



Environmental Stewardship Assessment Parsonage, First Church, Sterling, MA



48 Main Street, Sterling

This is a summary of observations and recommendations of a site visit on February 9, 2023 by Jim Nail and Bill Schroeder for MassIPL. The visit was prompted by the ESA for the church.

The Parsonage is a single-family home built in about 1790 (as listed by the Sterling Assessor) with a long history (see Photo 1). It is wood frame construction with plaster walls and clapboard exterior with 2755 square feet of living space. It uses an oil-fired baseboard hot water heating system that also heats domestic water via an indirect water heater. A

former garage has been converted into living space (circa 1993 according to assessor records). The most recent work was in 2014. The home has had insulation added and replacement windows installed. The attic and basement are both accessible via stairways but are unfinished.

Given the age of this building, the energy efficiency is reasonably good as the result of insulation work and window replacements noted above. The Energy Use Intensity (EUI) at the Parsonage was 47.1 in 2021 and 40.1 in 2022; even using the higher number, the Parsonage is just about average for the Northeast: the Residential Energy Consumption Index of the Energy Information Administration reports that the average EUI for homes in the Northeast built before 1950 is 48.1.

Captioned photos of observed conditions follow the text.

BEHAVIOR

Because homes are more consistently occupied than houses of worship, behavior is less of an issue. But it is also easier to anticipate patterns when the home will be unoccupied or when residents are sleeping so easier to program the thermostat to heat the home efficiently. On our visit, the thermostat appeared to be set correctly and Pastor Bartlett seemed knowledgeable about its operation. The Department of Energy recommends you set the thermostat down 7 – 10 degrees at night and estimates this will save 10% on costs over the course of the heating season

<https://www.energy.gov/energysaver/programmable-thermostats>.

To operate efficiently, boilers should be cleaned and tuned annually. The service tag hanging on the boiler indicates this maintenance is done regularly (see Photo 2)

Recommendation

Keep up the good work!

ELECTRICITY

Refrigerators are the appliance that is the biggest energy user in a home though over the last 20 years they have become much more efficient, with the most recent standards issued in 2011. The refrigerator is certainly within this range and probably was installed as part of the 2014 renovation. Washers and dryers are also big energy users and both of them are relatively new.

While there is no central air conditioning, there was a window air conditioner stored in the basement (see Photo 3).

While we did not make a complete inventory of the lighting in the house, we observed many LED bulbs.

Solar: The front roof of the Parsonage faces almost due south with no shade so is an ideal location. The Assessor's record shows the roofing was replaced in 2017, so the panels can go right onto the shingles. The roof has enough space for an array that would produce most if not all of the electricity the parsonage uses today. The solar installer will evaluate the roof structure to make sure it is strong enough to support the additional weight of panels.

Recommendation

While you talk to Sterling Municipal Light about solar at the church, also ask about the Parsonage. Each municipal electric company in the state sets their own policies and rules around solar so MassIPL isn't able to be knowledgeable in them all. Also check to see if the local historic commission would need to review or give approval to an installation since the panels would be so visible.

HEATING and DOMESTIC HOT WATER

Generation Equipment

Home heating is by far the largest energy user and source of carbon emissions in a home, with hot water heating typically the second or third largest user. The fuel uses, the type of system, and the age and condition of equipment all have significant impact on how much energy is used. In terms of the age and condition of the equipment, there is no urgent need to replace it. However, when you have the opportunity to replace it, the work will be significant so planning early will be helpful.

The property has the following equipment:

- Boilers — The Parsonage has an oil-fired Buderus boiler that appears to be in good condition (see Photo 4); based on the serial number, it appears that this boiler was

manufactured in 2009 (see Photo 5). Boilers have an expected useful life of 25 – 30 years so it is about halfway through its life.

- Domestic Hot Water — Hot water is supplied by an indirect tank paired with the boiler (see Photo 6). This is a relatively efficient way to heat water but requires that the boiler remain on all year round. Replacing it with a hybrid heat pump model would allow you to turn the boiler off from about May 1 – October 1 and reduce your oil consumption by likely 75 – 100 gallons. At oil's current \$4.00 per gallon rate and your electricity rate of \$.155 per kwh, you might save as much as \$150 - \$250 per year.

Controls

There is a single thermostat for the entire house, located in the upstairs hallway. It is a standard residential programmable model.

Distribution

Many of the pipes, especially from the boiler to the hot water heater, are uninsulated. Standard baseboard radiators are located in most rooms.

Recommendations

As long as the boiler continues to operate with no problems, there is no urgent need to replace it and priority should be given to the work recommended in the ESA for the church. Install pipe insulation of the appropriate diameter at the local home center or hardware store, cut it to length as needed, and wrap it around exposed pipes. This is an easy, inexpensive DIY project.

Consider replacing the hot water heater with a hybrid heat pump model. Check if Sterling Municipal Light Department provides a rebate. You will need a 220 volt electric circuit and your electrician would need to determine if you have capacity and space in your electric panel.

In any case, we recommend you replace the boiler and hot water heater by around 2030, in line with the state goal to reduce carbon emissions 50% by then.

A new heating system will most likely be an air source heat pump. The most common installation in homes today are “mini-splits”, which install wall hung units in each room. On the first floor, you might have the option of using floor mount units that are small cabinets that would fit in the space where the current radiators are. Another option might be an air-to-water heat pump that, like the current system, would distribute the warm water through baseboard radiators. However, because heat pumps provide lower temperature water (110 – 120 degrees F) compared to oil boilers (160 – 180 degrees F), you would also have to replace the current radiators with ones designed to operate with these temperatures. At this time, air-to-water heat pumps are relatively rare in the US but are much more common in Europe. HVAC professionals we speak to expect them to become more common in the coming years

Building Envelope

The “building envelope” consists of the walls, doors, and windows that separate the outside from the living space of the Parsonage. Since the most environmentally friendly

energy is the energy never used, improving the building envelope and thus lowering the energy used is an essential action, and you have already done much of this work.

Windows and Doors

As mentioned, replacement windows have been installed (see Photo 7). Doors appear to be adequate and fit well in their frames and have storm doors.

Insulation and Air Sealing

When additional insulation was installed, the thermal boundary was established at the ceiling of the second floor, which is typical. Blown cellulose was installed by drilling holes in some of the floorboards of the attic (see Photo 8). Thus there is no insulation (and no need for it) between the roof rafters. The attic door is insulated with 2 inches of extruded polystyrene foam (see Photo 9), continuing the thermal boundary between the attic and the living space.

In the basement, some air sealing was done around the foundation (see Photo 10). However, there is no insulation between the floor joists (see Photo 11), thus there is no thermal boundary. Typically 10 – 20% of the heat loss a home experiences is through the foundation, so installing insulation between the floor joists is a good potential project. The only reason not to is if there is enough residual heat from the boiler that the basement remains fairly warm; in this case, that heat will slow heat loss from the living space.

Buildings of this era typically have little insulation in the walls. While we couldn't do an in-depth assessment (that would require drilling small holes in various areas of walls), what we were able to observe seems to confirm this:

- Using a Flir infrared camera attachment to an iPad, the areas between the studs appear colder, indicating little insulation (see Photo 12).
- In the rear bedroom, insulation above the ceiling appears to be adequate but the area where the wall meets the ceiling shows significant cold air (see Photo 13). This is typical and is solved by air sealing the framing component known as the “top plate” to the drywall.

Recommendation

Call Sterling Municipal Light Department to schedule an energy assessment and draw their attention to the insulation and air sealing issues noted above <https://nextzero.org/sterling/energy-audits/>.

Blowing insulation into the exterior walls may be possible. Typically, a few clapboards are removed to allow a 2 – 3 inch hole to be drilled through the sheathing at intervals to allow a hose to be inserted to install the insulation; the holes are then patched and the clapboard reinstalled. If you plan to paint the Parsonage, consider doing this project prior to painting.

To insulate between the basement floor joists, mineral wool has a couple of advantages: it is highly resistant to fire, it does not absorb water or humidity, deters mice, and batts are easier to work with and neater than blown materials. It is a fairly small area so could even be done by parish members in a couple of hours.

Photos



#1 - This plaque erected by the Sterling Historic Commission relates the interesting history of the house and its owners.



#2 - The service tag on the boiler shows it received regular maintenance. Good work!



#3 - Window air conditioners are used in the summer and stored in the basement.



#4 - The oil-fired Buderus boiler is about 85% efficient.



#5 - The serial number of the hot water heater suggests the boiler was manufactured in 2009.



#6 - The hot water tank is an indirect model, circulating hot water from the boiler through a heat exchanger. Note the uninsulated pipes.

Photos (continued)



#7 – The Parsonage windows are double pane replacements, believed to have been installed as part of the 2014 renovation.



#10 – Spray foam has been applied to seal areas between the stone foundation and the wooden floor framing members. This reduces cold air infiltration – as well as mice and insect intrusions!



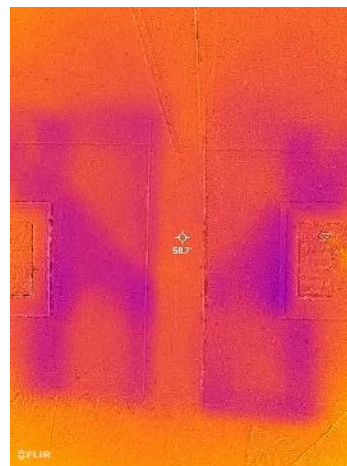
#8 – Blown in cellulose insulation has been added to the attic floor, as shown by the hole drilled into the floor board and the material seen in the gap between the boards.



#11 – There is no insulation between the floor joists in the basement. Mineral wool batts would be a good solution.

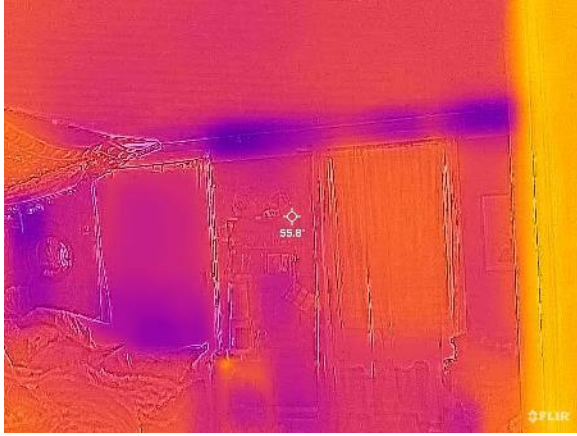


#9 – The door to the attic is well insulated, continuing the thermal boundary between the living space and the attic.



#12 – This infrared photo of a wall shows cold areas (purple) suggesting there is little insulation in the walls. Blowing in cellulose from the exterior is a typical way to address this situation.

Photos (continued)



#13 - In the rear bedroom (believed to be a converted garage), the dark area where the wall meets the ceiling indicates air leaking around the framing member called the "top plate". Air sealing this would reduce this heat loss

ELECTRICITY USE								
First Church in Sterling - Parsonage								
Provider Sterling Municipal								
Meter #		Rate		Serves> Parsonage				
Account #		2853001						
Year	Bill Month	\$	% of prior year \$	kWh	\$/kWh	% of prior year kWh	Cooling Degree Days	% of prior year DD
2020	January	\$79.36	#DIV/0!	599	\$0.132	#DIV/0!	0	#DIV/0!
	February	\$81.53	#DIV/0!	549	\$0.149	#DIV/0!	0	#DIV/0!
	March	\$72.79	#DIV/0!	505	\$0.144	#DIV/0!	0	#DIV/0!
	April	\$86.80	#DIV/0!	553	\$0.157	#DIV/0!	0	0.0%
	May	\$73.20	#DIV/0!	477	\$0.153	#DIV/0!	85	265.6%
	June	\$81.22	#DIV/0!	600	\$0.135	#DIV/0!	289	150.5%
	July	\$94.55	#DIV/0!	636	\$0.149	#DIV/0!	494	110.3%
	August	\$121.80	#DIV/0!	881	\$0.138	#DIV/0!	398	129.6%
	September	\$91.45	#DIV/0!	693	\$0.132	#DIV/0!	165	177.4%
	October	\$84.60	#DIV/0!	615	\$0.138	#DIV/0!	17	154.5%
	November	\$77.50	#DIV/0!	566	\$0.137	#DIV/0!	7	#DIV/0!
	December	\$78.30	#DIV/0!	614	\$0.128	#DIV/0!	0	#DIV/0!
		\$1,025.10	#DIV/0!	7,288	\$0.140	#DIV/0!	1,455	132.5%
2021	January	\$69.41	87.5%	576	\$0.121	96.2%	0	#DIV/0!
	February	\$90.88	114.5%	609	\$0.149	110.9%	0	#DIV/0!
	March	\$68.88	84.5%	452	\$0.152	89.5%	2	#DIV/0!
	April	\$76.35	104.9%	513	\$0.149	92.8%	3	#DIV/0!
	May	\$63.55	73.2%	405	\$0.157	84.9%	102	120.0%
	June	\$85.24	116.4%	637	\$0.134	106.2%	331	114.5%
	July	\$108.74	133.9%	650	\$0.167	102.2%	282	57.1%
	August	\$88.42	72.6%	626	\$0.141	71.1%	406	102.0%
	September	\$111.01	91.1%	841	\$0.132	121.4%	141	85.5%
	October	\$84.96	92.9%	561	\$0.151	91.2%	33	194.1%
	November	\$80.26	94.9%	571	\$0.141	100.9%	0	0.0%
	December	\$82.69	106.7%	595	\$0.139	96.9%	0	0.0%
		\$1,010.39	98.8%	7,036	\$0.144	96.5%	1,300	89.3%
2022	January	\$75.02	108.1%	600	\$0.125	104.2%	0	#DIV/0!
	February	\$84.00	121.0%	599	\$0.140	98.4%	0	#DIV/0!
	March	\$79.16	87.1%	506	\$0.156	111.9%	0	#DIV/0!
	April	\$78.38	113.8%	494	\$0.159	96.3%	0	0.0%
	May	\$73.28	96.0%	444	\$0.165	109.6%	138	4600.0%
	June	\$92.58	145.7%	628	\$0.147	98.6%	193	189.2%
	July	\$117.52	137.9%	749	\$0.157	115.2%	441	133.2%
	August	\$139.19	157.4%	883	\$0.158	141.1%	459	162.8%
	September	\$128.68	145.5%	799	\$0.161	95.0%	116	28.6%
	October	\$92.31	83.2%	524	\$0.176	93.4%	9	6.4%
	November	\$115.07	135.4%	659	\$0.175	115.4%	16	48.5%
	December	\$86.16	107.4%	614	\$0.140	103.2%	0	#DIV/0!
		\$1,161.35	114.9%	7,499	\$0.155	106.6%	1,372	105.5%

OIL USE								
First Church in Sterling - Parsonage								
Provider Harrington								
Account #		3712		Serves> Parsonage				
Year	Start Date	\$	% of prior year \$	Gallons	\$/gallon	% gallons of prior year	Heating Degree Days	% of prior year DD
2021	January	\$802.06	#DIV/0!	153.7	\$1.94	#DIV/0!	981	106.3%
	February	\$291.19	#DIV/0!	150.1	\$1.94	#DIV/0!	922	105.3%
	March	\$312.92	#DIV/0!	161.3	\$1.94	#DIV/0!	649	103.3%
	April	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	350	70.3%
	May	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	132	76.3%
	June	\$399.29	#DIV/0!	157.2	\$2.54	#DIV/0!	3	
	July	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	4	
	August	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	0	
	September	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	14	
	October	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	162	59.3%
	November	\$379.83	#DIV/0!	141.2	\$2.69	#DIV/0!	591	123.6%
	December	0.0%	0.0	#DIV/0!	0.00%	#DIV/0!	776	91.2%
		\$1,685.29	518.0%	765.5	\$2.20	456.47%	4,584	96.2%
2022	January	\$413.72	137.0%	153.8	\$2.69	98.78%	1,167	119.0%
	February	\$429.31	168.0%	181.9	\$2.69	121.19%	845	91.6%
	March	\$459.45	146.8%	170.8	\$2.69	105.89%	673	103.7%
	April	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	376	107.4%
	May	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	100	75.8%
	June	0.0%	0.0	#DIV/0!	0.00%	#DIV/0!	8	
	July	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	0	
	August	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	0	
	September	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	46	
	October	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	250	154.3%
	November	\$411.86	108.4%	104.8	\$3.93	74.22%	478	80.9%
	December	#DIV/0!	0.0	#DIV/0!	#DIV/0!	#DIV/0!	832	107.2%
		\$1,774.35	103.3%	611.3	\$2.90	79.86%	4,775	104.2%