Heating a Historic Church

Choosing the right low-carbon option for your building

Choosing a new, low-carbon heating system for a church is one of the most stressful decisions a Parochial Church Council (PCC) will ever face. Unlike a standard home, a church has vast air volumes, uninsulated stone walls, delicate historic fabric, strict Faculty or planning rules – and a mission to serve the community. Get it wrong and the bills can be painful. To make the right choice, you have to look past the sales brochures and understand how two crucial factors interact: **how you use your building** and **how hard the heating system has to work.**

Choosing a heating system isn't primarily about the technology. It's about how your church is actually used. Once you understand that, the technologies make much more sense.

Before you spend money

The first question

Before comparing heating systems, step back and ask a simpler question: how is your church actually used?

A church that is only occupied for a Sunday morning service has very different heating needs from one that hosts a toddler group on Monday, a foodbank on Tuesday, choir practice on Wednesday, and community events throughout the week. The building is the same, but the most economical heating strategy may be completely different.

Why it matters

Historic churches have enormous thermal mass. Their thick stone walls, pillars and floors behave like a giant thermal sponge. They are not simply empty boxes full of air.

Once those walls have cooled down, they need to absorb heat for many hours before they begin to feel warm again. Equally, once they have been gently warmed over time, they cool only slowly.

If your church is only used occasionally, allowing the building to cool between services may be perfectly sensible. In that case, it often makes more sense to heat the people rather than trying to warm the entire volume of air and the surrounding stonework.

A ministry note – if your church is seeking to use the building more, either through outreach or as a community space (or both), keep in mind **how that will change occupancy** and design the new system accordingly. Keeping a background warmth makes it more usable at any time.

What are you using now?

It is worthwhile documenting how you are heating the building at the moment. What temperature do you heat to and how often per week – and how well is this working? What energy does it use (in kWh), and what does it cost (in pounds)? Use per month if possible, as well as per year. You probably don’t spend anything on heating for 3-4 months of the summer.

How much heat do you need?

Before you begin to investigate the options for your circumstances, it's important to get a 'heat loss assessment' for your church. This is a calculation of how much heat is lost through your walls, roof and airflow in specific circumstances. The assessor will establish a 'design temperature' (often -3°C) and calculate how many kW of heat would be needed to maintain the selected indoor temperature under those conditions. For homes this is often 20°, but a historic church usually needs a lower target. (In the case of Infrared heating, which heats the people rather than the space, a spatial radiant heat-loss/coverage assessment is done instead.)

Get someone experienced in historic and ecclesiastical buildings to do the assessment, because standard domestic software often doesn't capture what makes churches different.

Many PCCs will receive proposals based on standard domestic or commercial heat-loss software. These calculations can be perfectly suitable IF the correct inputs and methodology are used, but historic churches present unusual characteristics that require proper engineering judgement, and hence someone experienced in these buildings.

The flow temperature rule

Once you start comparing heat pumps, another principle affects running costs…

If you are looking at heat pumps – whether they are Air-to-Water or Air-to-Air – there is one rule you must remember: **The lower the temperature of the heating system** (other things being equal) **the cheaper it is to run**.

Heat pump efficiency is measured by a Coefficient of Performance (COP). A COP of 4.0 means that for every 1 unit of electricity you buy, you get 4 units of heat. If a heat pump only has to warm water or air to a gentle baseline, it runs very efficiently. If you force it to push out high-temperature heat to rapidly warm a cold building, its efficiency drops and your bills can soar.

Let's look at the four main low-carbon heating technologies currently being proposed for UK churches, and see how they stack up.

The four competitors explained

1. Infrared radiant panels (IR)

Infrared panels primarily heat people and objects directly rather than trying to heat the whole volume of air. Instead, they emit invisible light waves that instantly warm objects and people directly – much like stepping into direct sunlight on a crisp winter day. They are usually tucked under pews or hung overhead. They convert essentially all the electricity they consume into heat (ie a COP of 1), but because they warm people and objects directly rather than trying to heat the whole building, using them for space heating would be far more expensive than a heat pump.

2. Air-to-Air heat pumps (A2A)

Essentially an air conditioning system running in reverse, these systems use outdoor units to extract heat from the air and blow it inside using internal fan units. Because they move heat rather than create it, they are extra efficient – often a COP of 3.5 or 4.0 or higher. They use refrigerant throughout all the internal and external units. *Note on aesthetics:* While people often fear the 'office look,' they don't have to look industrial. They can be hidden behind wood or willow screens.

3. Air-to-Water heat pumps (A2W)

This is a standard 'wet' system (similar to a gas or oil boiler system) which can be used with normal underfloor heating (UFH) or with radiators. To use a lower-temperature heat pump, you use radiators that are either thicker (double or triple-panel designs), a larger area, or modern fan convectors.



Heat pump enclosure for St John's Egham, new A2W heat pumps

Air-to-Water heat pumps are often easier to integrate into historic settings and usually require fewer outdoor units, making them well suited to churches that want to maintain a steady background temperature. Air-to-Water also has a lower embodied footprint, because only the ASHP uses refrigerant, the rest of the system uses water to transfer the heat.

Note on aesthetics: While Air-to-water heat pumps have a wider range of looks to offer, they can still be screened if needed provided appropriate tolerances are respected.

4. Between-joist heating

Between-joist hydronic radiant heating is an architectural choice of last resort. It is designed specifically for listed buildings where heritage authorities forbid digging up historic timber floors. Instead of embedding pipes in concrete, aluminium fins and pipes are retrofitted *beneath* the existing timber floorboards inside the open floor joist spaces.

Because air and timber are natural insulators, the system must heat the empty air void beneath the floor to force heat upward. This may mean higher water flow temperatures, which would require the heat pump to operate at a lower efficiency than optimum. As with Air-to-water heat pumps, the best flow temperature is determined as part of the overall system design.

The occupancy hierarchy

The table below shows how the same technologies change in their cost-effectiveness depending on your church's weekly calendar. These are **indicative warm-up times only:** actual performance will depend on the building, starting temperature, external conditions, heat loss, emitter capacity and controls. **There are many factors involved in choosing the best design in the end.**

Rank	**Sunday-Only** (Intermittent Use)	**3 Days a Week** (High Thermal Mass)	**5+ Days a Week** (Frequent/Continuous Use)
1st	**Infrared (Under-Pew)** Instant warmth right where people sit; no energy wasted heating empty air.	**Air-to-Air Heat Pump** Efficient space heat. Rapid fan recovery allows you to drop to a low setback mid-week.	**ASHP Radiators/UFH** Once the heavy floor or walls are up to temperature, it takes little electricity to keep warm.
2nd	**Air-to-Air Heat Pump** Fast air warm-up, though it still has to heat the air in the entire volume, and needs longer to heat the walls.	**ASHP Radiators/UFH** A very close tie to A2A if left on constant background, but it lacks the speed to handle deep mid-week setbacks.	**Air-to-Air Heat Pump** Rapid response times combined with efficient (COP 3.5+) space heating.
3rd	**ASHP with Large Rads** Takes too long to heat up from cold, leading to high pre-heating costs for a single service.	**Infrared (All types)** At 3 days of use, the hours add up. Because IR only gets COP 1.0, it starts losing its financial edge to COP 3.5+ efficient heat pumps.	**Between-joist heating** If high flow temperatures are needed, efficiency will be reduced, but you have shorter pre-heating cycles.
4th	**Between-joist heating** Keeping a low-efficiency system running 24/7 just for a 3-hour Sunday service could be expensive.	**Between-joist heating** The flow temperature penalty means it may cost too much electricity to maintain a 3-day baseline.	**Infrared (All types)** Because IR is only COP 1.0, running electrical panels for 40+ hours a week may result in large flat-rate electric bills.

The ‘steady state’ comfort secret

When looking at the 3-day and 5-day columns, non-technical committees often ask: ‘Why on earth would we leave the heating on all week when the building is empty for several days?’



Steady background heat keeps both people and the building's fabric comfortable – from the 09:30 prayer meeting to a packed Sunday service.

The answer lies in a real-world case study from All Saints Church. Using an old, 65%-efficient gas boiler, the church experimented. Traditionally, we heated ‘on demand’ from a cold start. Last winter, we tried maintaining a steady background of 16°C all week, only topping it up to 18°C on the 2 or 3 service days.

The steady-state method used very little extra gas – but was *dramatically* more comfortable.

Why? Because the cold stone walls pull radiant warmth straight from your body. You can heat the air, but if the walls stay cold, the room still feels chilly and draughty. This is the potential trap with Air-to-Air heat pumps: if you only turn them on an hour before a service, the air will be warm according to the thermometer, but the building may still feel cold because the stonework is cold. To be comfortable, it has to be run long enough to at least warm the top layer of the building's fabric where the people are.

By keeping a steady baseline temperature, the building fabric stays warm. A heat pump ticking along gently to maintain 16°C (starting in early autumn while the walls are still warm from summer) operates at its peak efficiency. If heating fights stone walls from a cold start, that efficiency drops.

Ancillary decisions

By now, you should have a good idea which type of heating system might best match your church's pattern of use. However, choosing the main heating system is not quite the end of the story. Every option brings a few practical consequences that are easy to overlook during a major project. Thinking about frost protection, pipework, organs and your electrical supply at this stage will help you avoid expensive surprises later and ensure that your chosen system works well in the real world, not just on paper.

Protecting your unheated building

If your PCC decides that a Sunday-only heating strategy (like Infrared) is the best fit, you will face one major catch: **the building itself will get very cold mid-week.**

Leaving a historic building entirely unheated all winter risks dampness, frozen plumbing, and irreversible damage to delicate instruments. The smart approach is to install a few tiny, low-cost, independent **localised frost-protection systems**. These are intended to prevent damage, not to keep the building comfortably warm.

For the plumbing: trace heating cables

A burst water main inside a freezing church can cause tens of thousands of pounds in structural damage to historic floors or crypts. Run a flexible **electric trace heating cable** along your copper pipes in the kitchen, toilets, and mains inlets, then wrap them in standard foam insulation. Modern trace heating cables are ‘self-regulating’. The cable contains a material that automatically generates heat only when the pipe temperature drops below 5°C.

For the vestry and toilets: wall-mounted frost guards

Small, enclosed rooms like vestries (where historic parish registers or fabric robes are kept) and toilet blocks cannot be allowed to freeze or succumb to dampness. Install a compact, heavy-duty **convector frost guard**. They come with a built-in thermostat that stays dormant all week. If the room drops toward freezing, it clicks on just long enough to lift the room air by a couple of degrees before shutting off again.



Example of convector-style frost guard

For traditional pipe organs

If your church houses a traditional pipe organ, this step matters. Organs do not mind being cold, but they **hate sudden changes in humidity and temperature**. If you leave a church to freeze all week, and then suddenly blast heat into the building on Sunday morning, the timber soundboards expand rapidly and split – quickly ruining a valuable instrument. Consult your accredited organ builder and install low-wattage **electric tubular heaters** directly inside the wooden organ casing or blower chamber. These look like long metal pipes and use very little electricity (typically under 150 watts). Connected to a dedicated thermostat or *humidistat*, they maintain a stable micro-climate *inside the instrument itself* all week, but not the empty church.

Check your power supply constraints

Before choosing any heating system, establish what your electricity supply can support. Air-to-Air systems can have a high electrical demand during warm-up, so a large installation may need a longer, gentler start to stay within the available supply. St Martin's Church, Woodhay, installed a 50kW A2A system with four external units and eight internal emitters last winter, carefully designed to work within its 100A single-phase supply. This illustrates that an A2A installation does not necessarily require a three-phase supply, although its warm-up strategy needs to be designed around the available electrical capacity. Larger churches with multiple units on a 100A three-phase supply may need to take a similar approach. Air-to-Water systems also need to be considered within the available electrical capacity, although the demands are generally less pronounced. Infrared can have relatively low power demand with under-pew heaters, but overhead systems can require much more. It may be possible to stagger heating so that systems are not all drawing maximum power at once.

Three-phase can be a good solution if you need it, but be very wary of upgrading to 200A. The physical connection may be capable of supporting this, but at 200A you will move into a commercial metering and electricity-contract arrangement, with potentially much higher ongoing charges. The cost will depend on the supplier and the contract. It is not simply a matter of paying the one-off cost of upgrading the connection.

Before agreeing to an upgrade, ask both your system designer and electricity supplier to establish what your existing connection can support, what upgrade is actually required, and **what the resulting electricity contract will cost you. Get this in writing before you commit**.

Summary checklist for the PCC

Before you invite a single installer to look at your building, your team should agree on the basics:

- **Get a proper heat-loss assessment** by a suitably experienced professional.
- **What are your electricity supply constraints?** Any move to electric heating may require a substantial electrical supply – potentially 100A or more, whether single or three phase, and a place in the budget to upgrade.

- **Is your building used predominantly for Sunday services?** Do not buy a wet central heating system. Focus your budget on Infrared to heat the people, and install cheap independent frost-protection for your plumbing and organ. Mind the total power draw, and size according to your electrical system constraints.
- **Are you a 3-to-5-day centre of the community?** Invest in the efficiency of a heat pump. Look seriously at **Air-to-Air** for fast, flexible space heating, or a **wet system with radiators/fan convectors/UFH** if you want to run a continuous baseline. A wet system especially makes sense if you already have radiators or underfloor heating.

Conclusion: making the right choice for your church

There is no universally 'best' heating system for historic churches. A Sunday-only church, a busy community hub and a church somewhere in between may all reach different conclusions – and all be making the right decision.

The key is to understand your own pattern of use, the thermal behaviour of your building and the practical constraints of heritage and electricity supply before talking to installers. A good designer should be able to explain why they are recommending a particular system, not simply tell you that it is the latest technology. You don't need to become an expert, but understanding the basics yourself means you can ask the right questions and make an informed decision about what is right for your church.

By matching the heating strategy to the building's real life rather than to trends or sales literature, your PCC can invest with confidence.

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