ESOS-ENERGY
Energy efficient solutions

Energy Audit and Survey Report

St Michael and All Angels, Kingsnorth, Ashford

Ashford Town Parish PCC

Version Control

Author	Reviewer	Date	Version
Paul Hamley	Matt Fulford	3rd February 2020	1.0

Contents

1. Executive Summary

An energy survey of St Michael and All Angels, Kingsnorth, Ashford 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.

St Michael and All Angels, Kingsnorth, Ashford is a smaller Grade II listed church on the site of an earlier Saxon building consisting of an 11th century nave with steeply pitched single roof, 18th century chancel and west tower. The church was extensively restored and re-ordered in 2006 with a suspended floor and new heating system. To the north east corner a two storey construction dating from 2007 is attached containing a meeting room and kitchen on the ground floor, offices and toilets on the first floor and a further office on the second floor. There is both gas and electricity supplied to the site.

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.

Short Term: 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
Draughtproofing measures, church doors	2000	£45	£50	1.12	List A	0.37	£135.90
Change 400W floodlights to 150W LED.	1000	£130	£400	3.08	None	0.31	£1,302.08
Stop morning floodlighting	300	£40	Nil	Immediate	None	0.09	£-
Consider using localized seat heating for office top up heating during cold weather	800	£104	£100	0.96	None	0.25	£406.90
Install solar photovoltaic panels on church offices roof	2430	£315	5000	15.84	Faculty	0.75	£6,697.96

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

Based on contracted prices of 12.9917p/kWh for electricity and 2.2411p/kWh for mains gas respectively.

If all measures were implemented this would save the church £630 operating expenditure per year.

2. Introduction

This report is provided to the PCC of St Michael and All Angels, Kingsnorth, Ashford to provide them with advice and guidance as to how the church 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. Where future church development and reordering plans are known, the recommendations in this report have been aligned with them.

An energy survey of the St Michael and All Angels, Kingsnorth, Ashford, Church Hill, TN23 3EF was completed on the 10th 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.

St Michael and All Angels, Kingsnorth, Ashford	**606213**
Gross Internal Floor Area	Church 165 m^2 Rooms 135m^2
Listed Status	Grade II
Typical Congregation Size	60

The church typically used for 16 hours per week for the following activities

Services	2.5 hours per week
Meetings and Church Groups	7 hours per week
Community Use Parent & toddler group Occasional school assembly	4.5 hours per week
Occasional Offices 15 Weddings in 2019 30 baptisms	2

Church annual use: 850 hours

Heating hours: 435 hours

Estimated footfall 10,700 people

3. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Michael and All Angels, Kingsnorth, Ashford and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single / Blended Rate	12.9917p/kWh	Lower end of current market rates
Standing Charge	21.9760p/day	N/A

The current gas rates are:

Single / Blended Rate	2.2411p/kWh	Lower end of current market rates
Standing Charge	285p/day	N/A

The above review has highlighted that the current rates being paid are in line or below current market levels and the organisation can be confident it is receiving good rates and should continue with their current procurement practices.

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

St Michael and All Angels, Kingsnorth, Ashford uses 5,200kWh/year of electricity, costing in the region of £800 per year, and 43,500kWh/year of gas, costing around £2,000.

This data has been taken from the annual energy invoices provided by the suppliers of the site.

Utility	Annual use/ kWh	from	to	Cost
Electricity - Church	5242	1/9/18	31/8/19	£794.83
Gas – Church	43501	31/8/18	31/8/19	£2,051.11

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	D0459864	AMPY Polyphase Type 5192J	Yes, but no signal	NW corner of church
Gas – Church	E016 K06628 17 D6	Honeywell Thermis BK-G10E	Yes	Storeroom, ground floor behind kitchen

All the meters are AMR connected and as such obtaining an energy profile for the entire energy usage should be possible.

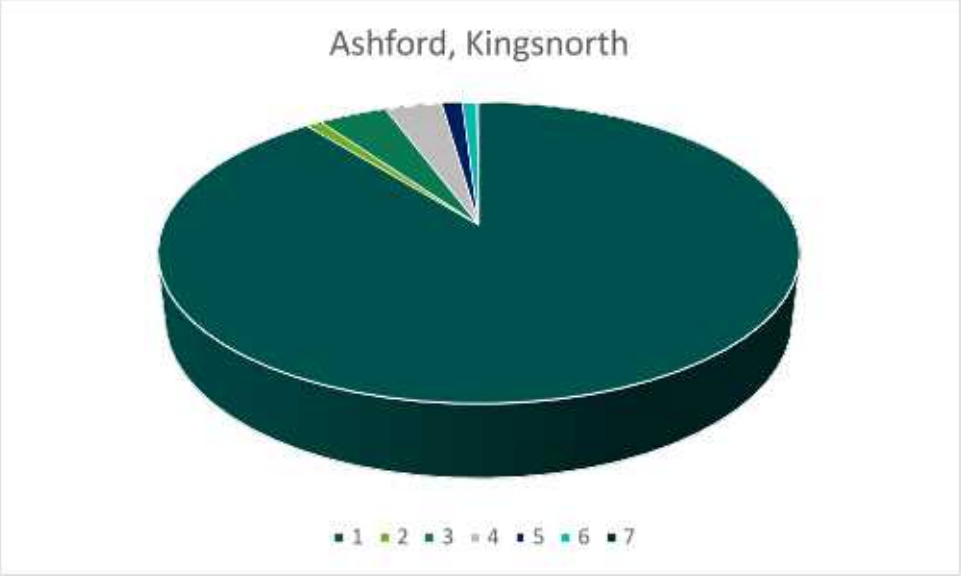
4.2 Energy Profiling

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

Service	Description	Power	Annual Use/ kWh	Estimated Proportion of Usage %
Gas heating	2 x Worcester Logamax Plus boilers, **50kW** each. 435 heating hours if always on full.	100kW	43500	89.3%
Boiler pump	Grundfos	140W	61	0.1%
Lighting				
Nave	4 chandeliers x 8 candle bulbs @11W	352W		
	x 8 LED downlights @15W	480W		
	1 chandelier x 4 candle bulbs	44W		
	X 4 LED downlights	60W		
Chancel	4 LED spotlights	100W		
	4 pendants	100W		
	CHURCH TOTAL	1136W	900	
Centre				
2nd Floor				
Office	4 spotlights	200W		
Store/boiler	2 – rarely used			
Stairwell	Uplight 2 x CFL @ 15W	30W		
	+ 1 large circular	40W		
1st Floor				7.6%
Office	8 Fluorescent T5, 40cm @ 20W (1350hrs)	160W		
Choir vestry	2 recessed	100W		
Toilet	1 large circular	40W		
Stairwell	Uplight 2 x CFL @ 15W	30W		
	+ 1 large circular	40W		
Ground floor				
Meeting	12 x CFL @ 20W	240W		
room	4 uplights x 2 CFL @ 15W	120W		
	1 large circular	40W		
Kitchen	1 fluorescent 70cm	30W		
Store	1 large circular	40W		
Toilet	6 x CFL @ 20W	120W		
Foyer	CENTRE TOTAL	1230W		
			1116	
Outside	2 x 400W. Average 5.5 hours/night	800W		
Floodlights			1575	
	9 total, rarely on	500W		
		1300W	100	

Porch, gate, Path Lights				
Heating [Electric]	Office 2 x convector heater 2kW each Occasional use	4kW	400	0.8%
Hot Water	Kettle @ 15 boils per week Coffee machine ~ 200 hours per year Heatrae Sadia Multipoint 30	3kW 2.14kW 2kW	100 400 100	1.2%
Other Small Power	Sound system est. 200 hours per year Vacuum cleaner Computer occasional use Computer daily use Photocopier	500W 2kW 100W 100W 500W	100 100 60 132 33	0.9%
Organ	Organ	500W	60	0.1%

Total Annual Consumption 2019: 5242kWh



KEY 1 Gas Heating 2 Electric Heating and boiler pump

3 Internal Lighting 4 External Lighting 5 Hot Water 6 Small power 7 Organ

4.3 Energy Benchmarking

In comparison to national benchmarks for Church energy use St Michael and All Angels, Kingsnorth, Ashford uses 87% electricity and 97% heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	St Michael and All Angels, Kingsnorth, Ashford use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Michael and All Angels, Kingsnorth, Ashford (elec)	300	17.5	20	10	87%
St Michael and All Angels, Kingsnorth, Ashford (heating fuel)	300	145	150	80	97%
TOTAL	300	162.5	170	90	96%

There is currently no benchmark data which takes hours of use and footfall into account.

[1] CofE Shrinking the Footprint – Energy Audit 2013

5. Energy Saving Recommendations (Electricity)

5.1 Lighting (fittings)

The majority of the lamps fitted appear to be LED or Compact Fluorescent Lamps (CFL). Any CFLs should be gradually replaced by LED when they fail. Any halogen lamps should be replaced by LED lamps immediately – the spotlights within the second floor office were not identified. Any new LED fitting would have a much longer life and hence reduce the need to replace the lamps in the ceiling.

The recessed lights in the first floor vestry office may be GU10, for which LED replacements are available. For the spot lights the Megaman range of LED spot (reflector) lights https://www.megamanuk.com/products/led-lamps/reflector/ provides some very suitable substitutes to the current lamps.

All of these lights are at an easily accessible height and can be changed by the church.

5.2 Lighting (control for internal lights)

There are several lights which may remain on all the time the building is occupied in areas such as corridors, toilet areas, staircases and the like. Some of these areas are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly. There are also spaces which benefit from a good amount of natural daylight coming in through the windows and skylights where artificial lighting is not required for much of the year during the day.

It is recommended that a motion sensor is installed on these specific lighting circuits so that the lights come on only when movement is detected in the space and turn off approximately two to five minutes after the last movement has been detected (note that the duration of the time lag after which the light goes off needs to be consider alongside the type of light that is fitted. LED lights are much more suited to being switched off after only a short duration than some fluorescent lights). These movement sensors (commonly called PIRs) also have light sensors integrated into them so they can be used to make sure that the light does not come on if there is already sufficient daylight in the space.

Your existing electrician or any NICEIC registered electrical contractor can install PIR sensors onto existing lighting circuits. This can be carried out without significant disruption to the use of the space.

5.3 External lights

The current floodlights are 400W and should be replaced by 150W LED units such as illustrated below or equivalent.

Brackenheath N6060; 150W, 4000K colour temperature.

5.4 Lighting (control for external lights)

The external lighting is reported as being on from dusk until dawn. An average of 12 hours with 800W of lighting gives a consumption of 3,500kWh, which appears to be too high for the annual church consumption of 5,200kWh. It is likely that the timer is set for two periods, evening and morning. If so, with an average of 5.5 hours use per night this gives under 1,600kWh.

For efficient operation and to reduce light pollution and nuisance to neighbours it is generally recommended that external lighting is turned off between 11pm and 6am unless required for specific purposes.

It is therefore recommended that the existing timer is adjusted to switch off the external lights between 11pm and 6am daily and also over the weekend if not required. A timeclock with a time and day capacity is recommended over those that only have time of day capacity. Sangamo (http://sangamo.co.uk/) make a wide range of commonly used timeclocks which any qualified electrician can install.

6. Energy Saving Recommendation (Heating)

6.1 Heating System and Strategy

The church currently uses two Worcester Logamax Plus 50kW gas boilers installed in 2019, one to heat the church and one the offices. This is reported to work well and provides adequate thermal comfort into the church. Given that the system is successful and not overly wasteful of energy we would recommend that this system is continued with and consideration is given to the following improvements.

6.2 Hydrogen

If gas boilers are to be retained in the medium to long term, then the boiler will need to be made hydrogen ready. Hydrogen is due to be added to the gas grid over the next five year period. If plans to decarbonise the gas grid are implemented; the hydrogen mix will eventually exceed 20% and a hydrogen compatible boiler (and piping) will be required. The transition will be overseen by the regulatory bodies in a similar way to that between town gas and North Sea gas.

6.3 Boiler Timing Optimisation

Experiments in the Diocese of Lichfield at over 50 churches have established that hot water radiator heating can be optimised by being switched off 45 minutes before the end of the service or event.

Purchasing of a temperature datalogger will allow the time for the church to heat (in different weather conditions) to be understood, as well as the time to switch off to be optimised. This would require someone with a computer to plug in the device and download the readings.

A suitable model retailing for around £40 is https://www.lascarelectronics.com/easylog-data-logger-el-usb-1/

6.4 Controls

Boiler timer controls are located in the boiler room on the second floor. It is suggested that a simple set of "how to" instructions are laminated and displayed adjacent to the controls which also indicate who has permission and who should be informed of changes and problems.

7. Energy Saving Measures (Building Fabric)

7.1 Roof Insulation

Fit 270mm of insulation into the loft

There is a void above the ceiling and underneath the steeply pitched roof.

The church is currently used on four days throughout the week. If it becomes more frequently used, it becomes worthwhile to install insulation if access is possible, up to the recommended maximum of 270mm.

The ceiling/roof of a building is the largest contributing area to heat loss from a building as heat rises. The insulation of such spaces can therefore have a dramatic impact on both the efficiency of the heating system and the temperature of the space below.

A free survey and quotation for the supply and installation of insulation to the loft spaces can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

7.2 Draught Proofing to Doors

The south porch door and tower door do not close tightly against the stone surround and hence an amount of cold air is coming into the church around the side and base of these doors.

The porch door has a leather strip which closes against the stonework. This should be kept maintained and effective. If the space is too large for a flap to keep airtight, rolling a long strip of leather around some fabric / foam / horsehair (something soft, compressible and elastic) and pinning it to the door with brass tacks would be effective.

If the tower door (above) is rarely used it should be made airtight.

Other simple measures such as using a small fridge magnet painted black over the large keyhole or the use of 'sausage dog' type draught excluders at the base of little used doors can prove to be very effective. Doors should be reviewed in daylight and gaps where the light shines through sealed or filled in whatever the most appropriate way is for the specific door.

7.3 Closed Door Policy

The main entry door in the porch should be kept closed in cold or windy weather and quickly closed behind the congregation by your friendly welcome team!

8. 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	Potential small system
Battery Storage	Yes, with SPV
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	No – archaeology in ground
Air Source Heat Pump	No – no location
Biomass	No – not enough heating load as well as air quality issues

8.1 Solar PV potential

A small solar photovoltaic system, capable of supplying daily office needs could be located on the south side of the office roof (above the skylights) subject to permission, although this would be partly visible at the east end. The panels would have to be installed above the skylights, below or level with them would be too shaded. The alternative is to install on the tower roof, which would involve more cabling.

Any location would have to be confirmed with your architect as to suitability for extra weight and wind loading on the roof structure.

The end of the office roof above the skylight would be visible from the path to the east of the church.

The office building roof offers an area of around 10m^2. This could generate 0.15kWpeak/m^2 giving a 1.5kWpeak system. A 1kWpeak system can generate 1000kWh annually in Kent, although due to the proximity of the chancel roof an over shading factor should be applied to give a total annual generation of 1350kWh. This is in the smaller than the church's annual electricity use of 5200kWh.

The tower roof has an area of approximately 12m^2, allowing for access around the edges this could accommodate 8m^2 of panels giving a further 1080kWh, a total of 2430kWh.

Options include installing a battery so that all of the energy generated can be used. It is assumed that panels would have to be laid directly onto the roof surface.

Using average 2018 domestic installation costs for small arrays (£1,667 per kWpeak); a 3kWpeak system would cost £5,000, plus extra for access at height and cabling. This does not include the 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 particularly in this sort of church. 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 government has advertised a "Smart Export Guarantee" to begin in 2020 which would pay for electricity generated and exported to the grid (the Feed in Tariff having ended). With a small system and a regularly used office, it would be expected that much of the electricity generated would be consumed on site, and this would be the case with a battery.

9. 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

10. 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.

11. 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.