ESOS-ENERGY
Energy efficient solutions

Energy Audit and Survey Report

Church Hall, Goudhurst

PCC of St Mary's Goudhurst and Christ Church, Kilndown

Version Control

Author	Reviewer	Date	Version
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1. Executive Summary

An energy survey of Church Hall, Goudhurst was undertaken by ESOS Energy Ltd to provide advice to the church on how it can be more energy efficient and provide a sustainable and comfortable environment to support its continued use. This audit has been provided in conjunction with 2buy2, the Church of England's Parish Buying scheme provider and is subsidised from Total Gas & Power, the Parish Buying schemes principal energy suppliers.

Church Hall, Goudhurst is a 1932 build brick building with solid walls laid to Flemish bond. There is electricity supplied to the site and it is heated by oil.

The church has a number of ways in which is can be more energy efficient. Our key recommendations have been summarised in the table below and are described in more detail later in this report. It is recommended that this table is used as the action plan for the church in implementing these recommendations over the coming years.

Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)	£/tonne of CO2
Switch electricity suppliers to ones which provide 100% renewable supplies	Nil	TBC	Nil	immediate	None	Nil	N/A
Replace fluorescent lighting in hall with new LED fittings	2,409	£299	£1,179	3.94	List B	0.74	£1,593.28
Install roof insulation above ceiling to 270mm depth	1,072	£47	£1,500	31.73	List B	0.29	£5,215.06
Replace oil boiler with an Air Source Heat Pump	5,700	£251	£25,000	99.45	Faculty	1.53	£16,346.63
Install Solar photovoltaic panels	9,000	£280	£15,000	53.57	Faculty	2.76	£5,425.35

The Church should check any faculty requirements with the DAC Secretary at the Diocese before commencing any works.

Based on contracted market prices of 12.4260p/kWh for electricity and 4.41p/kWh of oil.

If all measures were implemented this would save the church around £870 operating expenditure per year.

Operating costs of electric heating are equivalent or lower than those of oil, since less preheating is required.

2. Introduction

This report is provided to the PCC to provide them with advice and guidance as to how the church hall can be improved to be more energy efficient. In doing so the church will also become more cost effective to run and seek to improve the levels of comfort.

An energy survey of the Church Hall, Goudhurst, TN17 1AL was completed on the 20th January 2020 by Dr. Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Diocesan Environment Officers Energy Group developing advice for the Church of England and authored the "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE Associate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church.

Church Hall, Goudhurst	
Gross Internal Floor Area	105 m^2
Listed Status	Not listed
Typical Congregation Size	N/A

The hall is typically used for 48 hours per week for the following activities

Daily Nursery	40 hours per week
Church Groups	3 hours per week
Community Use	5 hours per week

Hall annual use = 2500 hours

Heating hours: = 1900 hours

Estimated footfall = 10000 people

3. Energy Procurement Review

Energy bills for oil and electricity have been supplied for the Church Hall, Goudhurst and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single / Blended Rate	12.4260p/kWh	Lower end of current market rates
Standing Charge	34,472p/day	N/A

The current supplier is SSE

We would recommend that the church obtains a quotation for electricity supply from the Diocese Supported parish buying scheme, http://www.parishbuying.org.uk/energy-basket. This scheme only offers 100% renewable energy sourced energy and therefore it is an important part of the process of making churches more sustainable. This would count towards the next phase of the Eco Church scheme which the church is working towards.

A review has also been carried out of the taxation and other levies which are being applied to the bills. These are:

VAT	5%	The correct VAT rate is being applied
CCL	not charged	The correct CCL rate is being applied.

The above review confirmed that the correct taxation and levy rates are being charged.

4. Energy Usage Details

4.1 Annual Consumption

The Church Hall, Goudhurst uses around 3,300kWh/year of electricity, costing in the region of £580 per year, and 1,000litres [10,720kWh]/year of oil, costing £473.

This data has been taken from the annual energy invoices.

Utility	Annual use/ kWh	from	to	Cost
Electricity	3,300	Q3/2018 1/7/18	Q2/2019 30/68/19	£581
Oil	1000 Litres 10720	1/1/19	31/12/19	£473

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Hall				cupboard on west wall of main room

The meter was not accessible as the nursery was in session.

It is recommended that the church consider asking their suppliers to install a smart meter so that the usage can be monitored more closely and the patterns of usage reviewed against the times the building is used.

4.2 Energy Profiling

The main energy use within the church can be summarised as follows:

Service	Description	Power	Annual Use/ kWh	Estimated Proportion of Usage %
Gas heating	(~1900 hours use)	20kW	10,720	76.5%
Boiler pump	(~1900 hours use)	50W		
Lighting	Fluorescent T8, F56W x 16 Kitchen ~80W Toilets 2 x 20W Upper room 1 CFL 25W TOTAL	896W 1000W	 2,500	 17.8%
Heating [Electric]	Portable radiant heater (upper room, rarely used)	1250W	0	-
Hot Water	Zip Hydroboil water heater, 2 hours/week	1.5kW	500	3.6%
Other Small Power	Fridge Microwave 1 hour/week Dishwasher Printer CCTV system 40 hours/week Vacuum cleaner 1.5 hour/week	100W 1000W 100kW 50W 75W	450 52 10 80 100 12 500 100	 9.3%
Organ	Organ	1kW	78	0.6%

Total Annual Consumption 2019: 3300kWh

5. Energy Saving Recommendations (Electricity)

5.1 Lighting (fittings)

It is recommended that when the fluorescent tubes require replacement, new LED fittings are installed. Compact Fluorescent Bulbs should be replaced by LEDs when necessary.

6. Energy Saving Recommendation (Heating)

6.1 Heating System

The hall currently uses oil fired central heating to heat the church.

The boiler is a Grant Module 50-70 of maximum output 20.5kW. It is located on the south wall of the building next to the nursery play area, which is not an ideal location should it require maintenance.

The following recommendations in Section 6 refer to maintenance and optimisation of the present system. Section 7 considers alternatives.

6.2 Magnetic Particle Filter

The boiler does not appear to be fitted with a magnetic particle filter as illustrated below. This apparatus catches any rust or metal particles and prevents them being deposited on the boiler heat exchanger. One should be installed if it is planned to continue using this heating system long term. Corrosion inhibitor should be added to the system when your boilers are serviced annually.

6.3 Endotherm Advanced Heating Fluid

In order to improve the efficiency of the heating system further it is recommended that an advanced heating fluid (http://www.endotherm.co.uk/) is added to the heating system.

This fluid in in addition to, and complements any existing inhibitors in the heating system and is added in a similar way. The fluid works to improve the ability of the boiler to transfer heat into the heating system and for the radiators and other heating elements to give out their heat into the rooms. It does this by reducing the surface tension of the water and increasing its capacity to transfer and hold heat. Case studies have demonstrated that the addition of this fluid into heating systems reduces heating energy consumptions by over 10% as well as helping the building heat up quicker.

Endotherm can be self-installed.

7. Alternative Heating Systems

7.1 Heat Pumps

A heat pump is recommended to replace the oil boiler and supply the present radiator system .

For optimum efficiency, they deliver low grade heat (warm water) at a constant rate, so are suited to regularly / constantly used buildings where the temperature is maintained.

Heat pumps are compatible with constant or regular heating.

Heat Pumps consume electricity, but deliver between 2.5 and 4 times the amount of heat in kWh that they consume. Heat pumps work by circulating refrigeration fluid and taking heat from a reservoir (the air or ground) and upgrading it (the fluid gets hot when compressed – in the building. When it evaporates it cools, and warms up again in contact with the external heat

supply, air or ground. The Coefficient of Performance (COP) relates the amount of heat energy delivered to the electricity used. It is normally between 2 and 4.

Air Source Heat Pumps [ASHP] require externally mounted units of similar appearance to air conditioning units with a clear airflow. An ASHP could be located in the same location as the present boiler, but it would be more convenient if a location at the east end of the building was found, away from the play area.

ASHPs have a lower COP when the air temperature is cold and when they are heating a building from cold. A move to ASHP powered central heating would allow for 100% renewable heating if electricity is procured from a 100% renewable source (including Parish Buying), or from onsite generation. For St Mary's Hall, with oil fired heating currently delivering 10,720kWh of heat annually, a COP of 3 would require 3,570kWh of electricity to supply it; and 4,290kWh at COP 2.5, costing £440 to £540, compared to the £473 cost of oil for 2019.

Costs of a heat pump in the 15-20kW range are about £25,000.

7.2 Under Floor heating

This would require relaying of the floor. Underfloor heating would raise the floor level by 150-200mm (unless suitable excavation is performed). It is a method requiring constant or regular supply of low grade heat, so is ideally suited to supply from a heat pump. Underfloor heating takes a long time to warm up; so it is only compatible with regularly used buildings, local examples include St Mary the Virgin in central Ashford which hosts an arts venue where the nave is fitted, and St Mary the Virgin, Willesborough, Ashford which hosts a café open every morning and activities on several evenings. Systems take a long time to warm up so they are only really suitable for a regularly used building. Should an underfloor heating system be selected, it should be run using a heat pump rather than an oil boiler.

The current use hours suggest this is a suitable location for underfloor heating, but the long warm up times mean it would lack flexibility for on/off weekend use of the hall.

This is an expensive option, costing in the region of £1000/m^2.

7.3 Use of Electric Radiant Panels

To deliver c. 11,000kWh of heat in a building which is used fairly constantly, direct electric heating requires 11,000kWh of electricity, whereas a heat pump uses about one third of this.

Radiant panels can be used to replace the current central heating radiators, but since they will be running for many hours during the heating season when the nursery is in session, heated to 20°C, there would be no benefit except for weekend use of the hall for short periods.

[The benefit for churches is rapid heating from cold for an irregularly used building].

If they were to be considered, low surface temperature panels designed for ground level installation and safe for schools (55°C) and hospitals (42°C) would be required. Normally available in white, they can be sourced in other colours including matching to stonework or brickwork, or decorated. https://www.suryaheating.co.uk/custom-image-heating-panels.html

Suitable electric panel heaters would be far infrared panels such as https://www.warm4less.com/product/63/1200-watt-platinum-white- . These can be purchased widely and fitted by any competent electrician. It is recommended that they are fitted with a time delay switch such as https://www.danlers.co.uk/time-lag-switches/77-products/time-lag-switches/multi-selectable-time-lag-switch/159-tlsw-ms so they can not be left on accidently after use.

Costs are £350-500 wall mounted and £500-700 ceiling mounted per panel.

8. Energy Saving Measures (Building Fabric)

8.1 Ceiling Insulation

It is recommended that the void above the ceiling is inspected, and loft insulation up to the recommended maximum of 270mm thickness is installed. [See image in Section 5.1].

This must be added to the roof prior to considering a heat pump solution as heat pumps require well insulated and airtight buildings to work successfully.

9. Renewable Energy Potential

The potential for the generation of renewable energy on site has been reviewed and the viability noted.

Renewable Energy Type	Viable
Solar PV	Yes
Battery Storage	Yes
Wind	No – no suitable land away from buildings
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Ground Source Heat Pump	More expensive.
Air Source Heat Pump	Yes
Biomass	No – not enough heating load as well as air quality issues

9.1 Solar PV potential

For St Mary's church hall, the south side of the roof offers a potential location – this would have to be confirmed with your architect as to suitability for extra weight and wind loading on the roof structure.

The south facing roof offers an area of around 60m^2. This could generate 0.15kWpeak/m^2 giving a 9kWpeak system. A 1kWpeak system can generate 1000kWh annually in Kent, to give a total annual generation of 9,000kWh. This is around 2.5 times the hall's annual electricity use (3300kWh) – although much of that use will be during the evening and night.

Using average 2018 costs for smaller domestic installations of £1,667 per kWpeak, a 9kWpeak system would cost £15,000. This does not include cost of any battery.

Battery Storage is not strictly a renewable energy solution, but battery storage does however provide a means of storing energy generated from solar PV on site to be able to be used at peak times or later into the day when the PV is no longer generating. It therefore extends the usefulness of the existing PV system and should be able to supply the entire demand of the building from solar generation. This is a new but fast-growing technology with prices expected to fall substantial over the next 2 to 3 years therefore investment into this may be worth delaying at this stage.

The viability of a solar PV system would be increased if the heating system was to be changed to either a direct electrical system, or to a heat pump. A heat pump is calculated to require around

4,000kWh, giving a total demand of 7,300kWh which is within the generation and storage capacity of a 9kWpeak solar PV plus battery system.

The government has proposed a new "Smart Export Guarantee" to replace the Feed in Tariff. The rate depends on the individual contract and is unlikely to exceed 5.5p/kWh. A cost-benefit analysis of solar PV should assume that the hall consumes most solar electricity itself.

10. Other Recommendations

10.1 Electric Vehicle Charging Points

There is a small parking area near the church hall. In order to make a visible statement on the churches mission of stewardship and to facilitate more sustainable transport choices by those both visiting the church and using the hall, the church may wish to consider installing an electric vehicle charging point, probably near to the church hall to allow visitors to charge their electric car.

Another location which could benefit is the vicarage and church office.

Installing a unit such as a Rolec Securi-Charge http://www.rolecserv.com/ev-charging/news/view/Robust-EV-Charging-With-Rolecs-SecuriCharge-EV-Wall-Unit-Coin-Token-PAYG would allow the church to be able to sell tokens or have a coin operated device that would at least cover the costs of the electricity use and could make a small income. As the hall is a place of work for the pre-school users it may be able to benefit from a grant to part cover the installation costs of a charger from https://www.gov.uk/government/publications/workplace-charging-scheme-guidance-for-applicants-installers-and-manufacturers.

10.2 Insulation, Church Office

It was reported that the church office, which is regularly used, is converted from a former coal house at the rear of the vicarage and has solid walls. This room can get very cold and hence requires a large amount of heating for its size. It is recommended that the PCC investigate firstly installing more loft insulation over the ceiling, if it is not already at the 270mm maximum depth and secondly, external insulation around the walls.

11. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available at https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-Nov-2019.pdf

12. Faculty Requirements

It must be noted that all works intended to be undertaken should be discussed with the DAC at the Diocese.

Throughout this report we have indicated our view on what category of permission may be needed to undertake the work. This is for guidance only and must be checked prior to proceeding as views of different DACs can differ.

Under the new faculty rules;

List A is for more minor work which can be undertaken without the need for consultation and would include changing of light bulbs within existing fittings, repair and maintenance works to heating and electrical systems and repairs to the building which do not affect the historic fabric.

List B is for works which can be undertaken without a faculty but must be consulted on with permission sought from the Archdeacon through the DAC. This includes works of adaptation (but not substantial addition or replacement) of heating and electrical systems and also the replacement of existing boilers so long at the same pipe work, fuel source and flues are used. It can also be used to replace heating controls.

All other works will be subject to a full faculty.

Works which affect the external appearance of the church will also require planning permission (but not listed building consent) from the local authority and this will be required for items such as PV installations.

13. Report Circulation

In addition to the PCC, this report is also sent to:

1. Your DAC secretary and your DEO, because
    - They maybe be able to offer you help and support with implementing your audit
    - They want to look across all the audits in your diocese to learn what the most common recommendations are.

2. Catherine Ross, the officer in the Cathedral and Church Buildings team centrally who leads on the environment, who wants to learn from all the audits across the country. She will be identifying cost-effective actions churches like yours might be able to make.