ESOS-ENERGY
Energy efficient solutions

Energy Audit and Survey Report

St Nicholas of the Cornilo, Ringwould

PCC of the Cornilo Churches

Version Control

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St Nicholas of the Cornilo, Ringwould 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 Nicholas of the Cornilo, Ringwould is thought to date from at least 1160, with a 13th century chancel extension, 14th century aisle and porch and 17th century tower. There is electricity supplied to the site, the heating is fuelled 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.

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
Draught proofing of doors	800	£35	£10-30	1	List A	0.17	£175
Replace external Lych Gate floodlight with LED floodlight	800	£142	£60	0.5	List B	0.20	£300
Replace four kitchen floodlights with LED floodlights	272	£48	£240	5	List B	0.07	£3,429
Total lighting	1072	£190	£300	1.5	List B	0.27	£1,111
Contact suppliers to arrange for the meters to be changed to smart meters	None	None	Nil	N/A	None	-	N/A
Switch electricity (and gas) suppliers to ones which provide 100% renewable (or green gas) supplies	None	None	Nil	N/A	None		N/A
Install Under Pew Electric Heating	14,600	£450+	£6,600	14.67	Faculty	3.93	£1,679

Install radiant panel far infrared heating panels in kitchen	Included above	Included above	£800	N/A	Faculty	N/A	N/A

Additional advice on how best to maintain efficiency in the existing boiler until it is replaced for under pew electric heaters has been provided in this report.

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

Based on the current contracted price of 17.81p/kWh for electricity.

If all measures were implemented this would save the church in the region of £650 per year (based on an oil price of 49p/litre or £735 annually for 1500 litres).

2. Introduction

This report is provided to the PCC of St Nicholas of the Cornilo, Ringwould 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 Nicholas of the Cornilo, Ringwould, was completed on the 2nd December 2019 by 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 Nicholas of the Cornilo, Ringwould	606166
Gross Internal Floor Area	185 m^2
Listed Status	Grade I
Typical Congregation Size	25

The church typically used for 3.2 hours per week for the following activities

Services	2 hours per week
Meetings and Church Groups	1 hours per week
Occasional Offices	4 per year

This gives a total of 170 Use hours per year.

The church is heated for an estimated 340 Heating hours per year, but with background heating employed with thermostat control.

Annual footfall is estimated at 2500

[Sundays 25 x 52 + tea & chat 25 x 12 + 4 PCC meetings + 4 baptisms/funerals + few visitors/day]

3. Energy Procurement Review

Energy bill data for electricity have been supplied by St Nicholas of the Cornilo, Ringwould and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single / Blended Rate	17.81p/kWh	Above current market rates
Standing Charge	25p/day	N/A

The current oil price is:

Annual consumption	1500 litres	16,050kWh
Current cost	49p/litre	£735 annually

Note that the oil price is very volatile, cost is dependent on time of year, market fluctuations and urgency of delivery.

The above review has highlighted that there are opportunities to gain cost savings from improved procurement of the energy supplies at this site. We would therefore recommend that the church obtains a quotation for its electricity supply from the CofE parish buying scheme, https://www.parishbuying.org.uk/index.php/categories/energy/energy-basket. This scheme only offers 100% renewable energy sourced electricity and therefore it is an important part of the process of making churches more sustainable.

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

St Nicholas of the Cornilo, Ringwould uses 1,740 kWh/year of electricity, costing in the region of £400 per year, and 1500 litres/year of oil, costing in the region of £750.

This data has been taken from information provided by the chruch.

St Nicholas of the Cornilo, Ringwould has one electricity meter.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	16M0007554	General Electric SGC 1311 SGM 1312	Yes	Tower ground floor, north wall

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.

4.1 Energy Profiling

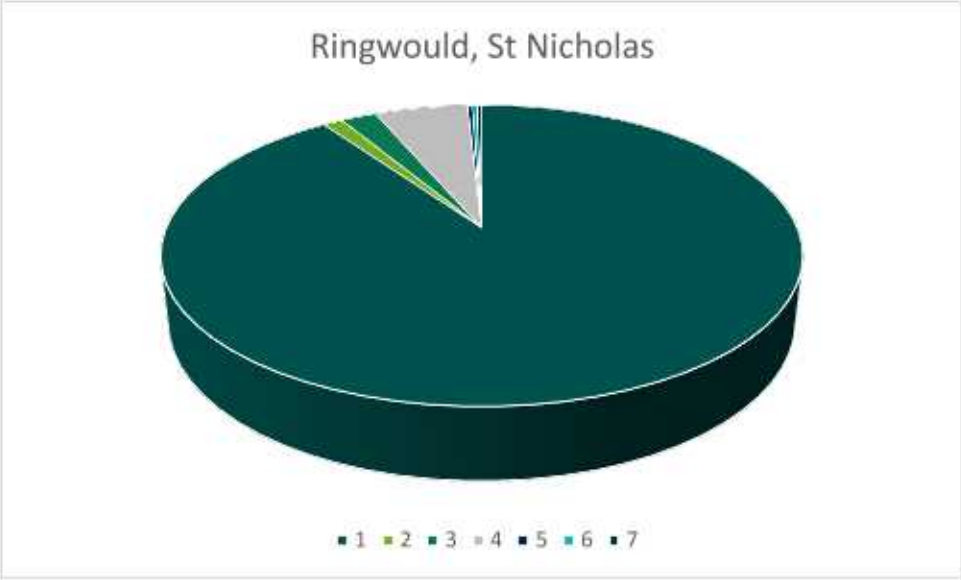
The main energy use within the church can be summarised as follows:

Service	Description	Power	Annual Use/ kWh	Estimated Proportion of Usage
Lighting	See Lighting survey, Appendix 1			%
	New LED lighting	480W	81	
	Kitchen floodlights	2000W	300	

	External floodlight	500W	1000	
Heating	Oil, Church, 50kW boiler 340 heating hours 1500litres average annual use (10.72kWh/L)	47kW average	16,000	%
Heating (electric)	Portable fan heater in ringing room Est. 70 hours use	3kW	210	%
Hot Water	Kettles, 2 x 2,5kW Est. 15 boils of 3 minutes/ month x 12 Ariston Water heater in kitchen under sink – rarely used Heatrae Sadia Handy hand wash heater (toilet only open for services and meetings)	5kW 3kW 3kW	22 8 20	%
Other Small Power	Printer PA System (on for services, not meetings)	200W 500W	2 50	%
Organ	Organ, pipe est 1.5h/ week	500W	50	%
		Total	1743kWh	

The figures above are best estimates: it is noted that the lighting was changed for LED in March 2019, and the figures for annual electricity use (1741kWh) are for a whole year so will include a portion of the pre-LED lighting costs. The use and cost for the financial year 2019-20 may be reduced as a result; but it appears that the major use is from the non LED floodlights.

Calorific value for oil is taken from https://www.rensmart.com/Calculators/HeatingOil



KEY 1 Oil Heating 2 Electric Heating (ringing room) 3 Internal Lighting (LED)

4 External floodlight 5 Hot water 6 Small power 7 Organ

As can be seen from this data, the heating makes up by far the largest proportion of the energy usage on site. The other significant load is from the external floodlighting.

4.2 Energy Benchmarking

In comparison to national benchmarks[1] for Church energy use, St Nicholas of the Cornilo, Ringwould uses 67% electricity and 57% of heating energy compared to the average small church.

	Size (m^2 GIA)	St Nicholas of the Cornilo, Ringwould use kWh/m^2	Typical SMALL Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Nicholas of the Cornilo, Ringwould (electricity)	185	9.4	14	10	-67%
St Nicholas of the Cornilo, Ringwould (heating fuel)	185	87	145	80	-60%
TOTAL	185	97	159	90	-61%

The low figures compared to average values reflect the low usage hours of the church.

5. Energy Saving Recommendations (Electricity)

5.1 Lighting (fittings)

The lighting makes up the major component of electricity use. The lighting in the nave, chancel and aisle were changed to LED in March 2019. The remaining lights in the kitchen, and that on the porch are floodlights; these offer the opportunity to reduce operating cost further for a short payback period

It is recommended that all of the floodlights, scheduled in Appendix 1, are changed for LED.

If all the floodlights were changed the total capital cost (supplied and fitted) would be £300-500 (based on a 100W LED floodlight cost of £60; the external light will have to be a fully weatherproofed example. The annual cost saving would be £190 resulting in a payback of around 2 years. These lights could be self-installed.

Lighting in the vestry/kitchen area

[1] CofE Shrinking the Footprint – Energy Audit Report September 2013

6. Energy Saving Recommendation (Heating)

6.1 Heating System and Strategy

The church currently uses oil to heat the church. An annual use of around 1500 litres is equivalent to 16080kWh. Estimating the annual heating hours, starting from an 06:30 to 11:00 Sunday heating regime (plus other times) gives 340 heating hours.

The burner is rated at 42kW, the boiler at 32kW; if it is operating at maximum capacity this gives 502 operating hours. A thermostat situated near the pulpit is used to maintain a minimum temperature of 12°C during the heating season and this background heating accounts for the extra hours.

There are only a few radiators, apparently much of the heat transfer is through the pipework, and it is reported that the church often does not exceed 14°C, with limited output from the radiators.

The boiler output when new is of the same order as a larger domestic boiler, so it is unsurprising that it is unable to heat the large volume of the church sufficiently or rapidly.

It is recommended that the church look to install electric under pew heaters which can deliver heat where and when it is required. This will have financial advantages as well as significantly lowering the church carbon footprint. Overhead radiant chandelier heaters have been discussed but are not suited to the church due to its layout not giving suitable installation points.

Moving to a Parish Buying contract would access 100% renewable electricity.

Meanwhile, the following advice is given to maintain the current system until replacement.

6.2 Reduce / Discontinue Background Heating

As with most medieval churches, this church would have survived most of its life without any form of heating. The modern additional of heating is not needed to preserve the fabric but only to provide thermal comfort to occupants. The previous trend of 'conservation heating' for fabric issues is now largely considered to be unnecessary and is being avoided by the likes of National Trust and English Heritage. The only times when background heating may be required is if there are historic wall paintings or to for the preservation of large artefacts such as tapestries. The organ (and other sensitive areas such as historic papers stored in the vestry) may require some local background heating specific to that area. In general, sensitive paper records should be removed for storage in the county archive and organs can be installed with a local background tube heater such as https://www.dimplex.co.uk/product/ecot-4ft-tubular-heater-thermostat within the organ casing in order to provide the heat where it is required. The fabric is often subject to the greatest damage by humidity (which is naturally higher when the air is warmer as warmer air has greater capacity for holding more moisture), as a result of large temperature swings (from central heating systems turning on and off) and from the excessive drying out/baking of timbers where high temperature heating units have been fixed to them (such as overhead heaters fixed to timber wall plates)

Providing constant background heating to the church building as a whole is excessive and wasteful of energy. At the very least we would recommend that this background level is reduced from 12°C to 10°C. From the discussion held, it is probable that the boiler and radiator system is unable to heat from below 10°C to a comfortable level without running for many hours, if at all, so this method should be maintained until system replacement. Fortunately, the church is small; this and low hours of use are keeping the current costs manageable!

6.3 Boiler Maintenance: Clean / Flush Existing Heating System

To ensure longevity, the system should be periodically flushed and cleaned to remove any scale and corrosion. The church should have a record of when this was done last. This should be added to the system when your boilers are serviced annually.

6.4 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.

6.5 Under pew heating

The church has seven rows of pews; the central area probably requires three sets of heaters whilst the south side probably requires one heater.

If 375W heaters are chosen (the experience of one church suggests that 500W heaters are too fierce) then this gives 10.5kW for 28 units – this is a third of the heat output of the boiler (assuming it is working at 100% efficiency), but all the heat is delivered directly to the congregation.

Of course, more heaters could be installed if desired. It is suggested that the switching is arranged so that blocks of pews can be switched individually – perhaps the easiest method is for each heater to have its own switch under the pew.

Although electricity is more expensive (3.9 times; current 17.81p/kWh compared to 4.57p/kWh for oil), perhaps only a third of the current energy use (kWh) would be needed.

For replacement, two most popular under pew heaters within churches are BN Thermic PH30 heaters (http://www.bnthermic.co.uk/products/convection-heaters/ph/) or similar from http://www.electricheatingsolutions.co.uk/Content/PewHeating. Cable runs to the pew heaters could run along the North and South walls (all cabling should be in armoured cable or FP200 Gold when above ground) to the both rows of pews quite easily.

As well as examples noted on installers websites, there is an under pew installation at the well-hidden St Cosmus and St Damian Church, Blean, Canterbury CT2 9JH.

6.6 Use of Electric Panels for Heating Vestry/Kitchen area

The heating within the vestry/kitchen area could be supplemented by installation of wall mounted or high level far infra-red panels. The church should consider the use pattern of this room and how much heating would be required in winter.

Alternatively, a plinth 'kickspace' heater could be located under the kitchen units within the vestry/kitchen area.

7. Energy Saving Measures (Building Fabric)

7.1 Draught Proofing to Doors

There are a number of external doors in the building. These have the original historic timber doors on them, but these do not close tightly against the stone surround and hence a large amount of cold air is coming into the church around the side and base of these doors.

Where a timber door closes against a timber frame it is recommended that draught proofing is fitted.

The west tower door has an ineffective weather bar, a piece of steel channel section cemented into the ground. Whilst this stops water entering it does not prevent draughts and should be supplemented. A rubber strip could be fitted experimentally along it's inner edge to fill the gap (measure the gap by using plasticine).

A product called QuattroSeal (see link below) is often used in heritage environments to provide appropriate draught proofing.
http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf. Note this cannot be used where the timber door closes directly against a stone surround.

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.

7.2 Windows

Hopper windows are often sources of draughts. This can be ameliorated by the use of black plasticine (recommended by Historic England) which will fill any gaps and is non-permanent.

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	No – not sufficient demand, visible roof
Battery Storage	No – no viable PV
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 and unsuitable radiator system
Air Source Heat Pump	No – insufficient hours of use, unsuitable radiator system
Biomass	No – not enough heating load as well as air quality issues

Despite none of these renewable technologies being suitable for the church; St Nicholas can achieve a very good environmental performance by adopting electric heating in conjunction with a 100% renewable electricity tariff, as offered through Parish Buying (or Ecotricity, Good Energy or Bulb).

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 Diocesan Environment Officer Teresa Redfern, 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.

Appendix 1 – Schedule of Lighting

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
NAVE					
12 LED downlights					
6 LED uplights					
CHANCEL					
12 LED downlights					
6 LED uplights					
AISLE					
6 LED downlights					
6 LED spotlights up					
VESTRY/KITCHEN					
4 Floodlights c500W	4	LED floodlights	170 hrs use		
	Total 2000W	c. 100W each	1600W		
			272kWh		
LYCH GATE			£48		
1 Floodlight (unknown)	1	To 100W LED	Est 500W		
			Est 5.5 hrs/day		
			1000kWh		
TOWER			£200	£300-500	1.3 to 2 yrs
1 Striplight c 20W					

A new LED lighting system was installed in March 2019 covering the nave and aisle.

The floodlights in the kitchen/ vestry and on the Lych gate were not changed. As these are powerful lights, changing to LED floodlights (which are available in various powers) would give noticeable savings.

If the lych gate floodlight is used for effect and turned on each evening controlled by a timer, a significant saving can be achieved by installing an LED floodlight. Alternatively, if the external lighting is only required to light access, a timed PIR sensor could be fitted so the light would only illuminate when required.