SOURCES OF GUIDANCE TO CHURCHES ON HEATING OF BUILDINGS

INTRODUCTION

General Synod affirmed in 2020 that the Scottish Episcopal Church needed to commit to working towards Net Zero carbon emissions by 2030 and recognised that this was a difficult challenge in all parts of the Church. It therefore determined that a new approach would be necessary for collective action. Further information is being developed by the Provincial Environment Group which formed in late 2021.

First steps are to look at energy use and energy sources in our buildings, as well as the carbon emissions associated with this. This will require long term and strategic planning, as well as expertise from specialists. There are a range of actions that can be undertaken (as highlighted in the Net-Zero Toolkit) but this note refers to the decisions that will need to be undertaken when considering the heating of buildings and sources of guidance that can assist in this process.

Strategy and scoping

Deciding on a strategy for the heating of your buildings involves a web of considerations: the pattern of use of the building; how much and at what cost-benefit the fabric of the building can be improved; the condition and performance of the existing system of heating; the cost-benefit of options for replacement and upgrading. The term “cost” must be broadened out to account for carbon emissions, environmental and compliance considerations, incentives like grants as well as the capital cost, the running cost and less tangible costs like the cost to historic building fabric.

A step-by-step strategy can be adopted within the framework of an overall net-zero plan for your church. It does not all have to be done at once.

SOURCES OF ADVICE

The question is often asked by Vestries “where should we go for advice on the heating of our buildings?” There are two main sources of advice on which to base decisions about the heating of buildings. They are:

- professionals (engineers, architects and building surveyors), and
- contractors (including specialist heating contractors).

Also, the details of some charges in the Province who have recently replaced their heating systems are given in the appendix.

Architects and Building Surveyors

Architects and building surveyors who are experienced in the maintenance, repair, upgrading and alteration of ecclesiastical buildings are always a good starting point for scoping advice. They will be able to provide a sound overview of a building, what to

prioritise in the context of an inevitably finite budget and how to go about getting work carried out. When it comes to the engineering systems in buildings, a competent architect or building surveyor will defer, where appropriate, to the expertise of an engineer specialising in building services. Given the increasing significance and impact on the environment of heating systems in buildings it is recommended that Vestries or their subcommittees should engage directly with engineers.

The relevant professional body for architects in Scotland is the Royal Incorporation of Architects in Scotland https://www.rias.org.uk/ .That for Chartered Building Surveyors is the Royal Institution of Chartered Surveyors https://www.rics.org/uk/. Both these professional bodies have lists of specialists in the conservation of historic buildings.

M&E aka Building Services Engineers

The term “Heating Engineer” is the source of much confusion. A consulting engineer specialising in building services is a professional not a contractor. In the industry they are known as M&E Engineers. This is short for Mechanical and Electrical Engineer. The term “Mechanical” includes pipework, boilers, fans, valves, control systems etc, in short, every aspect of heating, cooling, ventilation, water services and plumbing. Such an engineer will:

- provide independent professional advice, and
- will advise on, design and specify alterations and whole systems such that competent contractors can provide competitive and comparable quotations.

The relevant professional body for M&E Engineers is the Chartered Institution of Building Services Engineers (CIBSE) https://www.cibse.org/

Contractors

A “Heating Engineer” that is a contractor may provide a quotation and install a good and workable system, but they are not independent. They have, from the outset, a commercial interest. Generally, their initial involvement is “free”. A professional M&E Engineer will charge for their services but the initial cost that gets a project set up on the right lines is likely to be modest and well worth incurring. If, after such an initial consultation, the works required are straightforward and require no further professional input, the M&E Engineer will point the client in the direction of a suitable contractor and that will be the end of their involvement. If it is more complicated, it would be as well to retain the M&E Engineer to design and monitor the installation.

Planning Advice

Many changes to building will also require an application to be made to your Diocesan Buildings Committee under canon 35. Additional permissions are required, such as Planning Permission, and in some cases Listed Building Consent, when the proposed work affects the exterior of the building. Planning Aid Scotland (https://www.pas.org.uk/) offers a free advice service to individuals and community groups, by professional planners, to help understand the system in the local area and look at what might be required.

The relevant professional body for planners in Scotland is the Royal Town Planning Institute (RTPI)
https://www.rtpi.org.uk/find-your-rtpi/rtpi-nations/scotland/

HEATING BUILDINGS

There are three main parts to heating buildings:

1. Heat loss
2. The heat source
3. The heat distribution system

1. Heat Loss

It is always best to deal with the source of the problem first. That is often very difficult in church buildings. The options for improving the thermal performance of roofs, walls, windows, doors and floors may be limited. However, it needs to be borne in mind that a very large part of heat loss from, and discomfort within, a building may be due to rectifiable air leaks. In some buildings, like Church Halls, the range of options for significant improvement may be greater.

In making any assessment, the “value” of existing building fabric, in historic and embodied carbon terms, should form part of the calculation. For instance, replacing, rather than refurbishing, timber sash and case windows with uPVC ones will invariably result in a net loss to the environment if not also to the character of the building. It is possible to make “whole life” cost benefit calculations that will often produce very different results from those that derive from the sales pressure coming from commercial interests.

The pattern of use of an intermittently occupied building is also highly relevant to the consumption of energy and it may be possible to exercise some control over this aspect.

2. The Heat Source

Natural gas

Any building that has access to natural gas will currently be heated at much lower financial cost by gas than by any other form of heating. This is true of the capital cost of installation and the ongoing running cost.

Natural gas consists primarily of methane which burns to produce carbon dioxide (CO_2) plus some nitrous oxide (N_2O) and will likely be the major source of your carbon emissions if you have a boiler installed in your buildings. At present, a gas boiler has a significantly lower initial capital cost than compared with that of an electrical heat pump installation (its nearest competitor in terms of running costs) which would also require about twice the surface area of heat emitters because the heat it produces is at a lower temperature than gas.

It is possible that the addition of hydrogen to the Natural Gas distribution system may, in the future, improve its environmental credentials. The main obstacle to this becoming the norm is, currently, the difficulty of producing hydrogen cost effectively from “green energy” sources. It is worth noting, however, that this also applies to the mains electricity grid which has a long way to go in terms of decarbonisation and, in addition, there would be significant capacity restrictions on the electricity grid if it became the main source of heating for buildings. Gas heating in new buildings, where, in any case, the heating requirement will be largely designed out, will soon be banned but it is likely to continue to be one of the main sources of heating urban churches as we collectively transition towards net-zero.

Heat pumps

Heat pumps run on electricity. They are not a “free lunch”. They work by pumping heat out the ground (through boreholes or shallower arrays of underground pipework), the air or a body of water. They effectively “leverage” the energy that is put in and deliver a net increase in energy. The capital cost of heat pump installations varies from type to type and installation to installation, as does the maintenance cost of the replacement pumps, etc.

It may be concluded that, as we move forward, heat pump technology will become the norm in which case it may either be installed at the outset or its possible future use designed into the heating distribution system.

Biofuel

Biofuel installations are worth considering in rural locations when LPG, oil or electricity are the main alternatives. It will rarely be a viable option in an urban setting.

Churches in rural settings where disturbance or nuisance to neighbouring properties are not a consideration, and mains gas is unavailable, present a very different set of design criteria to urban churches.

Solar

Solar PV panels may be of some value but, without a very large installation and accompanying energy storage, they will likely not provide the main source of heating. They are generally highly visible and need consideration in relation to Listed Buildings. It is less necessary in Scotland than in locations further to the south to consider the orientation of roofs to which PV panels are fitted.

Direct electric heating

Buildings where it is possible to reduce the heating requirement through insulation and air infiltration management, may reach such a low level of heating requirement that the capital cost of a heating system is unjustified. In such cases direct electric heating for the limited occasions when it is needed may suffice. This is unlikely ever to be the case in an existing church building but where it currently exists, in an intermittently used building, its continued use could make sense.

Radiant heating systems that heat the individual occupant rather than the whole building may lend themselves to intermittently occupied church buildings. However, in most buildings, the heating system also provides an element of building fabric protection and this may be lacking in such a system, increasing the risk of timber decay and plaster deterioration.

3. Heating distribution

Piped systems

Options include wet pipe systems with radiators, underfloor heating and warm air heating. Wet systems can be served by biofuel, natural gas, LPG, electric boilers, heat pumps. If the heating medium is water heated by a heat pump or air source, the radiator sizing will have to be significantly expanded compared to that provided by an oil, gas or biofuel boiler. It is usually relatively straightforward to switch from one heat source to another using the same distribution pipework.

Should underfloor heating be necessary, it will require the floor to be lifted. So too will the installation of insulation in a ground floor with or without the inclusion of an underfloor heating system. In a church this may be complicated by pews and the platforms they sometimes stand on, raised up from the aisles. These various considerations may interconnect. Underfloor heating is unlikely to be sufficient on its own in a church that has a large internal volume and poorly insulated building fabric.

Underfloor systems can work well with heat pumps in the appropriate circumstances, but intermittency of use may extend any possible payback.

Systems that work in a similar manner to air-conditioning, but in reverse, can sometimes be worth considering.

Warm air heating

This option, with or without heat recovery, has a place in some situations. The main disadvantages of warm air heating as a means of distributing heat, in most ecclesiastical settings, are that it requires large ducts to be installed and it generates low level noise that is difficult to manage in relation to acoustics, especially music.

Acknowledgement

This guidance note was produced by David Gibbon, a RICS Certified Historic Buildings Professional, on behalf of the Provincial Buildings Committee, of which he is a member. The guidance has been approved by the Provincial Buildings Committee and the Provincial Environment Group.

Provincial Buildings Committee
April 2022

FURTHER INFORMATION

Reference materials -

Society for the Protection of Ancient Buildings (SPAB) Briefing Documents: https://www.spab.org.uk/sites/default/files/documents/MainSociety/SPAB%20Briefing_Energy%20effi ciency.pdf

HES Technical Papers: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId= 8a2a7b9d-e3b2-4c7d-8c17-a59400a8387b

Inspiration:

https://www.visitchurches.org.uk/what-we-do/news/solar-panels-installed-at-st-nicholas--chapel--kin. html

https://www.newburytoday.co.uk/news/news/10969/work-starts-on-241k-wash-common-church-refur b.html

ECO congregation Scotland: https://www.ecocongregationscotland.org/

Publicly funded advice and support: https://www.zerowastescotland.org.uk/ ; https://energysavingtrust.org.uk/

Ideas and advice from further afield: https://ecochurchsouthwest.org.uk/actions/church-buildings/

APPENDIX

Charge (Contact)	**Type of heating**	**Installation date**
St. Luke's Downfield, Dundee (Bruce Gowans. email: bruce_gowans@hotmail.com)	Domestic Gas Boiler replacement	2020
St James', Stonehaven (David Fleming. email:david.w.fleming@surescribe.com)	Electric. Overhead radiant heaters and below pew heaters. It is a computer controlled system.	2018
St. Mary's, Arbroath (Rev. Peter Mead. email: pete.mead@sky.com)	3 destratisfying fans fitted to the ceiling of the Church to improve the effectiveness of the existing gas fired heating system.	2019

Christ Church Morningside, Edinburgh	Gas condensing boiler. Combination of wet pipe radiator and convector systems. Original radiator-only system augmented/partially replaced with fan convectors and overdoor 'heat curtain' heater.	2020
Holy Cross, Davidson's Mains, Edinburgh	Gascondensingboiler. Wet pipe systems with radiators	2020
St Fillan, Buckstone Drive, Edinburgh	Electricity.Standalone electric convectionheatersonone wifi controlled circuit	2019
St Columba's-by-the-Castle, Johnston Terrace, Edinburgh	Natural gas. Combination of underfloor heating and radiator systems.	2018
St Salvador, Stenhouse, Edinburgh	Electricity. Radiant (halogen) heaters	2016
St Michael and All Saints, Brougham St., Edinburgh	Gas fired water-based fan convector system	2015
St Ninian, Comely Bank, Edinburgh	Natural Gas. Wet pipe systems with radiators	2015
Holy Trinity, Pitlochry	Replacement Gas boiler	2016
St John's, Alloa	Replacement Gas boiler	2017
St Mary's, Kirriemuir	Electric. Ceramic radiant heaters	2017
St Mary's, Newport on Tay	Replacement Gas boiler	2019
St Mary's, Aberfoyle	Electric. 12Kw heat and light chandelier and electric under pew heaters. Electric air curtain at the entry to the church.	2019
St Luke's, Glenrothes	Gas. Condensing boiler.	2020

Rectory, St Mary's, Aberfoyle	Heat pump. Vailliant aroTHERM Plus 12kW VWL 125/6 air source heat pump, together with a 260 ltr. hot water cylinder.	2021
St Andrew’s, St Andrews	Secondary glazing on all the windows in the Hall block including the 4.5 m high stained glass ones, replace lights with LEDs, install three smart controllers for different areas of the building and reflective pads behind all the radiators so they heat the rooms rather than the walls. Planning to put photovoltaic and water heating solar panels on the roof of the Church and to replace spotlights in the church with LEDs.	2022