Heating, Ventilation, and Air Conditioning Upgrade: St. Matthews Anglican Church

By Southface Engineering, April 2026

The report, *Heating, Ventilation, and Air Conditioning Upgrade – St. Matthews Anglican Church*, evaluates the aging HVAC systems at St. Matthew's Anglican Church in Ottawa and proposes three modernization strategies intended to improve comfort, reduce maintenance problems, add air conditioning, and decrease reliance on natural gas through greater electrification.

The overall goal of this study was to identify feasible options for the complete overhaul/replacement of the current heating system that will:

- Replace aging components or complete system that is now prone to failure;
- Provide humidity control and air conditioning for at least the church hall and office space;
- Improve operations through increased energy efficiency and updated controls that adapt operations to changing patterns of use in the building; and
- Drastically reduce the carbon footprint of the building.

The current heating system is a hybrid consisting of the original 1930 steam system and a hot water/forced air system installed when the basement was renovated in around 1995. Two 600K BTU/hr natural gas boilers feed both the steam and the hot water systems. Signs that the heating system needs to be replaced include progressive failure of the steam heating system and ongoing problems with the operation of the forced air system.

Although the boilers still function adequately and can maintain indoor temperatures even during very cold Ottawa winters, the system suffers from several problems: oversized piping left over from portions of the building no longer connected to the heating system, recurring leaks, aging controls, inefficient steam distribution, and asbestos insulation on piping. The basement air-handling unit installed during a 1997 renovation has also exceeded its expected service life and has ongoing zoning and control issues.

The report strongly favors radiant heating approaches for historic churches. It argues that in-floor radiant heating would provide the highest level of comfort because it warms the entire floor surface uniformly, reduces drafts, and maintains a more even temperature from floor to ceiling. The report also recommends displacement ventilation for cooling: cool air would be introduced slowly at floor level, where occupants are located, then rise naturally as it warms, improving comfort and indoor air quality while reducing energy use.

Three upgrade options are analyzed in detail. All three options envision shifting a large portion of the heating load from natural gas to electricity through the use of air-source heat pumps. This

also achieves the goal of adding air conditioning. The report recommends **Option 2** as the best balance of cost, energy performance, and comfort (p. 20). The project, from selection to completion, is expected to take approximately 12 months (p. 20).

Option 1: Centralized Air Handling (VAV System)

This option maintains the existing steam boilers but modernizes the air distribution in the basement and church (p. 13).

- **Basement:** The aging constant-volume air handler is replaced with a **Variable Air Volume (VAV)** unit. VAV boxes are added to existing ductwork to allow different rooms to be cooled or heated independently based on demand, which improves energy efficiency (p. 13).
- **Church Area:** A dedicated new AHU is installed specifically for the sanctuary. It uses **displacement ventilation**, delivering cool air through floor grilles at a low velocity. This air naturally rises as it warms, focusing cooling only where people are actually sitting (p. 13).
- **Heating:** Primary heating still comes from the existing radiators, but the new AHUs include heating coils connected to the boilers to provide supplemental warmth (p. 13).

Option 2: Distributed Heat Pumps (VRF System) – *Recommended*

This option shifts to a more flexible "split" system that eliminates the need for large, centralized air handlers (pp. 14, 20).

- **Technology:** It uses **Variable Refrigerant Flow (VRF)** technology, similar to residential heat pumps but on a larger scale. A central outdoor unit connects to multiple small fan coil units hidden throughout different zones of the building (p. 14).
- **Efficiency:** The system can "move" heat between zones—for example, taking heat from a sunny room that needs cooling and moving it to a shaded room that needs heating—which significantly reduces compressor runtime (pp. 14, 20).
- **Redundancy:** It includes electric heating coils for extreme cold (below -25°C) and keeps the existing steam boilers as a secondary backup (p. 14).

Option 3: In-Floor Radiant Heating & VRF Cooling

This is the most comprehensive (and expensive) overhaul, focusing on maximum thermal comfort (p. 15).

- **Heating:** The old radiators and steam boilers are completely removed. In their place, a **hydronic in-floor heating system** is installed. PEX tubing is fastened to the underside of the church floor (accessed via the basement ceiling) to turn the entire floor into a heat source (p. 15).
- **Primary Heat Source:** An **air-to-water heat pump** provides hot water for the floor for most of the winter, with a new high-efficiency gas boiler only used as a backup for the coldest days (pp. 15, 31).
- **Cooling:** Since floor heating cannot provide air conditioning, this option still requires the installation of the VRF system from Option 2 to handle summer cooling and ventilation (p. 15).

Key Considerations

- **Occupant Comfort:** The report emphasizes "displacement ventilation" for the main church area, delivering cool air at floor level to directly cool occupants without needing to cool the entire high-ceiling volume (pp. 9, 13).
- **Infrastructure Upgrades:** All options require upgrading the building's electrical service from 100A to 200A to handle increased demand from the new cooling equipment (pp. 17-18).
- **Organ Room:** Due to the sensitivity of the pipe organ, the report suggests monitoring the room's temperature and humidity before deciding on a dedicated climate control unit (pp. 11, 13).
- **Solar Potential:** The roof could potentially accommodate 98,000 Watts of solar modules, generating roughly 80,000 kWh annually at an estimated cost of $350,000 (p. 19). (Currently, St. Matthew's uses about 60,000 kWh of electricity per year at a cost of about $10,000).

Option	Reduction in CO_2 Emissions	Annual Energy Cost*	Construction Cost	CO2 Produced (kg)
Existing system	--	**$15,803**		**66,526**
Option 1: VAV AHU heat pumps plus gas boilers	**68%**	**$38,612**	**$645,000 plus steam system renovations****	**21,545**
Option 2: VRF heat pumps plus gas boilers	**75%**	**$32,874**	**$671,500 plus steam system renovations****	**16,771**
Option 3: VRF heat pumps plus in-floor heating plus natural gas back up	**89%**	**$34,133**	**$1,381,500**	**7,462**

Notes:

*Energy costs for heating and cooling includes operation of all fans and pumps.

**Cost for steam system renovations are estimated to be $140,000 to $480,000.