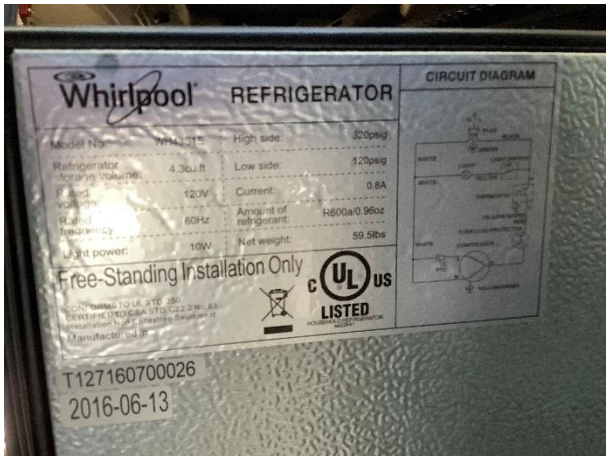
Tip: Based on the model number supplied, this product design may have been introduced to the marketplace for **1984** in which case the closest date suggested above to 1984 is likely the manufacturing date for this product.

E8a- Kitchen, small freezer estimated age per the web site appliance411.com. If this is as old as 1985 or even 1995, then it is an energy hog and should be recycled!

E9- Commercial fridge label



E10- Commercial freezer label



E11- Basement beverage fridge label, 4.3 cu ft

BUILDING ENVELOPE

"Building envelope" is a term energy efficiency professionals use to refer to the role walls, windows, insulation, and other physical characteristics play in determining energy use, cost, and carbon footprint. A "tight" envelope prevents the air warmed in the winter or cooled in the summer from leaking out of the building and a well-insulated envelope prevents heat from being transmitted through the walls and roof.

The Church of the Epiphany is predominantly brick masonry construction; brick is a poor insulator and it is challenging to add insulation without risking damage to the brick. Roof structure also likely has little to no insulation, with the slates attached to the sheathing and likely no insulation between that and the interior finish material.

Are your walls, ceiling, floors insulated to current standards? No

Building materials will conduct heat out and cold in at wintertime, and the opposite in summer. Well-insulated space retains its desired temperature and takes a shorter time to achieve this temperature. The exterior portions of a building (side, top, bottom) are the key areas for insulation. Buildings with pitched roofs and little-used attics are best served by having the floor of the attic insulated, as it is the "exterior" of the occupied space. Similarly, the ceiling of a little-used basement is the "exterior" of the occupied space. Older buildings, especially 19th/early 20th century with stone walls, present particular challenges for wall insulation. The Energy Star web site has good information on insulation:

http://www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_seal_insulate

Evaluation

Insulating brick masonry buildings is generally not recommended because the insulation may contribute to freeze/thaw damage to the brick over time. While much of the building will be very difficult to insulate, we believe there are 3 areas that should be considered.

First, the Hadley Hall roof. It appears that there is no insulation between the interior acoustic tiles and the roof sheathing (see Photo BE-1). The existing tiles could be stripped and 2 – 4 inches of a foam insulation boards installed, providing insulation value between R-12 and R-24 before installing the finish material.

Second, a similar treatment could be given to the roof of the Upper Hall, especially since there is consideration of doing significant renovation of the space already.

Third, the basement areas have no insulation against the foundation walls. Because these areas are below grade and concrete is a poor insulator, they conduct heat to the cooler ground. But because of the humidity in these areas discussed earlier, the first step in this project would be to evaluate the source of the humidity. While we did not see any signs of ground water intrusion such as peeling paint or staining, it should be ruled out and if needed, corrected, before installing these products. This article provides a good overview of diagnosing the source of the moisture: https://www.familyhandyman.com/list/affordable-ways-to-dry-up-your-wet-basement-for-good/

There are a number of products specifically designed for insulating basements beginning with flooring: https://www.familyhandyman.com/article/install-a-moisture-resistant-basement-subfloor/ and insulated wall panels such as this system from Owens-Corning https://www.owenscorning.com/en-us/basements This article provides an overview of several basement finishing systems including one DIY option https://www.thespruce.com/overview-of-basement-finishing-systems-1821300

Have you sealed areas of air infiltration? **No**

Just as open doors between zones are a cause of inefficiency, areas of air infiltration (aka "holes") cause inefficiency. The most common areas of infiltration are doors or windows that have gaps around the edges, places where pipes or electric wires enter the building, electric sockets and switches that are on outside walls, and along the sill plate (where the top of the foundation meets the framing of the walls). It is rather amazing how these small areas can add up to a large hole. The EPA estimates they can add up to as much space as if you left a window wide open! Sealing these areas can be a project for a work day with simple materials you can buy at any hardware store or home center: door and window weather stripping kits, socket and outlet insulation, caulk, cans of spray foam. Sealing these areas can also keep out mice and insects.

Evaluation

The most significant air sealing opportunity is around the windows in the office area. We could feel a draft around the edges of most of these windows and in one spot where the trim was missing, there is no caulking and thus an easy route for air infiltration (see Photo BE-2). The trim around these windows appears to be a simple piece of round dowel glued in place; it would be easily removed allowing caulking around the windows. Then replace the trim, either with the material removed or with new material if the process of removing the trim damages it.

Do you have high efficiency windows? Interior storms? Sun screens? Yes and No

High efficiency windows (sometimes referred to as *thermopane*) serve to provide additional insulation. Some are *fixed* while others are *operable*. Operable windows with cranks can shut tightly but may need weatherstripping if they are old. Older windows (typically single pane) that slide up-and-down typically have counterweights, with a cord or chain moving over a wheel at the top, with the counterweight in a void on the side of the window. This void needs to be filled with insulation when the window is upgraded to thermopane and a vinyl track installed for up-and-down movement.

In general, windows are considered to have the lowest return (measured in either financial terms or carbon reduction) of common energy efficiency projects as long as the windows are in acceptable condition. If the window frame is in good condition, you may be able to reduce the cost by replacing just the sashes with new thermopane sashes. However, if the frames have deteriorated there is likely significant air infiltration that loses more energy than the window itself. In this case, full replacement (taking the window and framing out to the rough framing and installing the window unit) is a necessary investment. In this case consider triple pane windows: the incremental cost to go from double pane to triple pane is a relatively minor part of the overall cost but results in double or more insulation value.

Interior storms also called *window inserts* add another layer of physical protection to block drafts and create an additional barrier to heat loss. Interior "storm" windows serve to make the single-pane windows similar to *thermopane* glazing, reducing heat loss in winter and heat gain in summer. This also improves occupant comfort. Stained glass windows are almost always single pane and allow significant air infiltration around the leading and sections that may be operable. Constructing interior "storms" can be a congregation workday activity, or purchased to fit the window. There are a number of companies that make window inserts which cost $100 - $150 for a typical size window. One noteworthy provider is Skylarc Innovations' Windowtherm panels www.skylarcinnovations.com which has been tested to increase window insulation value by R-2. For more information, see MassIPL's *EES Brief* on *Interior Storms.*

In the summer, consider window inserts that use a film that blocks the sun's heat from entering the building. Similarly, for windows that have screens, consider installing *sun screens* that block up to 80% of the heat from sun exposure, keeping the room cooler without the use of air conditioning. For both window inserts and sun screens, rooms that face south and west – especially frequently-used rooms like offices – are the best candidates. Install them in early June or when people using them room notice that the sun heats the room to an uncomfortable temperature. Remove them and replace the regular screens in early September.

Evaluation

There are a large number of windows and many of them are integral to the architectural style, especially in the Upper Parish Hall and the corridor outside the chapel (See Photo BE6). They are single pane with arched shape and intricate dividers, though some

in Upper Hall have had rectangular window fit into the arches (see Photo BE7). Because of their unique shape, the best option may be to build interior storm windows as discussed in the EES brief mentioned above. This activity (whether workday or purchase) helps members and visitors see how this solution can be used at home, and elsewhere.

The windows in the offices are rectangular with leaded glass (see Photo BE8). Many of these windows have window inserts (aka interior storm windows), apparently purchased from a local hardware store. Photo BE8 also shows an insert in place on one of the three windows while the clips on the frames suggest the other windows may also have had inserts at one time. A "low-hanging fruit" step is first to ensure that all the window inserts that you have are installed and then to purchase additional ones as needed for windows that don't already have them. These inserts provide some improvement to the thermal performance but due to the leading, this improvement is limited. Replacing them with double- or triple-pane would greatly reduce the energy loss through them but it would be virtually impossible to duplicate the appearance. Another extreme option is shows in this YouTube video: a process for sandwiching the leaded pane between two clear glass panes to create a triple pane unit, but we are not aware of any member having used this process https://www.youtube.com/watch?v=KDtCLd48QoU.

There are exterior storms on most of the Hadley Hall windows and doors so no additional work is needed (photo BE9).

The basement classroom areas offer good opportunities for window replacements (Photos BE10 and BE11). These windows are don't appear to be needed as emergency egress and could be replaced with fixed double or triple pane windows. Some classrooms have hopper style windows and they are also not likely needed as emergency egress (see Photo BE12). Fixed windows would likely improve the air tightness and may help lower the humidity in the summer.

Are all doors well-insulated and tight-fitting? **No**

Like windows, door replacements are expensive. But an old wooden door will likely have an insulation value as low as R-2 less while a new door may have an R-5 or more, over twice the insulation value. In addition, new doors are more intentionally designed to reduce the air leakage around them. If door show signs of age and wear – being out-of-square, large gaps between the edge of the door and the jambs or sills – a replacement is worthwhile, not only for energy savings but improved security. Most doors are "pre-hung", ie, it comes as a unit with the framing, jambs, and sills; these units are designed together to minimize air infiltration. However, if the framing is sound, you may be able to save money by just purchasing the door "slab", ie, the door itself, and having a carpenter or handyman hang the door in the existing frame and adding appropriate weatherstripping.

Evaluation
Many of the doors are integral to the design of the church and would be hard to duplicate. However, some doors are less important to the overall esthetics of the church and could be replaced, eg, the back door of the Garret (see Photo BE13), and similar doors in the Rector's office and music director's office; for replacements, consider not having windows in the doors to improve insulation value. Similarly, the doors to the Woodland Garden are likely to have an insulation value of R-2 or less and replacements would significantly improve this (see Photo BE14).

The infrared photo of the door of the Upper Parish Hall shows significant heat loss and should be replaced if the space is renovated (see Photo BE15). Also, there is an emergency exit door with cracked panels that should be replaced since it is less integral to the design (see Photo BE16).

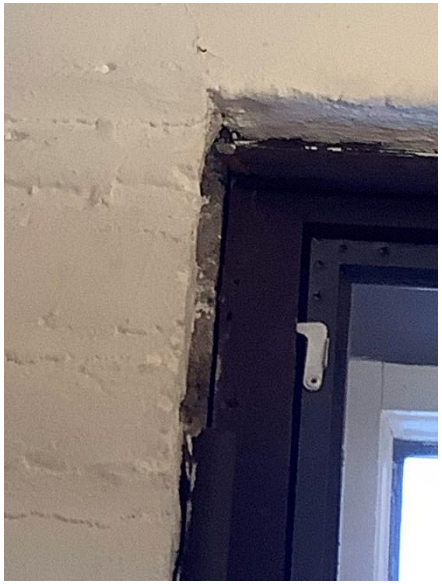
Do windows and doors have effective weatherstripping? **No**

Doors and windows that don't fit their frames well leave gaps that can allow a significant amount of air leakage – letting that heated or cooled air escape and requiring energy to heat or cool more air to replace it. Weatherstripping doors is an easy DIY project with many different types of products to suit the specific needs of different doors and windows. The *This Old House* web site has excellent information and videos about weatherstripping: https://www.thisoldhouse.com/doors/21112231/how-to-weatherstrip-a-door

Evaluation
Most of the doors are wood, and many have an arched shape. They are not insulated but would be difficult to replicate in a new door. Many need improved weatherstripping (see photo BE3 and BE4), an action MassSave is likely to do after their assessment. Monitor at the start of winter and summer seasons to ensure that the weatherstripping continues to function effectively.

BUILDING ENVELOPE
Photos

BE1 — This gap in the acoustic tile appears to show the roof sheathing, indicating no insulation.



BE2 — There is no caulk between the window frames and the walls, allowing air infiltration.

BE3 — Light can be seen at the top of the Sanctuary door that faces Central Street.

BE4 – The main door to Hadley Hall fits reasonably well, though there is a gap along the top arch.

BE5 —This door in Hadley facing Church Street also shows a gap and air infiltration, especially below the panic bar.

BE6 – Arched windows along the corridor are candidates for window inserts built as a parish work day.

BUILDING ENVELOPE
Photos (cont).

BE7 – Rectangular windows in arched openings could be upgraded to double or triple pane.

BE8 – The window at left has a window insert while the others don't, although the clips on the frame suggest inserts did exist at one time.

BE9 – Hadley Hall's French doors have storm doors.

BE10 – This basement window appears to have been used as a vent but now is a candidate for replacement

BE11 – This window is not operable and could be replaced with a double or triple pane fixed unit.

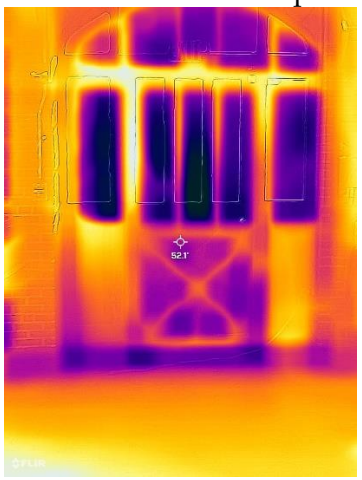
BE12 –The hopper style window is currently operable but could be replaced with a fixed unit.

BUILDING ENVELOPE
Photos (cont).

BE13 — The exterior door in the Garrett is a candidate for replacement. There are similar doors in the Music Director's and Rector's offices. Consider a solid door with no window for better energy performance.

BE14 – Doors to the Woodland Garden are also candidates for replacement. They are thing and wood is a poor conductor.

BE15 – Cracks in the panels of this door in the Upper Parish Hall indicate it should be rebuilt or replaced.



BE16– Infrared photo of the door in Upper Hall; darker areas, esp. the lower section of the door, show heat loss.

HEATING, COOLING AND WATER

Heating (and if used cooling) is likely the biggest user of energy at your HOW, and thus both the largest contributor to climate change and a significant expense. In looking at this equipment, three areas are evaluated:

- *Generation* (the equipment that heats or cools air or water)
- *Distribution* (the system that takes the heated air or water to the spaces where it is needed)
- *Controls* (mechanisms that control generation and distribution).

Each of these offers opportunities to decrease your energy use and carbon footprint. When it comes time to replace generation equipment, you should prioritize energy efficiency and lowest carbon emissions in choosing new equipment. That will likely mean upgrading to *heat pumps.* The MassSave program is prioritizing heat pumps as a replacement for fossil fuel-fired equipment and the Baker Administration's 2050 Decarbonization Roadmap says this:

- "...in order to achieve Net Zero, the use of gas for building heat must start to decline in the near term."
- "...electrification and efficiency strategies rely on infrequent opportunities to change out heating, ventilation, and air conditioning (HVAC) equipment, such as equipment end-of-life or major renovation. Leveraging these opportunities early is essential for keeping costs low."

Heating and cooling equipment typically last between 15 - 30 years and so it is likely every piece of equipment operating today will be replaced at least once between now and 2050. If your equipment is more than halfway through its useful life, you should begin educating yourself about new technologies, begin planning for its replacement, and setting aside money to pay for it. In addition, MassIPL believes it is likely there will be new programs and incentives developed in the next few years to encourage Commonwealth residents to replace fossil fuel fired equipment. Learning and planning now will mean you will be in a good position to take advantage of new programs as soon as they are available.

Though often taken for granted, water use can be significant and costly. This is especially true if the HOW is the location for a pre-school program and/or if it hosts a variety of other users (AA, AlAnon, choral groups, other congregations, and so on). In these instances, use of sinks and toilets draws considerable water. It also increases the demand of water supplies, a matter of increasing concern.

General Observations

Since the 2016 HVAC Master Plan by Norian-Siani Engineering, the following changes have taken place:

- The boiler noted as being 80 years old has been removed, along with the oil tank.
- The boiler noted then as 24 years old is now 30 which means it has reached the expected useful life of the system (see Photo H1).

- The air handling unit for the basement classrooms that the report noted needed further evaluation was scheduled to be replaced prior to the pandemic but was put on hold.
- The Commonwealth instituted new climate goals and explicitly stated we must move away from fossil fuels
- Advances in heat pump technology have made them the preferred heating and cooling technology whenever possible.

The HVAC Master Plan provided a number of good recommendations for lowering energy use but it should be revisited and updated to emphasize heat pumps wherever possible, if not the entire building.

Do heating/cooling zones that match use patterns? **No**

There are two ways to think of zones: 1) the physical areas served by a single thermostat, and 2) the usage patterns that determine which rooms require heat at particular times. Ideally, these should align so that only the spaces being used are heated or cooled. But often as building usage changes, heating systems are replaced, additions built, etc. zones may be designed for the convenience of the installer or low cost to the congregation.

The use patterns of HOWs are highly variable, even for buildings that otherwise are essentially identical. Often, only the offices or a meeting room are being used. Thus, the best efficiency is achieved when zones for heating and/or cooling allow for heating or cooling areas of the building consistent with how they are used. If the current zones of a HOW do not match use patterns, money and energy are being wasted. Updating zones can be more or less complicated (ergo expensive) depending on the type of heating or cooling distribution.

Evaluation

The *Space Use* table in Appendix B presents Church of the Epiphany's current pattern of use and the zones associated with them.

As is typical in most houses of worship the office space is the area used most regularly but is a relatively small percentage of the overall square footage of the building. All offices (main office, upper, Rector's office) appear to be on a single zone and are reported to have similar hours of use. However, the temperature and comfort level were reported to be highly variable. The Financial Administrator office was reported to be extremely hot and has two large radiators, while the Clergy Assistant and El Hogar offices had electric resistance baseboard heat to supplement their spaces; it is believed that these three offices were once a single large open space that has been divided.

Do controls and distribution optimize energy efficiency of HVAC equipment? **No**

Even if generation equipment is highly efficient, energy can be wasted if controls don't match heating and cooling to the actual need. The most familiar control is the ***thermostat***. (See the discussion on thermostats in the Behavior section.) Hydronic heating systems should also have an ***outdoor reset control***. It adjusts the water temperature based on how cold it is outside. For example, in deep winter it would set the boiler to heat water as high as 180° but in fall and spring only to 110°>140°. Thus, the amount of fuel used to reach a desired comfort level matches need. Next consider replacing existing pumps with ***variable speed pumps*** which vary the volume of heated water sent to the use locations. If heated water is returning at a temperature not much lower than it was sent out, the speed of delivery can be reduced so that the heat is transferred in the use spaces. Again, this reduces fuel use, and therefore cost. Similarly, for forced air systems, variable frequency drives adjust fan speeds to deliver the right amount of heat to rooms. An ***energy management system*** (*EMS*) is a computerized system that centrally manages all thermostats, logging in remotely to change settings rather than setting each individually on site. These systems also provide detailed information about energy use in the building to help manage use and cost even more closely. If your existing HVAC equipment is less than 10 years old, modest investments in these kinds of controls and distribution equipment can improve efficiency today while you plan for conversion to heat pumps in the future when the current equipment reaches the end of its useful life.

Evaluation

Except for the Sanctuary, the thermostats and control systems are old and inflexible, as discussed in an earlier section. The new thermostat for the Sanctuary shows there are more modern controls that can be installed for this system but depending on your timing for making changes, it may not make sense to spend money on these controls for the steam system. Any new system design should include modern controls to allow greater flexibility in scheduling times for heating and enable internet access to manage schedules more easily.

Most distribution is through radiators (see Photo H3) though the Sanctuary is also heated with forced air through the undercroft and floor grates that allow the heat to rise into the space (see Photos H4 and H5). There are many inefficiencies in this design.

The basement classrooms are heated with forced hot air and the air handler is failing; it was scheduled to be replaced but this project was postponed due to other needs during Covid. We also agree with the HVAC Master Plan's recommendations about identifying the sources of the humidity and incorporating central dehumidification into the new equipment.

In addition, there is supplementary baseboard electric heat in some areas and mini-split air conditioners in some offices (these will be discussed in more detail later).

Are heating/cooling/hot water pipes and ducts sealed and insulated? **Yes** and **No**

Getting space conditioning (water, steam, air) to the use location is the first delivery consideration. Uninsulated pipes and poorly-sealed ducts lose 10 - 30%of the heat or cooling before reaching the use space. Improving insulation and reducing air leakage in ducts is often a simple, inexpensive project that members and other volunteers can do on a work day if the ducts and pipes are readily accessible. Such work days are also good learning experiences, reducing anxiety about doing such work, thus increasing the probability that those involved will "go and do likewise" in other needed locations, such as their own homes. MassIPL can help organize this kind of event. Sometimes ducts are inaccessible behind doors or under floors. In that case, consider contracting with an Aeroseal dealer; the Aeroseal process injects a fine mist of a sealant into the ducts under pressure, causing the sealant to find and plug any leaks. You can find an Aeroseal dealer here: https://directory.aeroseal.com/

Once at the location, delivery should match space type and use. For example, in-floor forced air vents in large/high worship spaces are very inefficient, blowing warm or cooled air to the ceiling, rather than distributing at the level of people. (7± foot maximum) Similarly exposed steam radiators in classrooms (especially nursery and pre-school) risk burning occupants if they are touched. There are now ***"high-efficiency" radiators*** that can be wall-mounted, including in classrooms. Even better for classrooms (especially where kids crawl on the floor) and in large and/or high spaces (such as meeting halls and sanctuaries) is ***in-floor radiant***. This can be installed over existing flooring, or if accessible from below, beneath the current flooring. Use of in-floor radiant is beneficial in classrooms and worship spaces because heat will be uniform throughout the space, delivered where the kids or people are. The heat "pools" slowly, staying at the base of the space rather than going upwards to the ceiling. This system can be zoned within large spaces so that for small gatherings, the participants can be clustered at the heated area, which is beneficial in both energy efficiency and community formation.

Evaluation

Little of the distribution system is visible outside the boiler room but where steam pipes are visible they are insulated. The hot water pipes in the boiler room are not insulated and this could easily and inexpensively be installed.

The distribution through the undercroft tunnel is extremely inefficient and however heating the Sanctuary is ultimately changed, this should be eliminated in favor of either more efficient duct systems for forced air or additional radiators.

The ducts in the basement are likely to be very leaky, so we recommend having your HVAC contractor test them, then seal the joints with duct mastic or duct mastic tape and test them again. If further sealing is necessary, the Aeroseal process is an effective,

though expensive, choice, particularly in areas where the ducts are inaccessible https://aeroseal.com/air-duct-sealing-blog/looking-for-dealer/

Is your air conditioning SEER 14+ efficient? Yes

If you have air conditioning (AC), it can be a significant use of electricity in summer. Thus, it is essential to have highly efficient equipment that is properly sized for the space. Given most HOWs are old, AC tends to be localized, often through-window. Epiphany Church as installed several *mini-split* heat pump systems: an outdoor compressor feeds refrigerant to a small delivery device in the room or rooms without the need to run expensive duct work. The most common of these delivery devices hang on the wall (as your units do in both the main office and the Rector's office), but they can also sit on the floor or be installed in the ceiling.

Evaluation

As mentioned before, Epiphany Church has 3 air-conditioning only heat pumps, one for the main office (Photo H-7), one for the Rector's office (Photo H-7) and one that is a "mystery" as to what area it serves; however, since there are no obvious refrigerant lines from it, perhaps it serves part of the basement. The office unit is SEER 21.6 according to the AHRI Directory for this model number; we were unable to see the labels of the other units but presumably they are similar. The serial number of the office unit suggests it was manufactured in 2013 and likely installed that year, so these have 5 – 7 years of useful life remaining. However, they are candidates to be upgraded to new heat pumps that provide both heating and cooling.

Have you evaluated your HOW for heat pumps? Yes and No

In order to achieve net zero carbon emission by 2050, we must transition away from fossil-fuel fired heating equipment to the maximum extent practical. Any time an existing fossil fuel heating system reaches the end of its useful life, it should be replaced by equipment that doesn't emit carbon. Heating equipment typically has a useful life of 15 – 20 years so unless you have replaced equipment in the last couple of years, likely you will replace equipment in your HOW by 2030.

The leading technology today is a *heat pump*. A heat pump may sound like an exotic new technology, but is already widely used in Europe and Asia, and increasingly in the US. Simply put, a heat pump moves heat from one place to another. In fact, a refrigerator is a type of heat pump that cools food by taking the heat from the inside and blowing it outside-- you feel the heat coming out from under the refrigerator when it is working. Air conditioners work by a similar principle, using an electrically-driven compressor to cool occupied spaces while blowing hot air outside. So, by reversing the process, occupied spaces can be heated. The equipment for doing both heating and cooling is called a ***heat pump***. Because New England winters are cold, install

a *cold climate heat pump* which will remain efficient down to zero degrees Fahrenheit or lower. Because heat pumps operate on electricity, their carbon footprint will decrease as more wind and solar power is added to the electric grid; if you can install solar panels, your heat pumps may have zero carbon emissions. *See MassIPL's EES Brief* on *Heat Pumps.*

Upgrading to heat pumps will be more complicated than replacing an existing gas or oil furnace or boiler with similar equipment, so it is important to begin planning 2 – 3 years before the old equipment is at the end of its life. MassIPL always recommends working with a mechanical engineer on a major heating/cooling system project and it is especially important for conversion to heat pumps. Depending on the configuration of your current HVAC equipment, it may be possible to phase replacements, for example, converting offices or classrooms before converting the sanctuary or large gathering spaces. Because converting heating and cooling to heat pumps is such a high priority for the state, the MassSave program offers generous incentives that will help finance this project.

Evaluation

The 2016 HVAC Master Plan mentioned heat pumps in passing but as noted earlier, the technology has improved greatly and is the preferred heating source today. We recommend pursuing a phased process, starting with offices (where existing heat pump units could be replaced with new ones), then Hadley Hall; these areas represent the most-used spaces in the building. Given the known need to replace the AHU in the basement classrooms, consider incorporating this space into the Hadley Hall system. There is discussion of a significant renovation to the Upper Parish Hall which will provide many opportunities to lower energy use and would be the time to take it, the Chapel, Sproat, and Dewer off the steam system as well.

Two considerations in migrating to heat pumps will be:

- Electrical service to the building: The 2016 report recommended upgrading to 800-amp service; some electric work has been done but it isn't clear if it was brought to this level: the two electric panels in the boiler room are 200 amp and 125 amp (see Photos H8 and H9).
- Location of the outdoor heat pump units: There is limited space on the property to conceal additional outdoor units. The driveway along the back is aesthetically preferred but may not be practical for a unit to serve Hadley. It would be preferable to locate the unit for Hadley on the front along Church Street rather than in the Woodland Garden.

Last area to convert should be the Sanctuary which may be difficult to remove from a fossil fuel system. However, if that is the only remaining area, much smaller, more efficient equipment would likely be sufficient. If you must install a new fossil-fuel fired system, pay careful attention to the design and equipment to ensure the highest efficiency (95%+) and lowest use of fuel. For example, instead of installing a single large boiler, a common strategy we recommend is to design the system with at least two smaller (200>400 mbh) residential scale boilers. Install boilers that modulate the firing rate down to 10% of input to precisely

match heating load requirements for greater efficiency and less cycling. This enables each boiler to operate to maximum efficiency, so that in shoulder season or during the week when you need a minimum temperature, perhaps only one boiler is needed. Typically, maximum load is seen on cold high holiday worship days/nights. The boilers should also be phased, to come on in sequence, and cycle the sequence so that each is operated regularly. This further extends life of equipment. The boilers should be controlled with an "outdoor reset", so that temperatures modulate in relation to need based on how cold it is outside.

Is your domestic hot water heater 95%+ efficient? **No**

Standard domestic hot water ("DHW") vertical tanks are not very efficient (65±%) and little hot water is typically used in an HOW: virtually no HOW's have showers or clothes washers and use is typically limited to sinks and dishwashers. And because there are long periods of time when none might be used, there is some "standby loss", ie, after being heated the water cools off while waiting for a faucet to open and must be reheated to maintain temperature. Modern tank hot water heaters have significant insulation to limit this loss.

Similar to heating systems, the state is encouraging us to move away from fossil fuels for heating water and installing a ***hybrid heat pump hot water heater***. Like the heat pumps discussed above for space heating, a heat pump hot water heater uses electricity, but uses it 3 times as efficiently as an electric resistance tank. While heat pump water heaters are more expensive, their lower operating costs (and incentives from the MassSave program) can pay back the investment in under 2 years.

If you are not able to switch to a heat pump water heater and currently have a gas hot water heater, switch to an on-demand DHW system which heats water only when the tap is turned on, eliminating the waste of heated water in a tank cooling because no one is using it. This cuts energy use by 30 - 40%. On-demand DHW systems save more money because they typically last 20 years, compared to tanks which often need to be replaced in about 10 years. If you have an electric resistance hot water tank, on-demand is likely not a practical alternative.

Whatever type of hot water system you have, make sure it is no bigger than needed: 40 gallons is more than enough to serve sinks and dishwashers. If it is located far away from where hot water is used, try to move it closer when the time comes to replac your current water heater. Finally, be sure the temperature is set to no more than 120˚, both for energy saving and to prevent scalding. When used in dishwashers (whether residential or commercial), the DHW from the source (typically at the 110° level) is heated to an even higher temperature by the dishwasher. For more information, see MassIPL's *Everyday Environmental Stewardship* brief on *Domestic Hot Water*.

Evaluation
Epiphany Church has one 91-gallon electric hot water heater and is 92% efficient (see Photo H10). A tank this size is significantly oversized for the needs of the church, except possibly for the Hadley kitchen use.

The model number indicates it was manufactured in 2014. Typically, tank hot water heaters have an expected useful life of 10 – 15 years, however the Rheem Marathon series offers a limited lifetime warranty against leaks.

The conversion to heat pump heating/cooling is higher priority and given that this tank likely has many years of service remaining, it is not a priority to take action now. When it does come time to replace it, consider removing it here, installing point-of-use on-demand water heaters in bathrooms and install a hybrid heat pump water heater in the kitchen.

Do you have water-efficient faucets and toilets? Yes

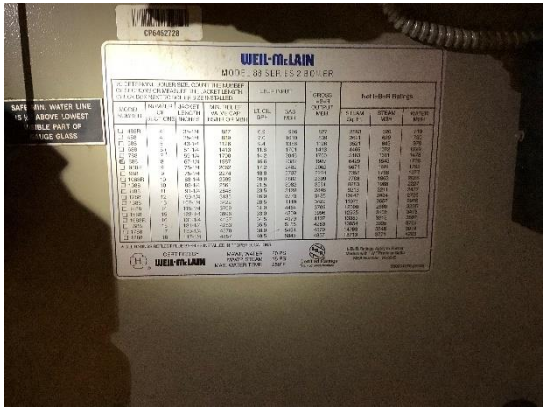
Water is another scarce resource that is often taken for granted but should be part of your environmental stewardship. There is also an energy connection: it takes considerable amounts of energy to pump the water, treat it, send it to you, then treat the wastewater. Reducing water use also reduces this energy. Many faucet aerators are 2.2 gallons per minute (gpm) when 0.5 gpm is sufficient for restrooms, 1.5 gpm for kitchens; faucet aerators are inexpensive and easy to install.

Toilets use 1.6 gallons per flush (gpf), or more (5+ gpf) if the toilet is old (before 1992). Given the higher gpf needed to flush defecation, and that the ratio of urination to defection of about 6:1, it means that for 6 out of 7 flushes more water is used than needed. Dual-flush converters are less than $20 and are easy to install. Each involves an environmental stewardship practice readily followed at work, homes, schools, day care centers and so on.

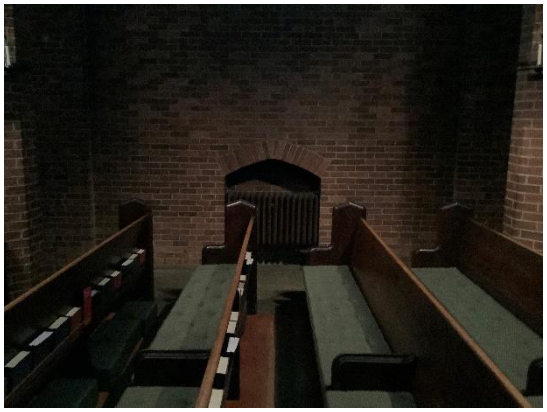
These are easy projects that members and volunteers can do on a work day. When replacing fixtures, look for the *Water Sense* logo, the water equivalent of the *Energy Star* label. (See https://www.epa.gov/watersense for more information.) Also see MassIPL's Everyday Environmental Stewardship brief on *Sinks and Toilets*.

Evaluation
No issues with toilets or sinks were identified.

HVAC Photos



H1 — The main heat source is a Weil-McLain steam boiler



H2 – Radiators like this one in the Sanctuary are common in the building.

H3 – The undercroft tunnels provide another path for heat to be distributed to the Sanctuary via the grates in the floor in Photo H4. The high temperature in these tunnels indicates how inefficient this system is.

H4 – Hot air grates in the Sanctuary floor bring warm air up from undercroft tunnels.

H5 – Heat pump for the main office.

H6 – Heat pump for the Rector's office.

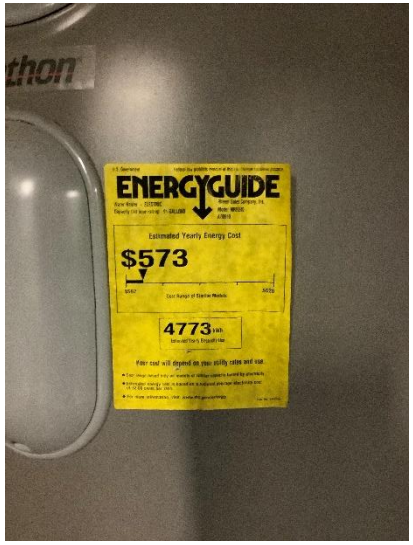
HVAC Photos (cont.)

H7 — "Mystery" heat pump that isn't known what areas it serves.

H8 For heat pumps, it is likely additional electric capacity will need to be added to this 200 amp panel and the 125 amp panel in H9.

H9 – 125 amp electric panel

H10 – This 91 gallon hot water heater serves the entire building.



H11 – While electric tank water heaters are not the most efficient, you installed one of the most efficient models of its type and size. Congratulations!

Appendices

Appendix A — Utility Use & Cost 2018>2020

SUMMARY OF UTILITY USE & COST

Parish of the Epiphany, 70 Church Street, Winchester, MA

insert Sq Ft. here: **21,000** *square feet*

		ELECTRICITY		Cooling	GAS		Heating	OIL		PROPANE		WATER & SEWER	
YEAR	TOTAL	$s	KWH	Degree Days	$s	THERMS	Degree Days	$s	GALLONS	$s	GALLONS	$s	VOLUME
2018	**$36,495**	$16,267	66,720	1,538	$17,719	18,554	4,864	$0	0.0	$0	0.0	$2,509	388
CO 2 lbs	*264,453*		*47,371*			*217,082*			*0*		*0*		
% of prior year	*111%*		*103%*			*113%*			*#DIV/0!*		*#DIV/0!*		
kBTU per SF	**99.2**												
% prior year	**114.3%**	117.7%	102.8%	121.4%	104.1%	112.8%	102.2%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	232.4%	225.6%
2019	**$29,942**	$16,909	69,080	1,413	$11,623	9,574	4,690	$0	0.0	$0	0.0	$1,410	236
CO 2 lbs	*161,063*		*49,047*			*112,016*			*0*		*0*		
% of prior year	*61%*		*104%*			*52%*			*#DIV/0!*		*#DIV/0!*		
kBTU per SF	**56.8**												
% prior year	**82.0%**	103.9%	103.5%	91.9%	65.6%	51.6%	96.4%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	56.2%	60.8%
2020	**$37,640**	$11,942	47,560	1,655	$24,177	22,147	4,040	$0	0.0	$0	0.0	$1,522	192
CO 2 lbs	*292,888*		*33,768*			*259,120*			*0*		*0*		
% of prior year	*182%*		*69%*			*231%*			*#DIV/0!*		*#DIV/0!*		
kBTU per SF	**113.2**	$0.57	2		$1.15	1		$0.00	0	$0.00	0	$0.07	0.0
% prior year	**125.7%**	70.6%	68.8%	117.1%	208.0%	231.3%	86.1%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	107.9%	81.4%
2021	**$32,377**	$12,267	46,320	1,542	$19,347	16,341	4,081	$0	0.0	$0	0.0	$763	92
CO 2 lbs	*224,077*		*32,887*			*191,190*			*0*		*0*		
% of prior year	*77%*		*97%*			*74%*			*#DIV/0!*		*#DIV/0!*		
kBTU per SF	**85.3**	$0.58	2		$0.92	1		$0.00	0	$0.00	0	$0.04	0.0
% prior year	**86.0%**	102.7%	97.4%	93.2%	80.0%	73.8%	101.0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	50.1%	47.9%
CO2 lbs 2018	**264,453**		**47,371**			**217,082**			**0**		**0**		
kBTU per SF for 2018	**99.2**	**The US Energy Information Administration calculates that the average house of worship in cold/very cold climate zones uses 42.6 kBTU per square foot per year. Is your house of worship better or worse than average?**											

ELECTRICITY USE

Parish of the Epiphany, 70 Church Street, Winchester, MA

Provider Eversource

Meter # **Rate** **Serves>**

Account # 568 036 1000

Year	Bill Month	$s	% of prior year $s	kWh	$/kWh	% of prior year kWh	Cooling Degree Days	% of prior year DD
2018	January	$1,348.21	121.6%	5,840	$0.231	101.4%	0	#DIV/0!
	February	$1,233.70	104.8%	5,160	$0.239	90.8%	0	#DIV/0!
	March	$1,197.18	115.5%	4,880	$0.245	97.6%	0	#DIV/0!
	April	$1,382.54	123.5%	5,640	$0.245	104.4%	1	2.08%
	May	$1,177.66	93.5%	4,800	$0.245	78.9%	142	273.08%
	June	$1,597.15	145.9%	6,520	$0.245	123.5%	209	78.87%
	July	$1,197.60	102.7%	4,880	$0.245	86.5%	466	136.26%
	August	$1,309.07	133.7%	5,320	$0.246	109.9%	463	165.95%
	September	$1,446.13	127.6%	5,880	$0.246	119.5%	216	105.37%
	October	$1,641.93	148.5%	6,680	$0.246	139.2%	40	54.79%
	November	$1,299.28	92.9%	5,280	$0.246	86.8%	1	33.33%
	December	$1,436.35	115.6%	5,840	$0.246	108.1%	0	#DIV/0!
		$16,266.80	117.7%	66,720	$0.244	102.8%	1,538	121.39%
2019	January	$1,464.66	108.6%	5,960	$0.246	102.1%	0	#DIV/0!
	February	$1,445.14	117.1%	5,920	$0.244	114.7%	0	#DIV/0!
	March	$1,153.63	96.4%	4,720	$0.244	96.7%	0	#DIV/0!
	April	$1,464.58	105.9%	6,000	$0.244	106.4%	20	2000.00%
	May	$1,338.26	113.6%	5,480	$0.244	114.2%	45	31.69%
	June	$1,377.12	86.2%	5,640	$0.244	86.5%	241	115.31%
	July	$1,290.22	107.7%	5,280	$0.244	108.2%	523	112.23%
	August	$1,402.51	107.1%	5,720	$0.245	107.5%	396	85.53%
	September	$1,431.82	99.0%	5,840	$0.245	99.3%	166	76.85%
	October	$1,549.33	94.4%	6,320	$0.245	94.6%	22	55.00%
	November	$1,481.00	114.0%	6,040	$0.245	114.4%	0	0.00%
	December	$1,510.29	105.1%	6,160	$0.245	105.5%	0	#DIV/0!
		$16,908.56	103.9%	69,080	$0.245	103.5%	1,413	91.87%

ELECTRICITY USE

Parish of the Epiphany, 70 Church Street, Winchester, MA

Provider Eversource

Meter # **Rate** **Serves>**

Account # 568 036 1000

Year	Bill Month	$s	% of prior year $s	kWh	$/kWh	% of prior year kWh	Cooling Degree Days	% of prior year DD
2020	January	$1,381.27	94.3%	5,560	$0.248	93.3%	0	#DIV/0!
	February	$1,334.24	92.3%	5,360	$0.249	90.5%	0	#DIV/0!
	March	$1,245.10	107.9%	5,000	$0.249	105.9%	0	#DIV/0!
	April	$888.53	60.7%	3,560	$0.250	59.3%	0	0.00%
	May	$680.53	50.9%	2,720	$0.250	49.6%	85	188.89%
	June	$690.44	50.1%	2,760	$0.250	48.9%	320	132.78%
	July	$930.97	72.2%	3,720	$0.250	70.5%	530	101.34%
	August	$1,050.94	74.9%	4,120	$0.255	72.0%	459	115.91%
	September	$1,022.94	71.4%	4,040	$0.253	69.2%	214	128.92%
	October	$1,032.98	66.7%	4,080	$0.253	64.6%	30	136.36%
	November	$962.59	65.0%	3,800	$0.253	62.9%	17	#DIV/0!
	December	$721.17	47.8%	2,840	$0.254	46.1%	0	#DIV/0!
		$11,941.70	70.6%	47,560	$0.251	68.8%	1,655	117.13%
2021	January	$611.80	44.3%	2,400	$0.255	43.2%	0	#DIV/0!
	February	$787.95	59.1%	3,040	$0.259	56.7%	0	#DIV/0!
	March	$705.76	56.7%	2,720	$0.259	54.4%	2	#DIV/0!
	April	$1,069.38	120.4%	4,120	$0.260	115.7%	1	#DIV/0!
	May	$1,106.75	162.6%	4,120	$0.269	151.5%	101	118.82%
	June	$1,010.64	146.4%	3,760	$0.269	136.2%	377	117.81%
	July	$1,372.66	147.4%	5,120	$0.268	137.6%	331	62.45%
	August	$1,448.28	137.8%	5,440	$0.266	132.0%	464	101.09%
	September	$1,437.68	140.5%	5,400	$0.266	133.7%	214	100.00%
	October	$1,554.24	150.5%	5,840	$0.266	143.1%	51	170.00%
	November	$1,162.15	120.7%	4,360	$0.267	114.7%	1	5.88%
	December		0.0%		#DIV/0!	0.0%	0	0.00%
		$12,267.29	102.7%	46,320	$0.265	97.4%	1,542	93.17%

GAS USE

Parish of the Epiphany, 70 Church Street, Winchester, MA

Provider National Grid **Serves>**

Meter #

Account # 15018-15520

Year	Bill Date	$s	% of prior year $s	Therms	$/therm	% of prior year therms	Heating Degree Days	% of prior year DD
2018	January	$5,453.42	187.5%	4,900.0	$1.11	154.4%	1,073	124.6%
	February	$4,101.86	134.4%	3,297.0	$1.24	104.8%	685	93.7%
	March	$4,294.44	168.5%	3,058.0	$1.40	118.5%	752	87.5%
	April	$3,323.76	186.1%	2,318.0	$1.43	129.6%	472	160.5%
	May	$370.01	88.7%	307.0	$1.21	71.1%	71	37.4%
	June	$110.70	68.0%	1.0	$110.70	1.2%	16	76.2%
	July	$96.66	75.5%	0.0	#DIV/0!	0.0%	0	
	August	$94.04	87.9%	1.0	$94.04	5.3%	0	
	September	$104.04	93.5%	1.0	$104.04	4.8%	35	125.0%
	October	$439.95	325.6%	471.0	$0.93	1046.7%	331	258.6%
	November	$2,186.41	106.5%	2,041.0	$1.07	107.5%	618	105.5%
	December	$2,596.84	71.9%	2,159.0	$1.20	66.8%	811	76.6%
		$23,172.13	136.2%	18,554	$1.25	112.8%	4,864	102.2%
2019	January	$168.73	3.1%	20.0	$8.44	0.4%	1,013	94.4%
	February	$121.97	3.0%	1.0	$121.97	0.0%	822	120.0%
	March	$1,191.64	27.7%	928.0	$1.28	30.3%	750	99.7%
	April	$1,843.09	55.5%	1,497.0	$1.23	64.6%	330	69.9%
	May	$824.37	222.8%	708.0	$1.16	230.6%	155	218.3%
	June	$222.40	200.9%	101.0	$2.20	10100.0%	6	37.5%
	July	$145.70	150.7%	24.0	$6.07	#DIV/0!	0	
	August	$143.77	152.9%	22.0	$6.54	2200.0%	0	
	September	$158.84	152.7%	25.0	$6.35	2500.0%	18	51.4%
	October	$695.22	158.0%	678.0	$1.03	143.9%	173	52.3%
	November	$2,303.17	105.3%	2,115.0	$1.09	103.6%	611	98.9%
	December	$3,804.22	146.5%	3,455.0	$1.10	160.0%	812	100.1%
		$11,623.12	50.2%	9,574	$1.21	51.6%	4,690	96.4%

GAS USE

Parish of the Epiphany, 70 Church Street, Winchester, MA

Provider National Grid **Serves>**

Meter #

Account # 15018-15520

Year	Bill Date	$s	% of prior year $s	Therms	$/therm	% of prior year therms	Heating Degree Days	% of prior year DD
2020	January	$4,352.19	2579.4%	3,950.0	$1.10	19750.0%	778	76.8%
	February	$3,882.96	3183.5%	3,525.0	$1.10	352500.0%	728	88.6%
	March	$3,137.60	263.3%	2,829.0	$1.11	304.8%	542	72.3%
	April	$2,908.73	157.8%	2,618.0	$1.11	174.9%	450	136.4%
	May	$1,966.10	238.5%	2,085.0	$0.94	294.5%	149	96.1%
	June	$155.25	69.8%	22.0	$7.06	21.8%	10	166.7%
	July	$140.01	96.1%	20.0	$7.00	83.3%	0	#DIV/0!
	August	$148.87	103.5%	21.0	$7.09	95.5%	0	#DIV/0!
	September	$130.74	82.3%	19.0	$6.88	76.0%	39	216.7%
	October	$1,211.35	174.2%	1,462.0	$0.83	215.6%	193	111.6%
	November	$2,726.72	118.4%	2,570.0	$1.06	121.5%	391	64.0%
	December	$3,416.44	89.8%	3,026.0	$1.13	87.6%	760	93.6%
		$24,176.96	208.0%	22,147	$1.09	231.3%	4,040	86.1%
2021	January	$4,591.54	105.5%	4,082.0	$1.12	103.3%	907	116.6%
	February	$4,076.83	105.0%	3,640.0	$1.12	103.3%	830	114.0%
	March	$3,440.21	109.6%	3,044.0	$1.13	107.6%	595	109.8%
	April	$2,962.45	101.8%	2,590.0	$1.14	98.9%	322	71.6%
	May	$340.81	17.3%	247.0	$1.38	11.8%	107	71.8%
	June	$138.07	88.9%	20.0	$6.90	90.9%	1	10.0%
	July	$160.64	114.7%	22.0	$7.30	110.0%	3	#DIV/0!
	August	$133.92	90.0%	20.0	$6.70	95.2%	0	#DIV/0!
	September	$139.45	106.7%	20.0	$6.97	105.3%	8	20.5%
	October	$690.96	57.0%	597.0	$1.16	40.8%	115	59.6%
	November	$2,672.52	98.0%	2,059.0	$1.30	80.1%	511	130.7%
	December		0.0%		#DIV/0!	0.0%	682	89.7%
		$19,347.40	80.0%	16,341	$1.18	73.8%	4,081	101.0%

WATER & SEWER USE

Parish of the Epiphany, 70 Church Street, Winchester, MA

Provider
Meter # **Serves>**
Account #

Year	Bill Date	$s	% $s of prior year	Units	$/unit	% of prior year volume
2018	January		#DIV/0!		#DIV/0!	#DIV/0!
	February	$360.28	137.27%	56	$6.43	133.33%
	March		#DIV/0!		#DIV/0!	#DIV/0!
	April		#DIV/0!		#DIV/0!	#DIV/0!
	May	$292.73	102.00%	46	$6.36	100.00%
	June		#DIV/0!		#DIV/0!	#DIV/0!
	July		#DIV/0!		#DIV/0!	#DIV/0!
	August	$1,170.89	220.75%	178	$6.58	211.90%
	September		#DIV/0!		#DIV/0!	#DIV/0!
	October		#DIV/0!		#DIV/0!	#DIV/0!
	November	$685.54	#DIV/0!	108	$6.35	#DIV/0!
	December		#DIV/0!		#DIV/0!	#DIV/0!
		$2,509.44	232.39%	388.0	$6.47	225.58%
2019	January		#DIV/0!		#DIV/0!	#DIV/0!
	February	$397.81	110.42%	62	$6.42	110.71%
	March		#DIV/0!		#DIV/0!	#DIV/0!
	April		#DIV/0!		#DIV/0!	#DIV/0!
	May	$267.45	91.36%	62	$4.31	134.78%
	June		#DIV/0!		#DIV/0!	#DIV/0!
	July		#DIV/0!		#DIV/0!	#DIV/0!
	August	$333.75	28.50%	50	$6.68	28.09%
	September		#DIV/0!		#DIV/0!	#DIV/0!
	October		#DIV/0!		#DIV/0!	#DIV/0!
	November	$411.40	60.01%	62	$6.64	57.41%
	December		#DIV/0!		#DIV/0!	#DIV/0!
		$1,410.41	56.20%	236.0	$5.98	60.82%

WATER & SEWER USE

Parish of the Epiphany, 70 Church Street, Winchester, MA

Provider
Meter # **Serves>**
Account #

Year	Bill Date	$s	% $s of prior year	Units	$/unit	% of prior year volume
2020	January		#DIV/0!		#DIV/0!	#DIV/0!
	February	$515.05	129.47%	78	$6.60	125.81%
	March		#DIV/0!		#DIV/0!	#DIV/0!
	April		#DIV/0!		#DIV/0!	#DIV/0!
	May	$263.00	98.34%	28	$9.39	45.16%
	June		#DIV/0!		#DIV/0!	#DIV/0!
	July		#DIV/0!		#DIV/0!	#DIV/0!
	August	$408.00	122.25%	48	$8.50	96.00%
	September		#DIV/0!		#DIV/0!	#DIV/0!
	October		#DIV/0!		#DIV/0!	#DIV/0!
	November	$335.50	81.55%	38	$8.83	61.29%
	December		#DIV/0!		#DIV/0!	#DIV/0!
		$1,521.55	107.88%	192.0	$7.92	81.36%
2021	January		#DIV/0!		#DIV/0!	#DIV/0!
	February	$219.50	42.62%	22	$9.98	28.21%
	March		#DIV/0!		#DIV/0!	#DIV/0!
	April		#DIV/0!		#DIV/0!	#DIV/0!
	May	$169.30	64.37%	28	$6.05	100.00%
	June		#DIV/0!		#DIV/0!	#DIV/0!
	July		#DIV/0!		#DIV/0!	#DIV/0!
	August	$373.74	91.60%	42	$8.90	87.50%
	September		#DIV/0!		#DIV/0!	#DIV/0!
	October		#DIV/0!		#DIV/0!	#DIV/0!
	November		0.00%		#DIV/0!	0.00%
	December		#DIV/0!		#DIV/0!	#DIV/0!
		$762.54	50.12%	92.0	$8.29	47.92%

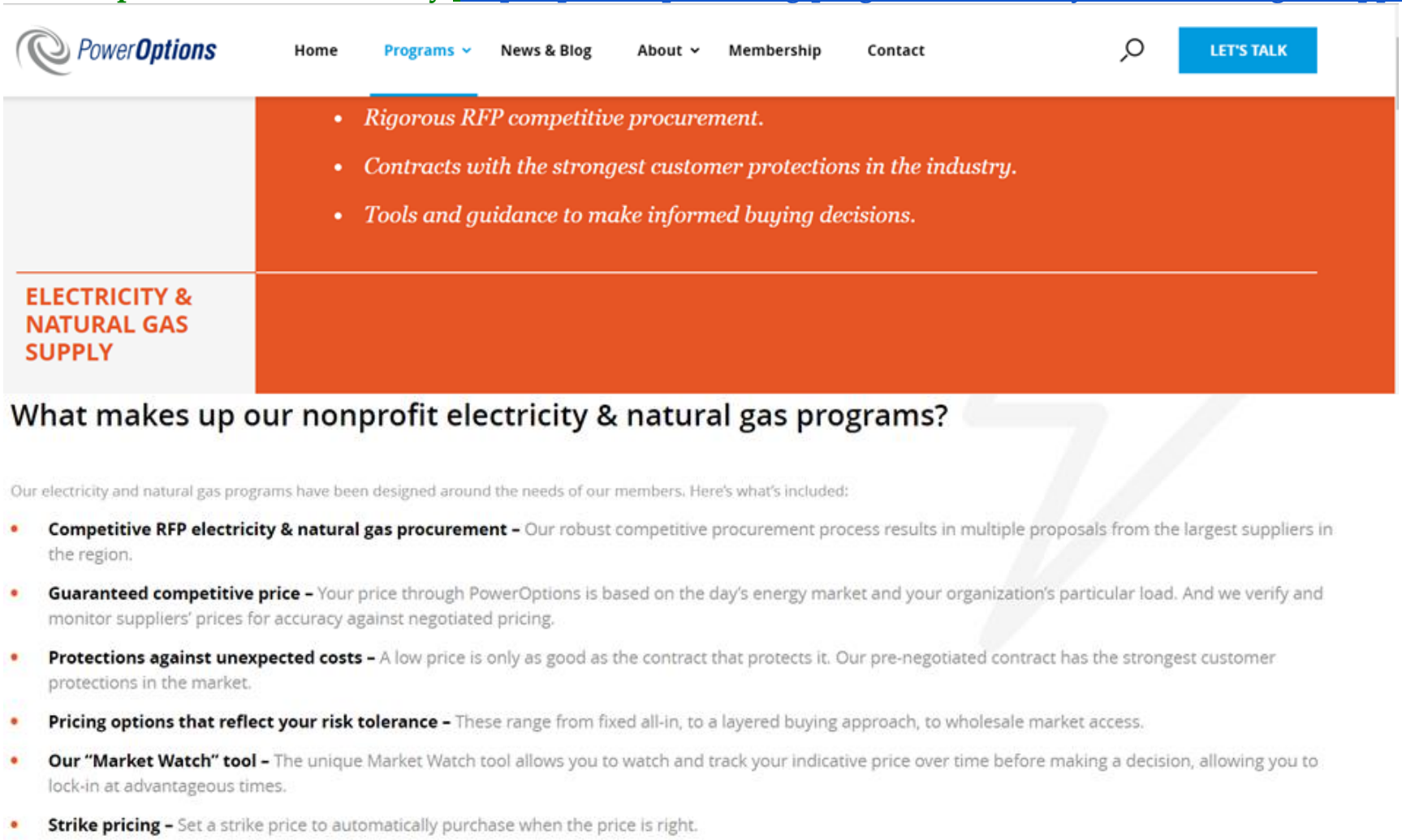
Appendix B — Space Use

Epiphany, Winchester/MA *Space Use by Day of Week*								
SPACE	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**NOTES**
Office and Main Office								Mini split heat pumps already installed in some offices (Lee to identify which) however they are approx 10 years old.
Morning	7:00 - 12:00	7:00 - 12:00	7:00 - 12:00	7:00 - 12:00	7:00 - 12:00	7:00 - 12:00	7:00 - 12:00	
Afternoon	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	
Evening	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Upstairs Offices								
Morning	8:00 - 12:00	8:00 - 12:00	8:00 - 12:00	8:00 - 12:00	8:00 - 12:00	8:00 - 12:00	8:00 - 12:00	
Afternoon	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	12:00 - 5:00	
Evening	n/a	n/a	n/a	n/a	n/a	n/a	n/a	In addtion to calendar used 3x/week various days
Chapel/ Sproat/Dewer Room								
Morning	8:00 - 12:00	n/a	n/a	8:00 - 11:00	n/a	n/a	n/a	
Afternoon	12:00 - 2:00	n/a	n/a	n/a	n/a	n/a	n/a	
Evening	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Hadley Hall								
Morning	8:00 -12:00	n/a	n/a	n/a	11:00 - 12:00	n/a	9-12 1x/mo	
Afternoon	12:00 - 5:00	n/a	1-3 1x/mo	n/a	12:00 - 1:00	n/a	12-5 1x/mo	
Evening	n/a	6:00 - 9:00	6-9pm 1x/mo	6:00 - 9:00	n/a	n/a	6-9 2x/mo	
Downstairs Classrooms								
Morning	8:00 - 12:00	n/a	n/a	n/a	n/a	8:00 - 11:00	n/a	
Afternoon	12:00 - 3:00	n/a	n/a	n/a	n/a	n/a	n/a	
Evening	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Old Parish Hall								
Morning	8:00 - 12:00	n/a	n/a	n/a	n/a	8:00 - 11:00	n/a	
Afternoon	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Evening	n/a	n/a	n/a	5-9pm 2x/mo	7:00 - 10:00	n/a	n/a	
Sanctuary								
Morning	4:00 - 12:00	When not in use, the Sanctuary needs to be keps at a mimimum heat (approx 60 degrtees F) at all times to protect the organ					8-12pm 1x/mo	
Afternoon	12:00 - 1:00						n/a	"
Evening	4-8pm 1x/mo	n/a	n/a	5-9pm 1x/mo	n/a	n/a	n/a	"
Rectory								
Morning	5:00-12:00	5:00-12:00	5:00-12:00	5:00-12:00	5:00-12:00	5:00-12:00	5:00-12:00	
Afternoon	12:00-5:00	12:00-5:00	12:00-5:00	12:00-5:00	12:00-5:00	12:00-5:00	12:00-5:00	
Evening	5:00-12:00	5:00-12:00	5:00-12:00	5:00-12:00	5:00-12:00	5:00-12:00	5:00-12:00	
Garrett Room								
Morning	8:00 - 12:00	n/a	n/a	n/a	n/a	n/a	n/a	
Afternoon	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Evening	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Appendix C — Bulk Purchase

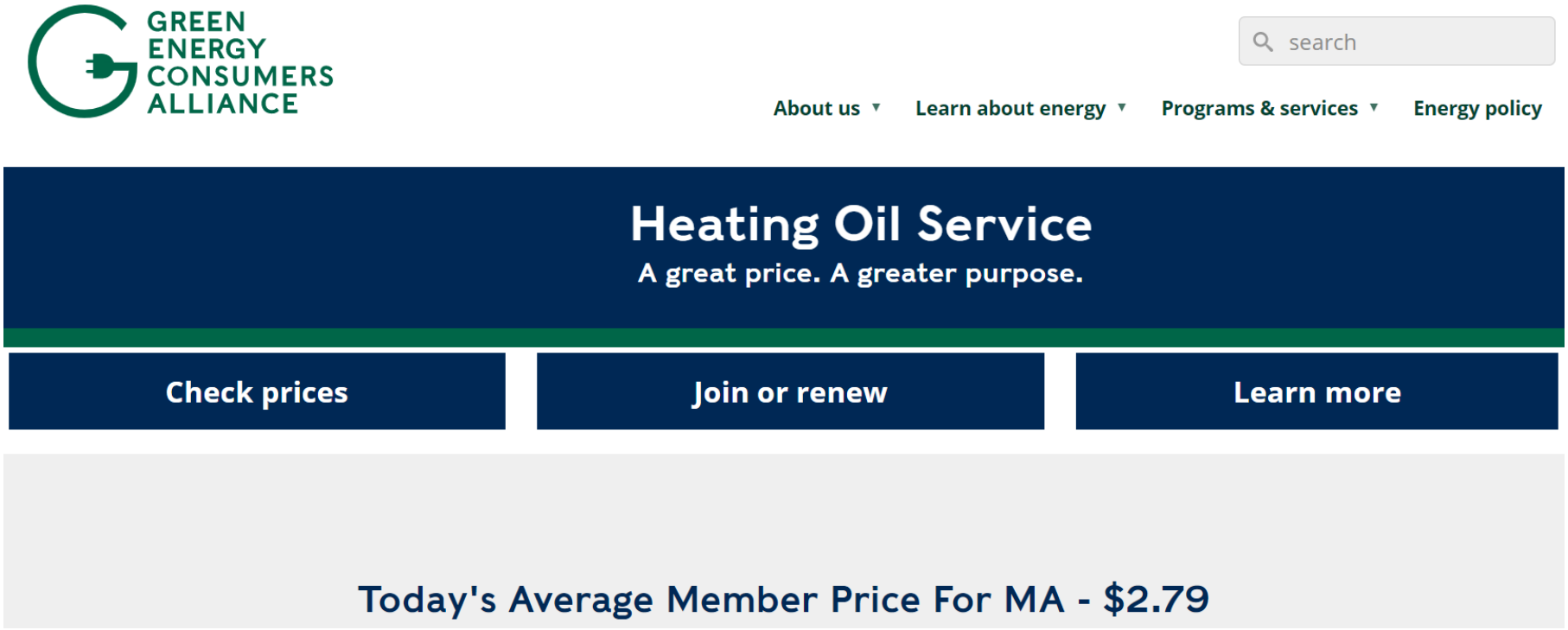
PowerOptions Gas & Electricity https://poweroptions.org/programs/electricity-and-natural-gas-supply/



Appendix C — Bulk Purchase

Green Energy Consumers Alliance

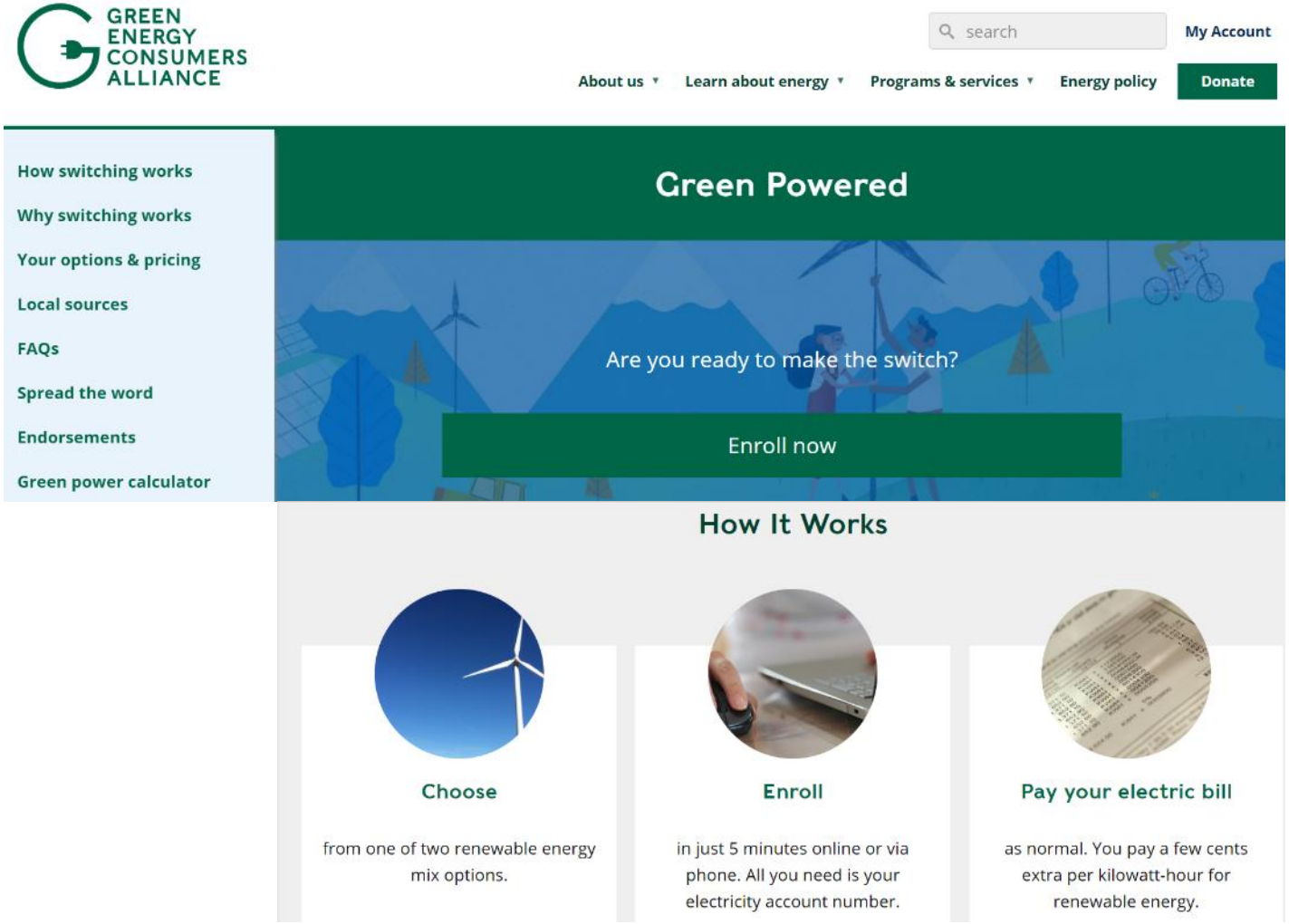
https://www.greenenergyconsumers.org/heatingoil



(Price as of September 2021. Check the web site above for current pricing.)

Appendix D — Green Electricity

Massachusetts Clean Energy Consumers Alliance
https://www.greenenergyconsumers.org/greenpowered



Check the site listed above for current pricing.

Appendix D – Green Electricity: Community Solar

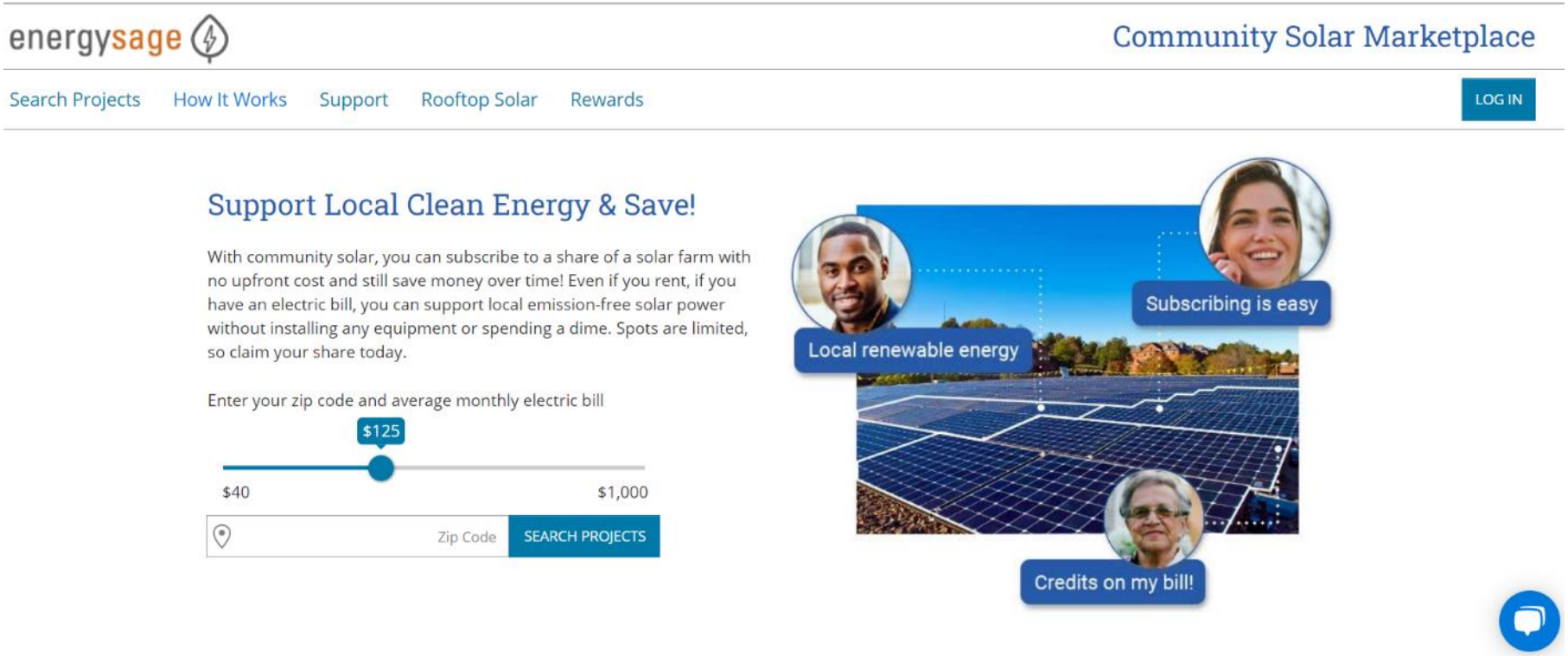
https://hampshirepower.com/

Faith Communities Meet Community Solar

Hampshire Power and Massachusetts Interfaith Power & Light are bringing the green economy to low-income communities for a more equitable, cleaner grid in the Commonwealth.

Contact: Stephen Condon, stephen@hampshirepower.com, 603-583-0228

https://communitysolar.energysage.com/



Appendix E — Efficiency Budget

As the example below illustrates, if you make no changes, you can expect energy costs to increase at least at the rate of inflation; here we have assumed 3%. If you take some actions, for example beginning with the simple, behavioral actions such as lowering the thermostat, turning off lights, signing up for bulk purchase of gas or electricity. The savings from those actions fund the Energy Efficiency budget line and provides funds in Year 2 for more extensive actions that in turn generate more savings for year 3 for more actions. Continue this process until you have achieved Net Zero carbon emissions then use the ongoing savings to fund your mission!

Illustrative **EFFICIENCY BUDGET**

	2021	% of Total	2022	% of Total	2023	% of Total	2024	% of Total
TOTAL Budget 3% inflation	**$23,600**		**$24,308**		**$25,037**		**$25,788**	
Electricity	$8,700	36.9%	$7,395	30.4%	$6,286	25.1%	$6,411	24.9%
Gas	$12,300	52.1%	$10,455	43.0%	$8,364	33.4%	$8,029	31.1%
Water & Sewer	$2,600	11.0%	$1,820	7.5%	$1,638	6.5%	$1,671	6.5%
Efficiency Budget $s saved	*$0*	0.0%	*$4,638*	19.1%	*$8,749*	34.9%	*$9,677*	37.5%
Actions for Saving$	*Low-Hanging Fruit* Behavior changes		LED lighting Smart Stats Boiler Outdoor Reset 0.8 gpf Flush Toilets 0.35 gpm aerators		On-Demand DHW Heating zones		Hire ME to plan heating & cooling system upgrade *Efficiency Budget $s to pay HVAC loan*	