



St Lawrence Church

LECHLADE-ON-THAMES



Lechlade St Lawrence PCC

Version 1

July 2023

Supporting document to the faculty submission to show the approach to meeting the net zero carbon target.

Preamble

The Faculty Jurisdiction (Amendment) Rules 2022 requires that we have regard to the ‘net zero guidance’ as issued by the Church Buildings Council. For these Rules, the following key pieces of guidance must be given due regard when relevant to your proposal:

*Heating Principles
Heating Checklist
Heating Options Appraisal
Electric Vehicle Charging
Solar Panel and Faculty
Biomass
Lighting
Floodlighting*

This document explains how the reordering proposals comply with these rules.

While not included in the net zero target, we explain the approach we are taking to embedded carbon.

The DAC commented¹ that:

The DAC, guided by its Sustainability Adviser felt that the PCC’s proposals relevant to environmental sustainability are sensitively balanced. It was noted that during the evolution of this project the Net Zero Carbon requirements have developed very considerably. One could take a view that this proposal is no attempting to be Net Zero Carbon and therefore criticise it for such but given its history and lengthy development the DAC was content that the proposal makes a balanced contribution to decarbonisation and in reusing the existing boilers that have life left in them. The DAC was content that this is the right balance in achieving the ‘least-worst’ heating solution for the current time. However, the DAC was concerned that the proposals do not include a specific statement on how this project will have ‘due regard for the CofE Net Zero Carbon guidance’.

We believe that the proposals for heating and lighting represents the most effective solution working within the overall objectives of the project and the constraints of working within the church. The project has been long in development and before the most recent guidance has been issued. Nevertheless, our proposals are consistent with the guidance.

We have sought professional advice from two of the leading church heating consultants who both consider the proposals are appropriate and are consistent with meeting the net zero target by 2030.

¹ Letter from the DAC Secretary to the Lechlade PCC dated 3 July 2023

1. Statement

St Lawrence church Lechlade is an established Eco-church with a silver award and working towards gold status, achieved by less than 1% of churches in England. We take the need for carbon reduction seriously and this has been applied in the development of this project. The carbon reduction components of the project have been well supported by the church community.

This reordering project has been diligently developed having due regard to the CofE net zero carbon guidance. Much of the guidance from the CofE was published while the project was well advanced. Nevertheless, we confirm that the project complies with the guidance.

We have sought professional advice from leading consultants who have extensive experience in church heating and lighting. They have undertaken a feasibility study and design work, having regard to the carbon reduction target.

This note explains the main components of the project to meet net zero and the reasons for their selection.

2. Requirements

We are required to meet the Church of England target of net zero carbon by 2030. This relates to operational carbon; in our case, the carbon element of the power used to heat and light the church. Other power use is relatively low.

The Church Buildings Council has set out the requirements² in its document Net Zero Carbon Church. In addition, we have been guided by guidance from the document 'Route Map to Net Zero Target by 2030'³ and the document 'Reducing Embedded Carbon'⁴. We have also attended many of the Webinars organised by the CoE Environment Programme; we found these very helpful in developing our designs.

3. Background

Lechlade St Lawrence church is making a faculty petition to carry out reordering works to meet the current and future needs for worship and mission. It is an active and growing church attracting all ages. The needs and proposals are set out in the Needs Statement⁵.

Work on developing the reordering proposals started in 2018 with an initial meeting with the DAC. The initial driver was to replace the 1960's radiator and air blower heating system which was ineffective in heating the central body of the church. The MIC control cabling was also damaging the lime plaster in the walls. An initial consultation with parishioners identified the lack of an effective heating as an important issue.

The lighting and power distribution systems complied with mandatory inspections. However, cable failures required some interim replacements; some lighting fittings sometimes failed and were unreliable. As an interim solution we have replaced light bulbs with LED bulbs and replaced some fittings.

² <https://www.churchofengland.org/resources/churchcare/net-zero-carbon-church>

³ 'Route Map to Net Zero Carbon by 2030' by the Church of England Environment Programme, 2023

⁴ 'Reducing Embedded Carbon', Church Building Council 2023.

⁵ Statement of Need v18, Lechlade St Lawrence PCC, May 2023

In parallel with the development of the reordering project, we engaged Martin Thomas Associates (MTA) to carry out a feasibility study of the heating, lighting and power requirements and advise on an appropriate heating and lighting solutions which would meet the net zero target. A copy of the MTA report⁶, dated September 2020, is on the faculty portal.

We then engaged Environment Engineering Partnership (EEP) to undertake design stage 3 work. EEP were also asked to have regard to the net carbon reduction target and provided a report on their design work⁷.

Both MTA and EEP have extensive experience of working in churches and historic buildings.

4. Eco church

We are an established and active Eco-church and has been promoting activities over the last three years within the headings of worship, buildings, land, community and global and lifestyle. The current scores and level by category are shown on Table 1

Category	July 2023	Level achieved	Target for Silver	Target for Gold	Percentage to Gold
Worship & Teaching	96/110	Gold	55	82.5	-
Buildings	220/390	Silver	195	292.5	75
Land	85/155	Silver	77.5	116.3	73
Community & Global	117/204	Silver	102	153	76
Lifestyle	119/160	Silver	80	120	99

The overall rating is currently Silver, and we are actively working towards Gold. We have been working with the Diocesan advisor and other churches in the diocese towards a gold level. This reordering project should enable us to achieve Gold on completion. The Gold award has been achieved by less than 1% of the churches in England and Wales.

This demonstrates the commitment of our parish to meet the Church of England Eco goals and we see the net reduction target as an extension of that initiative.

5. Scope of proposals

Heating

Heating our lofty church building is a challenge, though the proposal to create enclosed areas at the west end will reduce draughts and provide more effective heating.

The church is currently heated from two gas-fed conventional boilers circulating hot water to radiators fixed along the north and south walls, and convector blowers located around the perimeter of the church. The system was installed in the 1960's, originally with an oil-fed boiler. The gas boilers were most recently replaced in 2014.

The initial consultation in 2018 identified the lack of effective heating as a major concern of parishioners. Heat is not well distributed to the nave where people have complained about the cold

⁶ Lechlade St Lawrence, Mechanical and Electrical Services Feasibility Study, MTA, September 2020.

⁷ St Lawrence Church, Lechlade Project Inspire, Stage 3 Report, Engineering Services Installations, November 2022

in winter months. The current position is not consistent with our vision of an open and welcoming church for all ages and abilities.

The Church of England target to achieve net zero operational carbon emissions by 2030 has focused us to examine a range of heating options.

We discussed possible options with the DAC heating advisor. We then engaged Martin Thomas Associates (MTA), a mechanical and electrical consultancy with significant experience of church buildings, to undertake a feasibility study and advise on options for heating, power and lighting. MTA undertook a detailed evaluation⁸ and concluded under the following headings that:

Use of building: With the fairly regular and varied use of the building, a ‘whole building’ approach to heating is appropriate, compared with ‘local heating’ which takes the form of under-pew heating or high-level radiant heaters.

Heat source: the Church of England net zero target constrains the choice of heat source to heat pumps, biomass or electricity. Biomass is not a practical solution for a volunteer-managed organization. Heat pumps are more cost-efficient than direct electricity use. The land requirements for a ground-source heat pumps are constrained by the churchyard and lack of available land. The air source heat pump (ASHP) is the preferred source. This does not stop us using the existing gas boilers in winter periods while they still have a remaining life.

Use of photovoltaic cells: this option to place PV cells on the top of the south roof, not seen from ground level, was considered by MTA but discounted because the power generated would only meet 20% of total demand; peak power demand is in the winter when PV output is low; use of batteries would provide only limited diurnal storage. Electricity demand in the summer is low. Installing PV to export to the grid is not economic. In addition, using batteries also presents a challenge regarding location, weight and fire risk. This option was therefore not progressed at this time. With the increasing efficiency of solar panels and reducing costs, it might be worth revisiting option one in the future and before 2030.

Heat distribution: MTA looked at options for new radiators and fan convector system, underfloor heating, perimeter trench heating and central radiators. With an ASHP source, the temperature of the circulating water is lower than gas boilers and will require larger radiators to compensate. This then takes up more space in the nave and limits its flexibility. An underfloor heating system is more efficiently balanced with an ASHP output.

We concluded that a hybrid heating system is appropriate enabling continuing ‘slow’ heat with a boost from ‘fast’ heat to increase temperatures in advance of main events in the church:

- (i) ‘slow’ heat from an ASHP powering the water-based underfloor heating system.
- (ii) ‘fast’ heat from the existing boilers with distribution in trench heating. When the gas boilers reach the end of their life, they will be replaced with small electric boilers, mainly to meet the peak heating demand in the winter months.

⁸ Mechanical and Electrical Services Feasibility Report, Martin Thomas Associates Ltd, September 2020

We subsequently engaged Environmental Engineering Partnership (EEP) to undertake detailed design of the heating and lighting systems. EEP provided a Design Stage 3 Report⁹. EEP confirmed the hybrid heating system proposals and, working with our architect, developed the detailed design and drawings.

Heat distribution will be more effective using underfloor heating and discrete column convectors. A higher floor level provides the opportunity to include effective insulation and install underfloor heating without disturbing the existing lime concrete floor and at reasonable cost.

In discussions with EEP we are proposing two ASHPs with the equivalent output of the original single unit to provide resilience of supply.

Changeover from gas boilers to electricity

The DAC commented that:

The Committee would like to see ... a paragraph on how, when the existing boilers reach the end of their life in 10 years' time, the current design is able to be adapted to a decarbonised future heating source.

7.

The gas boilers were installed about ten years ago. We took the view that it would be premature to replace the boilers when they still have an effective life and embedded carbon. This also makes sense in deferring some of the capital expenditure. This would also enable us to assess the effectiveness of the underfloor heating and the extent of use for the trench heaters fed from the gas boilers. We envisage their use to be limited to the exceptionally cold weeks in the winter.

Operational experience will guide us to the selection of appropriate electricity-driven boilers to supply the trench heaters. These boilers would be located in the boiler room. One church we recently visited had a combination of underfloor heating and electrical panels; in discussion with the designer, the underfloor heating worked well and there was very little need for the supplementary heat.

6. Compliance with the Church Building Council guidance for operational carbon

We comment on compliance against the main headings in the guidance.

6.1. Heating Principles

The guidance on heating principles¹⁰ was published in February 2021 after the MTA feasibility study was carried out and concept designs prepared. Nevertheless, our proposals are consistent with the heating principles set out.

- we have assessed the current and future use of the building with details included in Annex 4 to the Statement of Need
- our proposals set out to move away from the use of gas to electricity to power air source heat pumps; in the interim, with 'slow' heat from underfloor heating and 'fast' heat from trench heating. While air source heat pumps will power the underfloor heating, we are proposing to maintain the existing boilers until they reach the end of their lives, thus retaining the

⁹ Project Inspire Stage 3 Report Engineering Services Installations, EEP, October 2022

¹⁰ Church Heating Principles, Cathedral and Church Buildings Division, February 2021

embedded carbon within the plant. When this occurs then the boilers will be replaced with electric units. All power would be sourced from renewable supplies.

- The underfloor heating can be installed with minimal disturbance to the existing floor. This integrated solution with a higher floor level will enable level access through the church for all abilities and route all cabling and other service under the floor and avoid unsightly cable runs and pipework above floor level, or making pipe and cable runs within the existing floor which would weaken the structure. The floor build-up will also provide additional insulation.

6.2. Heating Checklist

Our approach to the development of heating options generally followed the elements of this checklist with the initial work and feasibility study was carried out before the guidance was issued. Nevertheless, we have addressed the elements of the checklist.

6.3. Heating Options Appraisal

The guidance for options appraisal is set out in the document ‘Options Appraisal and Getting Advice’¹¹ dated August 2021. This is after our Feasibility Study was completed by MTA. MTA covered the factors mentioned in the document but perhaps not in the way this is laid out. Key factors we considered were:

- The existing heating delivery system of radiators and blowers was not effective, particularly in the centre of the church and the system is over 60 years old.
- There was a need to move away from gas to meet the net zero target.
- The reordering of the church included the removal of the pews (which are not fixed and can be moved within the church but with great effort); this removed the option of pew heating except in the chancel.
- The provision of a new higher floor allowed under-floor heating to be installed with no disturbance to the existing floor. Pipes and cables can be routed within the new floor with no trenching in the existing lower floor. The higher floor was to provide level access for all abilities from the porch to the communion rail.
- There is no space in the churchyard to accommodate ground source heating, so the preferred option is for an air source heat pump. The temperature output from the heat pump matches the underfloor heating requirements.
- Supplementary ‘fast’ heating is provided by trench heaters powered from the existing gas boilers until they reach the end of their effective life then would be replaced by electric water boilers. It is envisaged that these trench heaters will only be used for short periods on colder days in the winter.
- The solution is therefore a hybrid solution which we believe is effective and, with purchase of renewable grid energy meets the net carbon reduction target.

The feasibility study was reviewed independently by EEP who agreed with the proposals. EEP has since completed the design stage 3 work and produced drawings and a report which are on the faculty portal.

6.4. Electric Vehicle Charging

¹¹ Options Appraisal and Getting Advice, Cathedral and Church Buildings Division, August 2021

We have limited parking space for only two cars, used by staff, volunteers and disabled drivers for Sunday services. We have not considered the demand, options and practicalities of installing charging points, but this may be considered in the future.

6.5. Solar Panel and Faculty

In 2020, MTA investigated the feasibility of solar panels on the south aisle roof; a part of the church building where the panels would not be visible. One option was to generate the church's own summer use with a small number of panels on the roof with a battery to balance supply and demand. At that time, the low summer demand did not justify the cost of the panels and battery. A second option was to install a greater number of panels on the south roof and export excess electricity to the grid was not feasible due to the low feed-in tariff.

With the increasing efficiency of solar panels and reducing costs, it might be worth revisiting option one in the future and before 2030.

6.6. Biomass

This was not progressed as the Grade 1 church in the Lechlade conservation area does not have the facility to locate the necessary equipment and receive deliveries. In addition, the system requires technical and operational manpower that the parish does not have.

6.7. Lighting

The guidance is set out in the document 'A brief guide to lighting in churches'¹² which was published in May 2022. This is after the feasibility study by MTA but Stage 3 before design work by EEP. We asked EEP, who have extensive experience of lighting design in churches and historic buildings. Much of the guidance in this document is technical and we have asked our consultants to be consistent with these requirements.

6.8. Floodlighting

We have six floodlights to illuminate the church tower and there are no proposals to change these. All these lights are LED. Individual parishioners normally ask for the lights in remembrance of relatives or certain events when donate to the lighting costs.

7. Compliance with the Church Buildings Council for embedded carbon

The DAC noted in its letter of 3rd July:

'... this is perhaps the first time that the Victorian Society urged this DAC to consider the environmental impact of a reordering project. This was welcome. The Committee agrees with the Society that: 'the embodied energy in the floor and the benches is significant, added to which the proposed new floor, seating, and extensive amount of steelwork and glazing that would be required in the new gallery would have a major environmental footprint'. The statement requested in the previous paragraph must explain how the PCC is planning to offset the carbon footprint of this project.'

We should point out that the quantity of steel in the gallery is sufficient to accept the dead and safe live loading, as defined in the building regulations, from the gallery structure as designed by our structural engineer. We do not agree that this is 'extensive'.

¹² A brief guide to lighting in churches, Cathedral and Church Buildings Division, May 2022

The Church Building Council states that:

Embodied carbon is the carbon associated with the material extraction, transport, manufacture and installation of a product. Whilst embodied carbon is not in scope of the Church of England's net zero carbon target until after 2030, churches can take action now, and it is important to consider when carrying out maintenance and renovations to further aid emissions reduction.

The Church Building Council has produced guidance¹³ for reducing the extent of embodied carbon of church building project. We understand this guidance is to reduce embedded carbon of the reordering project as recommended by the DAC rather than challenge the proposals.

This guidance outlines rules of thumb that can be applied to all projects. In summary, consider the principles:

- Retain/reuse/repair/recycle or upgrade before disposal/rebuild
- Avoid large changes for small energy savings

When new items or rebuilding are required:

- Retain materials and structures.
- Use less material.
- Use salvaged materials.
- Use recycled materials.
- Use natural materials.
- Use long-lasting products.
- Find products/suppliers with a low carbon footprint through using clean energy, low carbon supply chains and less transport.
- Consider waste disposal.

While the guidance is relatively recent, we have given close thought to minimise the additional embedded carbon resulting from implementing the project through the various measures set out in the guidance. This does not change the principles of the project, supported by the DAC, but emphasises the need to take these guidelines into account when designing and constructing the project. For example

Retention of materials and structures

We are not proposing any significant changes to the existing structure. We are retaining the existing concrete floor as it is structurally sound and forms a good base for the new floor construction.

Recycling materials

The new floor insulation includes 'Foamglass' which comprises recycled glass. The company states that it proposes to half its emissions by 2030 and use green energy.

We plan to reuse the oak doors to the existing kitchen cupboards and use in the new storage cupboards wherever possible.

We are retaining four shortened pews and looking at the feasibility of using some of the pew timber in flooring and storage cupboard frames. We are investigating alternative ways of clearance of the pews.

¹³ A guide to reducing the embodied carbon of church building projects, Church Buildings Council, 2023

External paving is to be from recovered stone. We have recently relaid Shelley's Walk, a public footpath through the churchyard, with recovered paving slabs.

Use of natural materials

The new floor will comprise Purbeck stone quarried in Dorset. This also meets the criteria of long lasting.

Use long lasting materials

The Purbeck stone as above. Also, the steel, timber and glass in the proposed gallery is long lasting.

Use less material

We are seeking to minimise material use. For example, the extent of concrete is limited to a new covering to the boiler room and foundations for the gallery. A shallow limecrete layer is proposed in the floor.

Wastage

We do not envisage significant wastage or transport of material off site. The only excavation is for the gallery foundations.

A recent example of material re-use

Gloucestershire County Council has recently relaid Shelley's Walk, a public footpath through the churchyard, with recovered paving slabs.

Summary

Our assessment of embedded carbon to date is consistent with the guidance, based on a qualitative assessment where the types of material to be used have been selected but not quantified. We plan to carry out an assessment of embodied carbon during the design stage 4 activity when details and quantities of material can be confirmed.