**Carlisle Diocese DAC**

**Proposed Way Forward for Churches on the Implementation of the February 2020 General Synod Motion**

On Wednesday 12th February the Church of England’s General Synod set new targets for all parts of the church, to become carbon ‘net zero’ by 2030. The case for implementing a strategy for carbon footprint reduction in the church building estate is now well established and the Cathedral and Church Buildings Division have produced a document giving guidance on practical measures to implement that plan, whereas this short note is intended to give more technical advice to those who want to know how these objectives may be achieved.

The most obvious measure that should be taken is to encourage parish churches to sign up to Eco Church run by the charity A Rocha and undertake the church surveys they have produced. There are three stages Bronze, Silver and Gold, Bronze being easily obtainable by most churches, but thereafter problems related to high heat losses through the church roof, leaded lights or stained glass window glazing and inefficient boilers may become apparent and will have to be addressed.

The Carbon Trust suggest that 25% of the heat input to a building is through the roof and a further 25% through the windows, therefore a reduction by say a half is going to make a significant impact on the church building carbon footprint and reduce fuel costs. But there are major problems: -

Remedial works can have high capital cost with long payback times. Therefore projects to reduce a church’s carbon footprint have to be carefully considered, but General Synod has made the commitment on behalf of everyone of us and it is summed up in the 5th Mark of Mission –

**To strive to safeguard the integrity of creation, and sustain and renew the life of the earth**

There are further issues to consider:-

1. **Capital Costs**

It is possible that the church centrally may be able to finance a fund in the near future that could operate the C of E equivalent of to the Government sponsored Green Deal scheme currently in operation for domestic and industrial consumers and other schemes in the pipeline.

In the meantime, there are funding bodies such as the Pilgrim Trust, the Radcliffe Trust, the Oswald Allen Bequest and the Worshipful Company of Goldsmiths who may consider applications for energy conservation measures in Historic Churches. The Church Care website has further details.

1. **Roof /Wall Insulation**

There is resistance from Heritage bodies to the installation of insulating materials to the underneath of lathe and plaster or wooden boarded internal ceilings, because the appearance of the ceiling is greatly changed.

The installation of insulation materials to roof and walls of old buildings requires careful consideration and professional advice. It is important that account is taken of the build up of the existing construction, particularly in relation to the roof. When insulation is added to the underside of a plastered roof or ceiling using for example Celotex Insulation Board, the effect will be to reduce the temperature within the fabric above the board. There are circumstances where this might promote a risk of condensation occurring within the roof fabric, a situation that must be avoided wherever insulation is applied, and it is important to ensure that external breathability is maintained. See the Ecological Building Systems website.

If the roof covering needs replacement and especially if it is of the slate on sarking type, multifoil insulation can be laid on top of the rafters instead of sarking, giving similar U values to those normally achievable for the rafter-level insulation of a pitched roof, of between 0.20 - 0.16 W/m2K depending on existing rafter depth and available space. This method has the advantage of avoiding increasing the overall thickness of the existing roof and the issues that may arise where that occurs. However, care must be taken to ensure an adequate ventilation space is maintained between slates and foil for moisture control purposes, as noted above. The work has to be carried out by specialist roofing contractors.

It should be noted that the Building Regulations currently require a minimum roof insulation U value of 0.15 W/m2K for new buildings. By comparison a recent study by a student at Edinburgh University showed that a typical non-insulated ‘slate on sarking’ roof might only achieve a dramatically poorer U value of only 1.6 W/m2K.

There is also potential of reducing heat loss through external walls by applying insulation to internal or external surfaces but this tends to be expensive, disruptive and may have a significant effect on the building’s appearance.

1. **Secondary Glazing**

The installation of removable secondary glazing is relatively easy to achieve, the down side is the high cost, because standard sizes of glass supporting framework as used in domestic properties cannot be used, each window has to be measured and fitted with custom made frames. Provided the installation is carried out by a specialist manufacturer and installer, the problems related to condensation damaging mediaeval glass, can be avoided. The glazing would be removed to storage during the warmer months then re-installed.

In addition to the above measures heating energy requirements can be reduced by paying attention to the topics below:-

**Adventitious Openings**

Reduce draughts by for example enclosing open porches or installing lobbies on the church side of the main entrance doors. There are many examples of successful installations, which have been achieved with due regard to their appearance. These have been very successful where the external doors are ancient and add character to the building, but leak cold air. The downside is that they can be expensive and unless of an open glazed design they can form an unwelcoming barrier to people.

**Natural or Passive Ventilation**

Providing a gentle airflow through the building should not be seen as a contradiction to heat loss prevention. The control of ventilation is important in the prevention of condensation in the building, which leads to black mould, damage to fabrics and stained-glass deterioration. Ideally the ventilation should be passive, i.e. not relying on power supplies, to provide between 0.5 and 1.0 air changes per hour, which should be able to be provided naturally, by ensuring that window hoppers (fanlights) are slightly open. The majority of our traditionally built churches have solid masonry walls , some with rubble cores, bonded and pointed with lime mortar. This achieves a weathertight structure that is able to breathe, meaning that water vapour is able to move through the wall in both directions in a balanced way. Internal ventilation is part of the process of keeping a dry church. Your architect should be consulted on possible ventilation implementation measures.

**Heat sources - Boilers**

Modern condensing boilers, whether fired by natural gas or heating oil, achieve thermal efficiencies up to 96% depending on the return water temperature, whilst non-condensing boilers have usually a maximum efficiency of 78%. They also produce lower levels of NOx emissions.

Changing to more greener forms of heating must be approached with care, for example Air Sources Heat Pumps (ASHP) look an excellent ‘green’ alternative to fossil fueled systems, but this is not always so. Heat pumps produce low grade heat, i.e. low temperature but lots of it, therefore to be successful the building most be well insulated, whereas most of our churches are not. Also, the best application is in new buildings such as Church Halls designed for ASHP heating utilising underfloor heating, which is excellent at utilizing the low grade heat by being permanently kept on. Installation costs are high, partly offset by the Renewable Heat Incentive paid by Ofgem. It is also possible to consider a more comprehensive installation where the electrical power for the ASHP is provided from solar panels.

If ASHPs are used as a heat source for a ‘wet’ heating system, there will be a need to increase the number of radiators due to the lower circulating water temperature.

The ASHP installations that have been successful in the county have been in smaller churches with low ceilings typically 4/5 m high, where the heated volume is low.

Further guidance on heating is given in the Church Buildings Council Guidance Note – ‘Choosing the right heating system’ published in January 2020. General Synod's commitment to a low carbon future will require fundamental changes to the way we heat our buildings, so the latest document says that churches should be expected to have at least considered the option of moving away from fossil-fuel based systems towards green electricity-based heating. Up to 30% of our electricity is generated from renewable sources according to Energy UK.

If your church’s boiler or electric heating doesn’t need replacement or upgrading, churches can make a real contribution to carbon footprint reduction by resourcing their gas and electricity from a green energy supplier such as Parish Buying or Ecotricity. These companies purchase electricity from windfarm, solar farm and wave power generators, which are all renewable sources, the gas comes from biomass generators or they can use carbon offset for the remainder. Ecotricity is working towards the construction of biomass plants that will produce methane gas from organic material such as grass, which can be pumped directly into the gas grid. Their prices are competitive with conventional suppliers.

Review the heating system timer settings, can the heating be switched on before the service ends or can the day settings be altered to match building usage more closely. Lastly, can the thermostat be turned down a degree or two without affecting comfort.

Many churches especially those in rural areas are used only 2 or 3 times a month giving the church council concerns over the high cost of fuel and maintenance costs. Consideration should be given to alternative heating systems that heat the body and not the air space, such as electric under pew heating, electric cushions or radiant heaters. These are only switched on when heat is required. There are potential problems due to the electrical load exceeding the power available, radiant heating heats what it falls on, usually the head and the building fabric is not warmed. A concern if the church is always damp in winter. It is recommended that church’s consult their DAC Heating Adviser if any of these methods of heating are being considered.

**Lighting**

Many churches have already undertaken rolling programmes of replacing existing light fittings with LED lamps. This has several advantages:-

LED lamps produce more light per watt than incandescent or halogen lamps, but at less power consumption, e.g. LED lights are up to 80% more efficient than the examples just given even traditional lighting such as fluorescent tubes. 95% of the energy in LEDs is converted into light and only 5% is wasted as heat.

The life of the average LED lamp is estimated to be over 50,000 hours compared to 10 to 12,000 hours for incandescent lamps, thereby reducing the cost of lamp replacement.

**Solar Panels**

Current thinking amongst politicians and energy specialists is that all heating may have to switch to electricity over the next 10 years. The cost of electricity, which currently is a tertiary fuel (one that is generated from another fossil fuel|) can be mitigated by the church becoming a microgenerator. All of our churches have south facing sections of their roof giving an excellent opportunity for installing solar panels. However, there are a number of concerns that have to be addressed before panels can be installed: -

1. Can the roof support the weight of the panels which may amount to 10-20kg per square metre? The Church Architect needs to be consulted for advice.
2. Local Authority Planning permission needs to be obtained, and if the church is a listed building, Heritage England may have to be consulted. However, they are becoming more understanding about the installation of panels than initially thought. (See the Guidance Note on their website) Their main concern is the change to the appearance and character of the building as they consider the roofs are a major contributor.
3. A location has to be found for the inverter and metering equipment; this should be a separate room not normally accessible by the public.
4. During the 32-week heating season there would be significant imports of power from the grid for heating if it is wholly electric powered, e.g. in December it is estimated that generation will provide 0.07kWh each day from a potential 10kW array, against an average church heating load of 60/70 kW. In the summer the reverse happens with exports to the grid, therefore the price paid by generators is a factor.
5. The cost of the panels is reducing, but a short-term payback cannot be expected and the FiT’s (Feed in Tariff) scheme was scrapped by Government last year. The good news as stated above is that installation costs have been significantly reduced.

There are many other energy reduction measures that can be carried out, but require more technical input. It is recommended that you consult your DAC Building Services Adviser or Heating Adviser who will be pleased to help you.

09.09.2020

The author wishes to acknowledge the helpful comments on the document made by M Craig, DAC member and J Polhill DEO Energy Group Chairman.