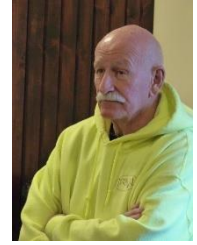


1. Church of the Redeemer, Rockport, ON

Several members of the Anglican Diocese of Ontario Green Group visited the above church in April, 2022 to learn about the infrared thermal heating equipment and its use during the winter. We were welcomed by Warren Stewart, one of the wardens; he also kindly provided detailed information after the visit.



The Church of the Redeemer is a relatively small church. The nave was built in 1895, while the subsequent 2004 additions consisted of an entry hall, a meeting/social room, and a bathroom. The only larger appliance is a small refrigerator.

The floor areas are as follows:

Nave and transept 567sqft = 52.6 m²

Presbytery/apse 187sqft = 17.4 m²

Narthex/entry 261sqft = 24.2 m²

Meeting room 377sqft = 35.0 m²

Bathroom 54sqft = 5.0 m²



The church is heated with 8 infrared (IR) heaters located at the top of the vertical wall and pointed about 45 degrees from wall towards the centre of the church: three on each side of the nave, and one on each side of the sanctuary. Six of the heaters (installed in 1992) are about 1.5 metres long, and two more recent (in 2014, at right below) measure about 1.2 metres. When active, red-hot heaters 'shine' infrared radiation that warms up



the first surface it encounters: people, pews, floor etc. A heater illuminates an area from the wall to about the centre of the church, although the heat is strongest near the wall (due to it being closer to the heater than the centre of the church). Although the heat is near-instantaneous, achieving a pleasantly warm environment for occupancy requires that the heaters operate for about two hours prior to the event; during this time, the ambient air also warms up from the contact with the warmed surfaces, and through the contact with the warm air other objects also warm up somewhat. The heaters are turned off shortly after the service begins since by then the heat is sufficient to last during the entire service. No heat is provided during the week, so the church gradually cools down to a temperature near-equilibrium with the outside air; the rate of cooling and the minimum value depends on the outside temperature during the week.



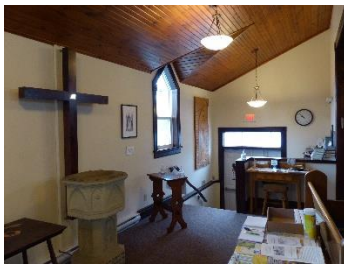
Each IR heater is controlled by a separate circuit breaker, all breakers being accessible in a small control panel at the back of the nave. Each breaker is turned ON at the start and OFF at the end of the heating period. The wiring for the heaters is inside the wall; the beautiful walls and ceiling are covered by wood, the shape resembling a boat hull (the church builders were associated with ship-building industry then located in Rockport).

Although there have been no instances of failure or required intervention, as a safety precaution a person is usually present during the heating time.

Two electronic organs are located in the nave, both used by an organist during the services. They have not been affected by the indoor temperature fluctuations over the years, as both are performing well.



The meeting room itself and the large bathroom and the crawl space below are heated continuously during the winter by baseboard heaters, with temperature controlled by thermostats in each room and set at 10°C. The relatively large entrance hall (spanning the width of the



nave and the adjacent meeting room) is also heated with a thermostat- controlled baseboard heater at the base of the entrance staircase.

The areas that are continually heated during the winter months are the meeting room, the bathroom and the crawl space below, with thermostats set at 10°C.

As noted above, the above equipment has operated successfully since the time of installation. The 2018 costs for all electricity (heating all spaces, lighting, refrigerator) were **\$2038.86**, distributed as follows:



Hydro 2018

Tuesday, April 05, 2022

3:53:01 PM

Entry Date	Category	Transaction Amount	Memo	Actual Amount
1/21/2018	Hydro One	\$395.96		(\$395.96)
2/26/2018	Hydro One	\$383.96		(\$383.96)
3/26/2018	Hydro One	\$237.60		(\$237.60)
4/24/2018	Hydro One	\$257.77		(\$257.77)
6/22/2018	Hydro One	\$147.27		(\$147.27)
6/28/2018	Hydro One	\$77.99		(\$77.99)
8/3/2018	Hydro One	\$45.91		(\$45.91)
8/30/2018	Hydro One	\$42.64		(\$42.64)
10/31/2018	Hydro One	\$87.83		(\$87.83)
11/25/2018	Hydro One	\$105.80		(\$105.80)
12/31/2018	Hydro One	\$256.13		(\$256.13)
				-2038.86

2. St. Philip's Church, Milford, ON



2.1 Premises*

St. Philip's Church building in Milford, ON consists of several parts: the entrance through a small vestibule through the tower at left, the nave and sanctuary, a Sacristy connecting to the office (in white above), and a hall with adjacent kitchen next to the office.

The Church comprises a small entrance vestibule, the nave and the sanctuary; the total area is 109.5 sq meters. It was built in 1921 from cement blocks and its interior walls later refinished by adding (about 1 inch) styrofoam insulation and gyprock sheets. The wooden floor is supported by wooden cross-beams with a small vented crawl space below and is covered with a wall-to-wall carpet. The Church roof is covered with metal sheeting (baked-on paint). The nave is equipped with an organ.

The Hall was added to the Church in 1954. It has a carpet-covered concrete floor (with no subfloor space) and cement block walls which were later inside vertically strapped and 1-inch insulation sheets glued on between the wood 1x2in straps; total floor area is 68 sq meters. In 2008 the walls and ceiling were refinished by adding gyprock sheets (throughout) and wainscoting (near the floor) and by repainting the walls and ceiling.



The current kitchen was built in 1986 as an expansion of the smaller kitchen (built at the same time as the Hall), along with adjacent hallway. The expanded kitchen was constructed from wooden walls (insulated with 6-inch fibreglass bats and covered with exterior plastic siding) and roofed with metal. In 2011 the kitchen was renovated but no insulation was added. The kitchen contains two stoves, two refrigerators, and a dishwasher.

2.2 Heating

The primary heating system consists of large electric heating units (see above right); four in the Church and three in the Hall, each 48x24x6 in in size.

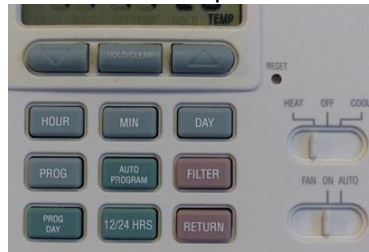
In other spaces (sacristy, kitchen, bathroom, office, Sacristy, and the sanctuary of the Church) heating is provided by smaller electrical heaters mounted near the floor. The total heated space is 220.6 m² (the total unheated area is 16.8 m²). The large heaters are governed by a) circuit breakers in the fuse panel, two programmable thermostats (in the nave and hall, respectively), and simple individual thermostats (kitchen, office, sacristy, bathroom).

The temperature during the winter is set at 6°C on the programmable thermostats, and at the minimum (=10°C) on the others. In the colder months, the programmable thermostats are used to provide a temperature of 20°C for Sunday services. They are set at 15°C at 8:00 a.m. and at 20°C at 8:30 a.m. to achieve the desired 20°C in time for the service at 11:00 a.m. The conditions for proper heating are correct thermostat setting, good batteries in the thermostat, AND closed doors to the outside.

The following additional steps are important for achieving heating efficiency:

- a) During the cold season always close every door behind you (heat is lost immediately when doors are left open).
- b) If you are touching the thermostats be sure the word 'HOLD' is not displayed (if it is push <Hold> button to cancel).
- c) If you are in the Church (or Hall) when it is not being used and you notice the temperature is above 6°C or above the outside temperature, please check to see if a heater is stuck in an 'ON' position (the heater unit will be hot). If so, shut off the breaker to the heater on the circuit breaker panel in the Entrance Hall (Figure 6) or contact the responsible person (section 3.4.4).
- d) Batteries must be changed. Lithium batteries last two heating seasons.

Programmable thermostat for temperature controls.



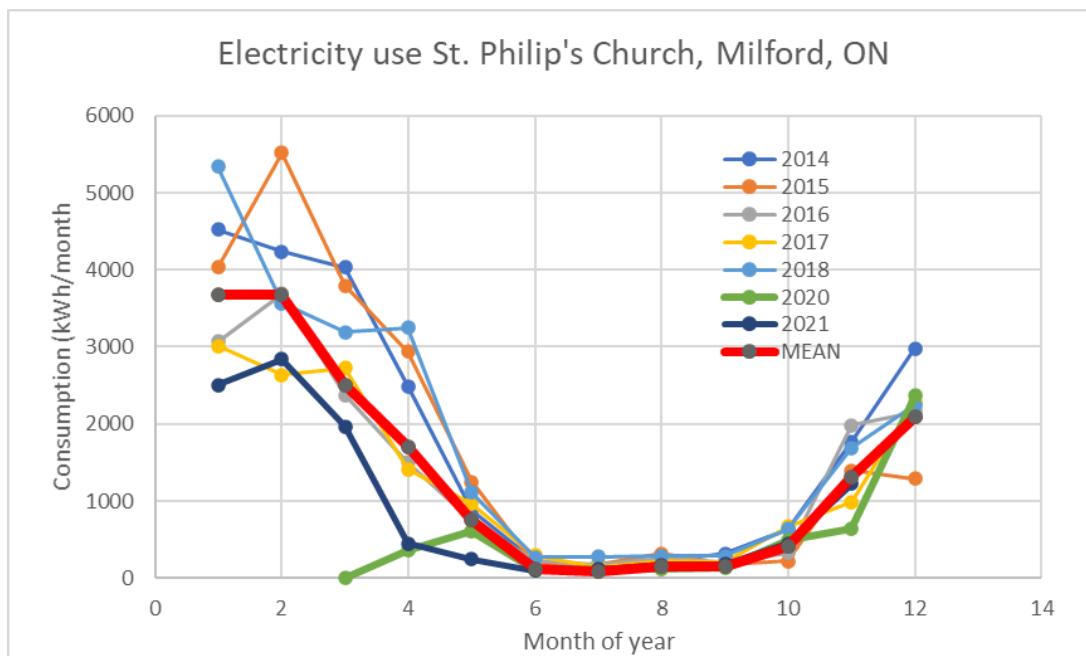
The heating system is looked after by Bruce Walker.

* Extracted from the St. Philip's Church Operations Manual, 2022 edition

2.3 Performance and cost

The heating system described above has been in operation for over 20 years, without modifications or failures. None of the heaters malfunctioned or needed repairs. Other than changing/ setting the programmed temperatures, care is required to ensure the programmable thermostat batteries are replaced in a timely manner.

The most detailed record of energy use are monthly invoices sent by Hydro One. These list both consumption and cost, for the last several years also recording separately daytime and overnight use (because these are sold at different rates). Using the monthly invoices since 2014, the following graph has been prepared (the first two values for 2021 are not available).



The graph shows that:

- Heating during the winter uses most of the electricity. The six months November-April use about 88% of all electricity consumed, while the six summer months use only 12%. For the same reason, the COVID years (2020, 2021) did not differ greatly in electrical consumption.
- The interannual outdoor temperature variability during the cold season results in substantial differences in heating costs.
- Considering the heated areas only, the annual consumption is about 16500 kWh, or 45kWh/day or 1.9kWh/hour; and with the total heat area of 220.6 m², 75kWh/m²/year.

3. Implications

During the winter, the high energy use depends mostly on the minimum temperature setting. This is so because the heat loss is proportional to the temperature difference between the indoor and outdoor air. Therefore, a very important part of devising a church heating approach is a decision on the minimum temperature that is maintained during the week/ when the church is not used: although the indoor temperature is low, it is kept much longer than the high one (in a church with one weekly service, the low temperature duration is 161 hours every week (with 2 hours for preheating and one for service), nearly 98% of the total heating time).

While the minimum setting at St. Philip's seems lower than that used in other churches*, it still results in a fairly large consumption and large cost. Even though electricity in Ontario is mostly 'clean' (greenhouse gas-free) thanks to actions of previous governments and thus its use does not worsen the climate emergency, heating the church is still relatively expensive considering that no one benefits from this 'idle time' expense.

An important challenge for individual churches is therefore finding the lowest temperature that should be maintained during winter months. Prior to the installation of electrical heaters, St. Philip's was not heated at all during the week, without detrimental effects on the structure. The Church of the Redeemer is also not heated during the week (although the other spaces equipped with baseboard heaters are). St. Philip's numbers indicate that costs could be further reduced with a minimum temperature setting closer to 0°C. How 'close' may well differ for every church and would require experimentation by those responsible for the church premises.

** A recent informal pool of a few churches in the Diocese found that ranges of no heating to 13°C (55.4°F) temperatures were used this past winter, in all cases without adverse impacts on the building or the indoor equipment (including electronics). Since the settings have in most churches been initially established without testing for the minimum acceptable setting, it is advantageous for churches to do such testing and respond accordingly.*