MASSACHUSETTS
INTERFAITH POWER & LIGHT
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Christ Church United, Lowell

This is a summary of observations and recommendations of a site visit on Tuesday, November 6, 2007, by Thomas E. Nutt-Powell, for MIP&L. The visit was prompted by a request to assess environmental stewardship options for the facility, and the larger community. Photos of observed conditions follow the text. Available utility use and cost information follows the photos. It is important to make use of gas and electric company financial incentives when making energy upgrades.

UTILITY USE & COST

Information was available only for oil. Oil cost estimated for 2007 is about 31% higher than for 2006. Use is estimated to be up only 11%. The estimated cost for oil in 2007 is almost $25,000, for about 10,000 gallons. The volume and cost of utility use is fertile grounds for improved environmental stewardship. Use for heating (oil or gas) should vary in direct relation to heating *Degree Days*. The % change at the end of the year should be about the same. If your use % is higher, it indicates increasing inefficiency.

Using the MIP&L *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.

HEATING and DOMESTIC HOT WATER

Generation Equipment

The building has the following equipment:

- Boiler — Oil-fired steam boiler by Burnham installed in 2001. It has an efficiency estimated at 75%±. (See photo #1.) There is a condensate return tank and pump. A fan-assisted combustion air system was also installed. (See photo #3.)
- Domestic Hot Water — There are two DHW tanks. The larger (75 gallons) is gas-fired , and is located next to and serves the kitchen; it was installed in 1995. The smaller (40 gallon) is electric, and serves the rest of the building; it was installed in 2000. (See photos #4 and 5.) Generation efficiency for DHW tanks is 65%±. Use efficiency is even less, given how few hours the building is occupied in whole or in part.

In-Space Equipment

All of the building is heated by steam radiators. (See photos #5, 10 and 11.) There are two (2) zones, with digital thermostats controlling valves. (See photo #2.)

1. Sanctuary, which also controls the basement space under the Sanctuary including Room 2. (See photo #5.)

2. Rest of building, with thermostat in the large hall.

Recommendations

The recommendations focus on heating. If installation of air conditioning is also an option, then use of geo-thermal should be seriously considered. [*Note*: Implementation of these recommendations is sensibly based on retaining the services of a Mechanical Engineering firm with significant experience in (a) energy upgrades and (b) working with the community of faith.]

Best Overall Outcome — All Hydronic Heating

Convert the entire building to hydronic heating, with zones matching use patterns. This can be done in **phases**, as set forth below. The timing is a function of funds availability. Given heating costs, it is likely that there will be significant savings that can be allocated to repay any debt incurred.

Thermostats

Convert all thermostats to those with an "adaptive recovery" feature. This senses how long it takes to reach the desired temperature, and starts the system "just in time". This is much better than humans guessing! See MIP&L's *Everyday Environmental Stewardship* brief on thermostats.

Radiation

Where possible use an in-floor radiant solution, which gets heat evenly through the room. This is an especially good solution for basement spaces, and for spaces with under floor access. (See photos #5 to 8.) Regardless, use high-efficiency radiation for all upgrades.

Phase 1

- Install interior "storm" windows for all locations. Priority sequence is most to least used spaces. If window is not operable, make installation year-round. (See photo #10.)
- Add insulation where possible. (See photo #14.)
- Install primary controls for all boilers to provide operation in relation to outside temperature, and other applicable contemporary standards.
- Install at least two (2) direct vent condensing mode 93% efficient gas-fired boilers sized to serve Phase 1 spaces and DHW. Using two boilers ensures that heat is always present, even if one boiler fails. Rotating the boiler start sequence also extends the Estimated Useful Life ("EUL") of each boiler. Having at least two boilers also means that the equipment selected is residential scale, which is a cost and maintenance control option. It also permits addition of more such boilers as funds available for conversion from steam to hot water in future phases.
- Install hot water heat for the Basement rental space.
- Install hot water heat for the office, the 1st floor rest rooms, and two chapels of the Parish House.
- Zone each space separately.
- Install one in-direct fired DHW tank, fired by the new high-efficiency boilers. An option is having one of the new boilers have an on-board on-demand DHW generation capacity.

The existing oil-fired boiler remains in place, serving only the remaining locations still on steam heat.

Phase 2

- Install additional direct vent condensing mode 93% efficient gas-fired boilers sized for Phase 2 spaces.
- Likely sequence of Phase 2 spaces is the set of occupied spaces in the basement, 1st and 2nd floors in the connection between the hall and the Sanctuary. The large basement kitchen would be included if resolution achieved on its use (type and frequency).

The existing oil-fired boiler remains in place, serving only the remaining locations still on steam heat.

Phase 3

- Install additional direct vent condensing mode 93% efficient gas-fired boilers sized for Phase 3 spaces.
- Phase 3 would include all spaces not completed in Phases 1 and 2. The Sanctuary is the largest in terms of heat load demand.

The existing oil-fired boiler is removed.

LIGHTING and ELECTRICITY

Observations

Electricity is costly, and is a significant cause of environmental pollution. The facility uses incandescent lamping and bulbs in many areas, though significant efforts have been made to use CFL bulbs.

Recommendations

1. Begin a systematic upgrade so that all fixtures use energy efficient bulbs. Good high-efficiency bulbs are available for all applications, including spots, floods and dimmable. This can be financially assisted in large part by the electric company.
2. See the MIP&L web site for a guide for CFLs (compact florescent lights). Contemporary equipment meets a broad range of uses, including dimmables.

COMMUNITY STEWARDSHIP

Concurrent with the work on the energy use of the facility, the congregation can engage in efforts to help others in the community of faith, and the broader Lowell community, know what is possible in the way of environmental stewardship. Among the activities is sponsoring a **Global Warming Café**. A *GWC* is a friendly gathering at which the issues of global warming are presented, a method provided on how to calculate one's own carbon footprint, and means offered on how to reduce one's environmental impact. MIP&L has a package available that helps individuals and congregations host a GWC.

#1 — Oil-fired steam boiler was (efficiency 75%±) installed in 2001. Steam is less efficient given need to heat to 212° regardless of outside temperature. Steam is less readily zoned. Convert to higher efficiency solution, with geo-thermal an option, especially if AC is in the mix for future.

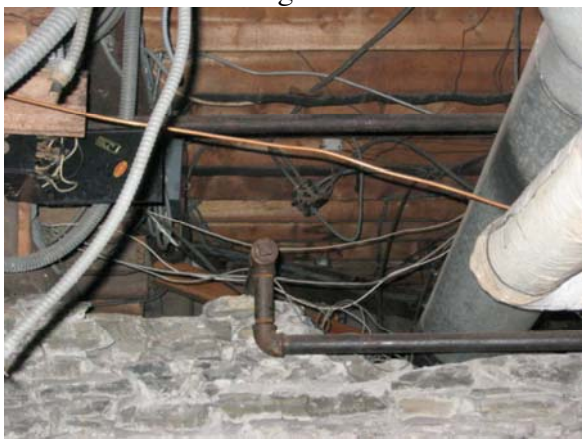
#2 — There are only two zones for heating, each with a valve controlled by in-space digital thermostats.

#3 — The atmospheric boiler required addition of fan-aided combustion make-up air, seen here wall mounted.

#4 (above) and #5 (below) — There are two DHW tanks — 40 gal electric and 75 gal gas. Efficiency is 65%±. Replace with one in-direct fired tank served by an efficient (93%) gas-fired boiler. This is part of a phased program of conversion to more efficient hydronic heating using high efficiency boilers, contemporary controls and zones matching use patterns.

#5 — The sanctuary has steam radiation, both wall and via in-floor convection radiation with return air ducts.

#6 — The radiator in the metal box is fed by the steam lines. Warm air moves upward, aided by cooler air returning through the duct system. The sanctuary can be converted to hydronic heating using in-floor radiation. Then insulate foundation and ceiling.



#7 — On conversion of heating, ensure electrical system in proper condition. Address obvious wiring problems now.

#8 — The basement space in the Parish House is to be rented. As the most used space, this is the first in line for energy upgrades. In-floor radiant is especially efficient in these locations. Lower ceilings to reduce CF of space needed to be heated.

#9 — Use of spaces such as the large hall will dictate modifications in heating. This space could be 2 levels, and multiple rooms.

#10 — 2nd floor music room is typical of smaller spaces with steam radiators. Install interior "storm" windows as low cost, high yield action.

#11 — Hall from sanctuary to/through parish house. Continue upgrade to CFL bulbs. Upgrade all lighting fixtures, with electric company audit and $s. Old steam pipes are possible conduits for new hydronic pipes. Insulate. Keep doors closed to heated spaces to maximize efficiency and occupant comfort.

#12 — There are several specialized spaces (such as this large kitchen) for which future use needs to be determined. Use *EnergyStar* equipment always. Visit www.energystar.gov for information on best efficiency for appliances and equipment.

#13 — The 1st and 2nd floor chapels are examples of existing spaces sensibly zoned separately.

#14 — Insulate where possible. This is the closet in the music room. Thermal separation of conditioned spaces from "outdoors" is basic to good efficiency.

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 OF UTILITY USE & COST

Christ Church United, Lowell

YEAR	TOTAL	ELECTRICITY $s	ELECTRICITY KWH	Cooling Degree Days	GAS $s	GAS THERMS	Heating Degree Days	OIL $s	OIL GALLONS	WATER & SEWER $s	WATER & SEWER VOLUME
2005	**$23,577**	$0	0	2,143	$0	0	3,478	$23,577	11939.2	$0	0
2006	**$18,892**	$0	0	2,111	$0	0	2,703	$18,892	8152.1	$0	0
% prior year	**80.1%**	#DIV/0!	#DIV/0!	98.5%	#DIV/0!	#DIV/0!	77.7%	80.1%	68.3%	#DIV/0!	#DIV/0!
2007	**$24,741**	$0	0	2,356	$0	0	2,415	$24,741	10043.5875	$0	0
% prior year	**131.0%**	#DIV/0!	#DIV/0!	111.6%	#DIV/0!	#DIV/0!	89.3%	131.0%	123.2%	#DIV/0!	#DIV/0!
2008	**$0**	$0	0	0	$0	0	0	$0	0	$0	0
% prior year	**0.0%**	#DIV/0!	#DIV/0!	0.0%	#DIV/0!	#DIV/0!	0.0%	0.0%	0.0%	#DIV/0!	#DIV/0!

DD through ***October-07***

CO_2 lbs 2006	**182,607**	**0**	**0**	**182,607**	

Some of 2007 is estimated

It takes about 7 NE trees to offset 100 lbs of CO2

www.MIPandL.org

You are encouraged to visit MIP&L's web site for *Everyday Environmental Stewardship* **Briefs** to help implement good stewardship practices.

OIL USE

Christ Church United, Lowell

Provider Account # **Serves>**

Year	Start Date	$s	% change $s	Gallons	$/gallon	% change gal	Heating Degree Days	% change Degree Days
2005	January	$4,669.47		2,610.1	$1.79		868	
	February	$4,056.11		2,263.1	$1.79		661	
	March	$4,636.73		2,411.6	$1.92		604	
	April	$1,281.78		639.4	$2.00		173	
	May	$601.35		309.3	$1.94		110	
	June	$403.69		206.7	$1.95		5	
	July						0	
	August						0	
	September						0	
	October	$1,049.25		436.8	$2.40		96	
	November	$2,375.75		1,068.4	$2.22		269	
	December	$4,502.67		1,993.8	$2.26		692	
		$23,576.80		11,939.2	$1.97		3,478	
2006	January	$4,073.37	87.23%	1,708.4	$2.38	65.45%	568	65.44%
	February	$4,079.04	100.57%	1,762.3	$2.31	77.87%	667	100.91%
	March	$4,127.21	89.01%	1,772.1	$2.33	73.48%	502	83.11%
	April	$761.71	59.43%	319.3	$2.39	49.94%	178	102.89%
	May	$565.51	94.04%	224.5	$2.52	72.58%	66	60.00%
	June						0	0.00%
	July						0	
	August						0	
	September						2	
	October	$820.27	78.18%	381.7	$2.15	87.39%	88	91.67%
	November	$1,164.33	49.01%	531.9	$2.19	49.78%	199	73.98%
	December	$3,300.97	73.31%	1,451.9	$2.27	72.82%	433	62.57%
		$18,892.41	80.13%	8,152.1	$2.32	68.28%	2,703	77.72%
2007	January	$4,954.91	121.64%	2,262.2	$2.19	132.42%	687	120.95%
	February	$6,132.63	150.34%	2,795.4	$2.19	158.62%	801	120.09%
	March	$3,571.74	86.54%	1,484.2	$2.41	83.75%	538	107.17%
	April	$1,940.87	254.80%	790.0	$2.46	247.42%	327	183.71%
	May	$154.29	27.28%	63.0	$2.45	28.06%	33	50.00%
	June						0	
	July						0	
	August						0	
	September						0	
Estimated	*October*	*$350.95*	*42.78%*	*125.8*	*$2.79*	*32.95%*	29	32.95%
	November	*$2,312.43*	*198.61%*	*800.2*	*$2.89*	*150.43%*	0	0.00%
	December	*$5,323.61*	*161.27%*	*1,722.9*	*$3.09*	*118.66%*	0	0.00%
		$24,741.43	130.96%	10,043.6	$2.46	123.20%	2,415	89.35%