GUIDANCE NOTE

Diocesan Advisory Committee for the Care of Churches

DIOCESE OF EXETER
THE CHURCH OF ENGLAND IN DEVON

RENEWABLE ENRGY

As part of the 'Shrinking the Footprint' campaign, the Church of England nationally has pledged to decrease the Church's carbon emissions by 80% by 2050 (on 1990 levels). This national target is then deferred to each Diocese, to which the Diocese of Exeter signed up in 2007.

There are three quite distinct facets in Energy Economics:

1. Reduce Energy Demand (the most important one)
2. Minimise increases in demand where increase is unavoidable (e.g. essential preservation of deteriorating fabric)
3. Change method of Energy Production to satisfy the remaining demand.

The first steps that a church can take are small ones, such as changing to a properly accredited green electricity supplier, and using low energy light bulbs where possible.

Many churches are also starting to look at the long term with regard to their energy consumption, and ways in which they can improve the energy efficiency of their buildings, reduce costs, and become more sustainable. This may mean looking at the options for renewable energy, each of which are described below. However, many of the churches in the Diocese are historic, usually listed, buildings. This does not rule them out from being able to install micro-renewable equipment, but there may be more restraints and more careful consideration would need to be given to the impact of the installation on the church building and churchyard than if it were a modern building.

Issues that would need to be considered are:

1. how the installation will impinge on the historic character of the building in question (each building will be looked at on a case-by-case basis);
2. what the overall visual impact will be;
3. how any fixings will affect the fabric of the church; and
4. whether any important historic fabric (such as traditional slating) will be replaced or compromised with the installation.

It has to be remembered that many of our church buildings have been around for many hundreds of years; services installations in a building are by their nature relatively short-lived and so, assuming a serviceable infrastructure can be established, their impact on the historic asset should be kept to a minimum.

As a general rule of thumb, before looking into alternative means of generating energy, it is important to investigate and improve the energy efficiency of a building as much as possible, without creating new problems. The majority of churches in the Diocese are 'traditional' buildings, meaning that they have solid walls, no damp-proof course, and are constructed with natural materials. To seal up such a building to eliminate draughts and improve energy

efficiency would not only be very hard to achieve, but could also be damaging to the fabric of the building. Older buildings need to 'breathe', and to reduce ventilation could lead to problems of damp, condensation and rot. Steps should therefore be taken that make improvements to the energy efficiency, but not to the extent that it would be damaging to the building. Your church architect or surveyor would be able to advise further on this, and what may be appropriate for your particular building.

Energy efficiency is dealt with under Part L of the Building Regulations, however these requirements do not apply to buildings which are listed or in a Conservation Area, where compliance with the energy efficiency requirements would unacceptably alter their character or appearance or increase the risk of long-term deterioration to fabric or fittings.

Buildings that are used primarily or solely as a place of worship are also exempt.

ENERGY PRODUCTION

There are five main types of electrical system available: Mains Power, Hydroelectric, Wind, Photovoltaic (PV) and Combined Heat and Power (CHP).

Mains Power through the National Grid may derive from conventional Power Generation or from Renewable sources with reduced Carbon Emissions.

Hydroelectricity is generally the least applicable for a church, mainly as it requires a watercourse and a drop in water levels either running through the site or very close by, or through church-owned / leased / gifted land areas.

PV and wind are the main systems that a church could consider for Electrical power.

CHP implies that there is a sustained and coincident heat load with a sustained electrical load. In this respect, a Church on its own is unlikely to yield benefit. However its energy demand profile may be complementary to an adjacent energy user, such as a School/college, offices or a community centre, where both parties stand to gain significantly. In particular a church property may have long periods of low-level heating demand and very brief levels of high demand.

Various different Heating systems are considered below.

1. Photovoltaic (Solar electricity)

The main advantage of Anglican churches is that they have south-facing roof slopes, which in theory is very good for installing PV. If there are hidden roof slopes, for example between the nave and aisle(s) then they may be suitable for a PV installation, as the visual impact is minimised. Two systems are available: panels that are fixed on top of the existing roofing material, and those that become the roofing material, either as integrated panels (fitted directly onto the roof structure) or in the form of solar-slates. Electricity produced which exceeds the local property demand would generally be sold back to the national grid.

The first system consists of modular cell units linked together that then sit on a metal frame. This frame is drilled to the roof, with weatherproofing around the fixings as appropriate. This is likely to have a 30+ year working life (perhaps more than 40 years). The advantage of this system is that the original roofing material is maintained beneath the panels, and should not impede maintenance. When the system needs to be renewed, the disturbance to the roof structure should be minimal.

Secondly, solar slates can be used instead of the existing roofing material, but are generally about 80% more expensive to install than the panels. This system is not as suitable for historic buildings due to:

(i) Lifespan – a good slate or lead roof will have a lifespan of around 100 years, whereas any replacement solar-slates would need to be renewed much sooner than this. Most traditional roof coverings represent an investment against future recovering on account of their trade-in value, that would be lost if replaced with short-lived proprietary materials;

(ii) The 'shininess' of the solar-slates. Although by using these 'slates' the profile of the roof is maintained rather than installing equipment on top of existing roofing material, they may be more shiny and reflective than the original roofing material. Panels are by contrast a more 'honest' addition to the building, and can be seen for what they are, rather than trying to replicate an existing material.

Recent guidance issued by English Heritage 'Small scale solar electric (photovoltaics) energy and traditional buildings' (for details of how to obtain a copy, see below) is firmly in favour of panels *over* roof coverings, rather than replacement.

At the present time PV is generally not considered to be suitable for supporting whole-building (peak) electrical requirements – for this would generally require a substantial (and expensive) array of panels. Modest-sized arrays are capable of supporting part-load, with energy requirements being drawn from the PV generated electricity first when available (during the day) - the connected Mains supply supplies the balance. It is also worth bearing in mind that this technology is rapidly developing, but has not yet necessarily reached a point of economic break-even over the likely life of the PV units. This is not to say that it is not worthwhile for the environmental benefits though!

Church tower roofs are sometimes suggested as possible locations for PV panels. Although the panels would be hidden visually, they would have to be laid flat or at a shallow angle, which could pose problems for maintenance. Surface area is generally limited – but this could still make a worthwhile electrical contribution over many years.

Ground-mounted panels, which have been used within the curtilage of some domestic listed buildings, are generally not considered to be suitable for a churchyard due to the likelihood of theft or vandalism.

2. Wind Turbine

Although a free-standing horizontal axis wind turbine would be suitable in certain situations (e.g., in a spacious or exposed graveyard), there may be a number of inherent problems with these. There may be archaeological issues arising from burying a small cable in the churchyard. There are, however, new types of turbines becoming available known as Vertical Axis Wind Turbines (VAWT), which may be much more suitable for churchyards, or for attaching to church buildings. These units do not have conventional (propeller) blades but are more like a helix design. They can cope with turbulent airstreams from any direction, are less noisy, have less vibration, and are possibly more bat-and bird-friendly. They may be suitable for church tower roofs, for example, although usually a concrete base foundation is required for a purpose-designed mast.

In terms of the difference in pay-back between a 2 kWe PV installation and a 2 kWe wind turbine, it is likely to be 15-20 years with PV (depending on the current electricity value, and including obtaining grants to help fund the installation), whereas it could be half this for a wind turbine on a site with a decent average wind-speed (i.e., more than 5.5 m/sec at hub-height). Disadvantages are that there tend to be more planning and site restrictions with a turbine, and they will also require more periodic maintenance than PV panels.

3. Combined Heat and Power

Although not true renewable energy system options, there are now several small-scale combined heat and power (CHP) systems available on the market, which can run off either mains-gas or diesel-oil. The environmental interest in these systems is that they actually produce electricity on-site, (avoiding transmission losses experienced in the National Grid), and the associated heat that is produced during a system's operation is captured by a heat-exchanger and utilised via a thermal-store (accumulator-vessel) to supply space-heating and / or hot water requirements, rather than going to waste. This can significantly improve the economics of the system, however small units are basically low in electrical efficiency (33% down to <25%) only compensated for by a coincident and appropriately sized heat demand to use the recoverable waste heat.

A micro-CHP system could be utilised to provide electricity to the main church building for general requirements, plus a base heat-load for a large hot-water accumulator-vessel / thermal-store, which could in turn reduce a conventional boiler's work-load, or replace it altogether (depending on the size of the building's heat-load).

HEATING SYSTEMS

Three different Heating systems are considered:

a. Solar thermal (solar hot water)

This system is similar to PV in terms of the roof orientation issues that need to be considered. Consequently, the approach would be same, i.e. to have independent panels rather than to seek to integrate them with the roof covering or to substitute historic covering with solar panels.

The panels (either flat-plate collectors or evacuated-tube designs) are fixed directly to the roof surface on a frame, and pipes then generally pass through the roof to link to the plumbing inside the building. The flat-plates are generally cheaper, and are generally less visually intrusive. They work best for providing hot water for sinks and washing facilities, but via an accumulator vessel. A large solar thermal installation could provide supplementary heat (to a main heating system, e.g. a boiler or a heat pump) for under-floor heating networks. Issues to consider are: the appropriateness for some churches (as they may not have mains water supply); the route of the pipes entering the building; the need for an accumulator tank (where to site it); and the length that the pipes may have to run to get the water to where it is needed (may be some distance in a large church, which may prove problematic).

To maximise efficiency churches need to be using large quantities of hot water, so this would not be suitable for just washing up say once a week. A building that has more regular weekday use may want to consider this option, perhaps linking to facilities in a church hall as well, if applicable.

b. Heat pumps

For use with church buildings, heat pumps essentially come in two forms: Air-Source and Ground-Source.

An air-source heat pump works like a refrigeration unit in reverse. It utilises the ambient temperature of the air outside the building as the low-grade heat source, which is multiplied by the heat pump's operation and used to warm water to supply an internal heating

network, either an underfloor or radiator design. It consists of a box like a refrigeration unit, which needs to be housed outside (can be in a shed or similar structure if ventilated), or in some circumstances could be in the roof space. Air Source Heat Pumps are cheaper to install than a ground-source system because there is no external heat-collection pipe network in the churchyard, but the unit does need an electrical supply. There may be issues regarding noise with an air-source heat pump, which would need to be considered.

Ground-source heat pumps work by capturing the low-grade heat in the ground (typically 12- 13° C). This heat is collected via a trenched pipe network or a bore-hole. In terms of multiplying the heat that it has captured, it can be 300 - 400% efficient, although doesn't generally lend itself to a conventional radiator heating system. It is much more suitable for underfloor heating. A borehole based system (depending on the heat requirement) would need perhaps several boreholes of 60 – 70 m deep, and getting the drilling-rig needed for this to the site may be problematic within churchyards, depending what access routes are available.

The trench based system would need (depending on the heat requirement) several significant loops of trench at about 5 feet deep, and would be cheaper and arguably easier to undertake than a borehole, although both systems would have archaeological considerations for churches.

Heat pump solutions are generally only worth considering in the context of replacing the heating system, rather than as a bolt-on to an existing system. The latter could be relevant to a recent underfloor heating system, but this will be a rare situation.

c. Biomass

This consists of a boiler fuelled by either a processed or unprocessed form of wood-fuel (also known as biomass); the attraction of biomass being both its competitive price (compared to fossil-fuels) and that it is largely carbon-neutral, (with the CO_2 released during combustion being used by other trees to grow). Batched-fired systems (e.g. log-boilers) are manually fed as required, whereas fully automatic boiler systems draw processed fuel (e.g. wood-pellets or wood-chips) from an adjacent hopper as required. Space would be needed for the boiler and a feed mechanism, along with an accumulator water tank, although the tank does not have to be located with the boiler. If the boiler is remote from the church (e.g. in a boiler-room in the churchyard), the hot water produced by the boiler can be distributed via buried insulated pipes (with approximately a 1°C loss over 1km). Access to the site and fuel-storage are the main difficulties, as tractor or tipper-lorry access is needed for a wood-chip delivery, and pellets need to be pumped from a tanker. The initial capital cost for a biomass boiler system is more than that for a conventional oil or gas boiler, but significant fuel-cost savings can be made over several years, (e.g. wood-chips and logs will have a running-cost approximately half the price of oil at current prices, and the cost of wood-pellets, although similar to oil at the moment, should reduce in price and become more competitive.

CHP may be fuelled by Natural Gas, Heating Oil or from bio-energy sources, especially bio-gas. CHP was considered in the electrical notes above.

Where to go for further advice

If your PCC is considering the installation of a renewable energy system, it is best to make initial enquiries at an early stage to see whether it would be acceptable in principle.

A faculty would be needed for any type of installation, and **Informal Advice** from the DAC should be sought early on. **Planning Permission** may also be needed (as churches are not

exempt from Planning Permission where alterations or additions to the exterior of the church building or churchyard are proposed). The local authority planning department should be contacted at an early stage to see whether permission is needed, and whether the principle of the installation is acceptable. English Heritage and the National Amenity Societies may also need to be consulted depending on the listing grade and age of the church building.

General advice on environmental issues for parishes can be obtained from the **Diocesan Environmental Officer** (Martyn Goss); martyn.goss@exeter.anglican.org (01392) 294924.

Devon Association for Renewable Energy (DARE) have been working with churches to undertake scoping-studies exploring opportunities for renewable energy installations. If you wish for such a study to be undertaken at your church contact DARE on 01837 89200, or info@devondare.org

English Heritage have produced the following free guidance notes, all of which are available to download from their website www.english-heritage.org.uk or from www.helm.org.uk:

- Energy Conservation in Traditional Buildings;
- Small scale solar electric (photovoltaics) energy and traditional buildings;
- Small scale solar thermal energy and traditional buildings;
- Climate Change and the Historic Environment;
- Micro wind generation and traditional buildings;
- Building Regulations and Historic Buildings.

Grants may be available from various sources for the installation of the equipment, as a church is often classified as a 'community building', depending how much activity alongside the building's basic role as a place of worship takes place (e.g. pre-school groups, concerts, meetings, etc.). The level of grant will vary depending on the funder and the type of equipment being installed.

Further information on current grants can be obtained from the Senior Church Buildings Adviser louise.bartlett@exeter.anglican.org 01392 294944.