Hambledon Church of St Peter & St Paul

Assessment of Energy Savings Opportunities

EMphasis3 CO_2 Reductions
2,000 tonne reduction in CO_2 emissions

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ENERGY **ENVIRONMENT** **TRAINING**

Contents

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This service is provided as part of the "EMphasis3 CO2 Reductions" project which is partially funded by the 'European Regional Development Fund'.

1 Executive Summary

Opportunities for reducing energy use have been investigated at Hambledon Church of St Peter & St Paul as part of a wider Building Energy Audit program through the EMphasis3 project. The following table summarises the opportunities identified during the site energy audit.

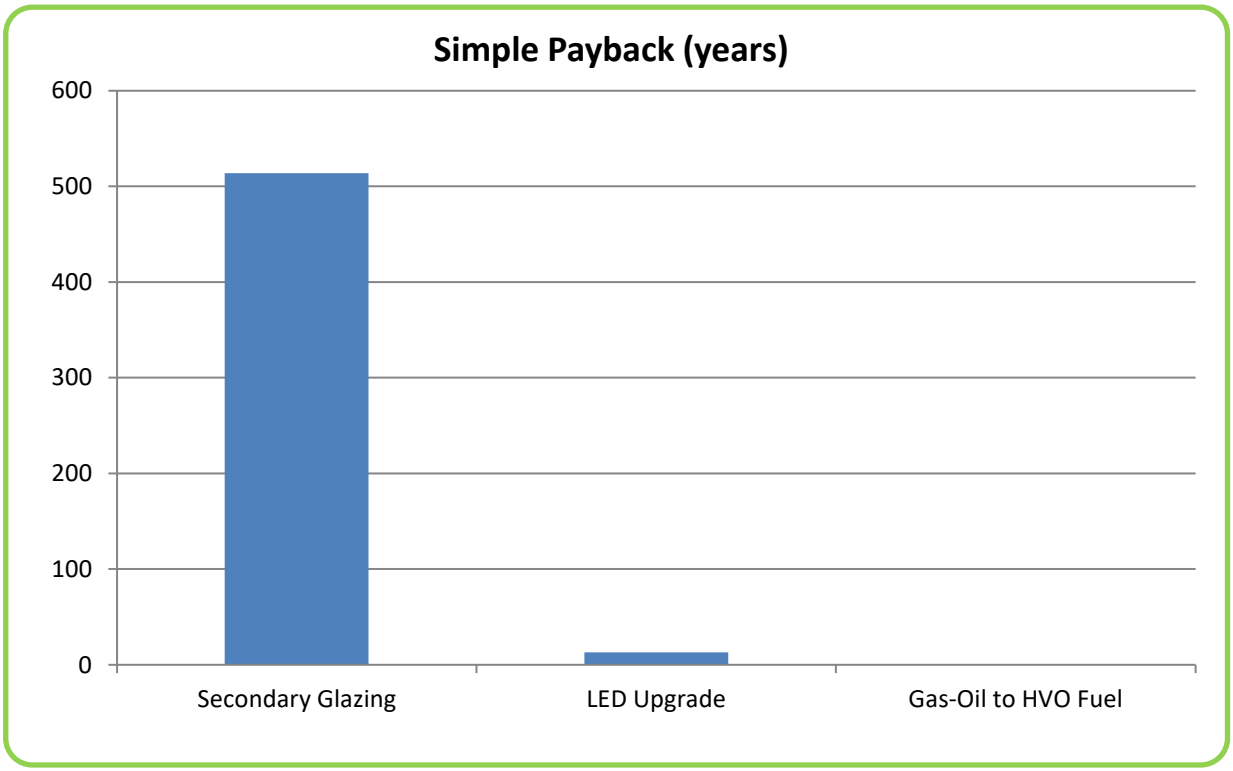
Project Name	Utility Saved	Annual Consumption saving (kWh)	Annual Total £ saving[1]	Annual tCO_2e saving	Capital Expenditure £	Simple Payback (years)	Lifetime tCO_2e savings
Secondary Glazing	Gasoil	1,140	86	0.3	44,175	513.8	2.3
LED Upgrade	Electricity	2,169	325	0.6	4,258	13.1	12.0
Gasoil to HVO Fuel	Gasoil	0	-5,916	11.1	0	0.0	222.1
Total		**3,309**	**-5,505**	**12.0**	**48,433**	**-8.8**	**236.4**

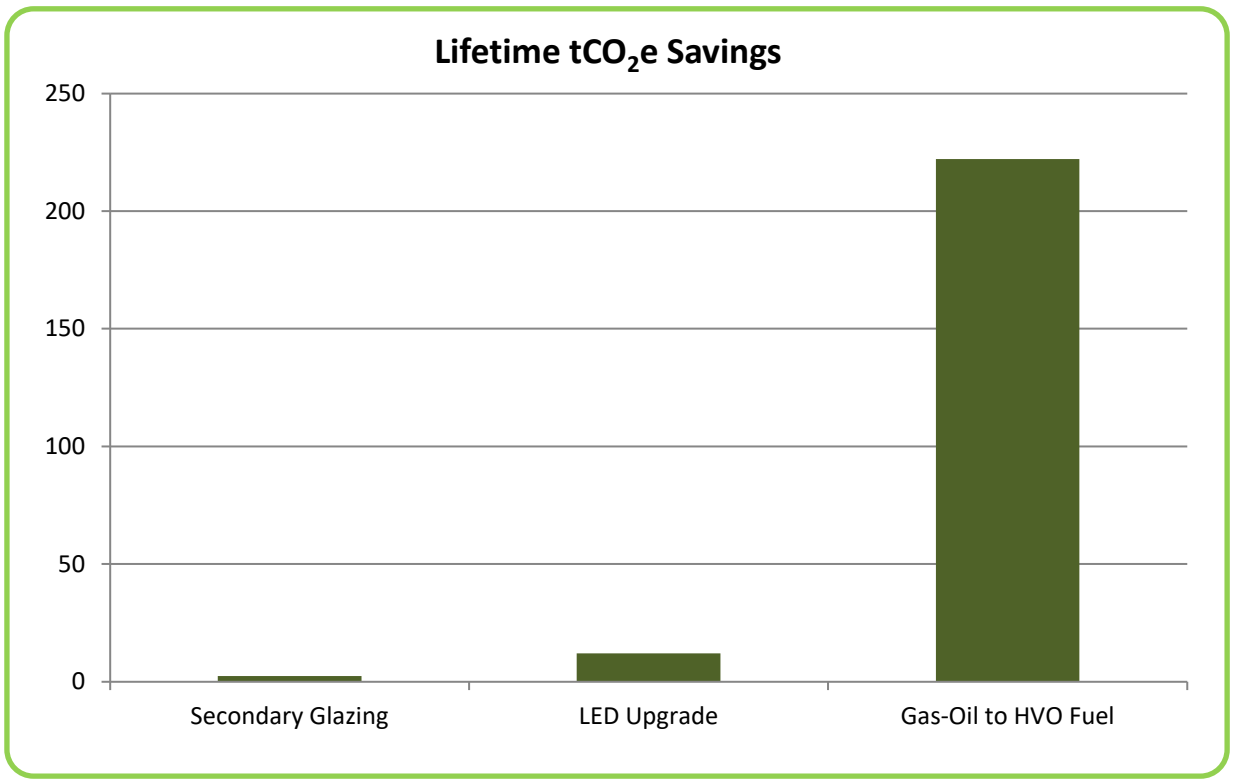
Note that the total Capital Expenditure may be reduced through an application to The EMphasis3 project which looks to part-fund SME energy efficiency projects through its grant scheme, up to an intervention rate of 36%.

The table below summarises the estimated CO_2e emissions before and after the implementation of the above projects:

Current Annual tCO_2e	18.2
Estimated Annual tCO_2e Savings	12.0
Estimated Future Annual tCO_2e	6.2

Simple payback and Lifetime tonnes CO_2e savings for each project are represented in the following graphs:




Lifetime tCO2e Savings
250
200
150
100
50
0
Secondary Glazing
LED Upgrade
Gas-Oil to HVO Fuel

2 Project Details

Consultant Name:	Isabel Romero
Email address:	IsabelR@gepenv.co.uk
Site Address:	Church Ln, Hambledon, Waterlooville PO7 4RT
Site Visit Date:	10th March 2022

2.1 Site Description

Hambledon Church's main structure dates from the 13th century, although it has had some additions from the 15th and 18th centuries. The church has some loft insulation. However, all the windows are single glazing only.

The Domestic Hot Water (DHW) system is provided via electric Point of Use water heater. The heating in the church is provided via an old oil-fired boiler (Firebird Popular 310, Output rage between 73kW – 91kW). The boiler has a heat recovery system. The heat is distributed to the church via cast-iron radiators and cast-iron heating floor grills that has the hot water pipes underneath. There are no destratification fans and the client did not want to install any due to potential noise issues.

The lighting in the church is a mixture of LED, halogen spotlight and floodlights. There is no renewable energy technology currently installed on-site.

For the recommendations in this report the following factors have been used:

Electricity Cost #	15.00 p/kWh
Electricity Carbon Factor*	0.27730 $kgCO_2e/kWh$
Gas-Oil Cost #	7.54 p/kWh
Gas-Oil Carbon Factor*	0.25676 $kgCO_2e/kWh$

*Based on 2019 DBEIS carbon factors.
Based on default values, as client has not confirmed the tariffs.

For the avoidance of doubt, energy prices include CCL where appropriate but exclude delivery charges, VAT and other fixed elements.

3 Energy Audit Methodology

Energy consumption data has been estimated from CIBSE TM46 for 'Public Building with Light Usage' benchmark figures: electricity is based on 20kWh/m² and gasoil is based on 105kWh/m² these values may not reflect the actual usage of the property.

4 Analysis of Current Energy Consumption

The energy consumption at Hambledon Church was for the 12-month period between January and December 2019 is summarised below:

	Electricity (kWh)	Gasoil (kWh)	Total Energy (kWh)
Total	11,200	58,800	**70,000**

5 Action Plan

The following table provides a summary of the measures identified. A detailed analysis of each measure is shown in section 6.

Project Name	Utility Saved	Annual Consumption saving (kWh)	Annual Total £ saving[1]	Annual tCO_2e saving	Capital Expenditure £	Simple Payback (years)	Lifetime tCO_2e savings
Secondary Glazing	Gasoil	1,140	86	0.3	44,175	513.8	2.3
LED Upgrade	Electricity	2,169	325	0.6	4,258	13.1	12.0
Gasoil to HVO Fuel	Gasoil	0	-5,916	11.1	0	0.0	222.1
Total		**3,309**	**-5,505**	**12.0**	**48,433**	**-8.8**	**236.4**

[1]The total cost saving includes all cost savings (energy, renewable income) and is adjusted for any additional annual costs (e.g. maintenance, staff costs).

Note that the total Capital Expenditure may be reduced through an application to The EMphasis3 project which looks to part-fund SME energy efficiency projects through its grant scheme, up to an intervention rate of 36%.

6 Detailed Recommendations

Recommendation 1:		
Description	Secondary Glazing	
Technology Type	Secondary glazing	
Project Description	The Church's windows include stained glass and simple leaded work. The thermal properties of these windows can be improved by installing an external secondary glazing layer. This is a highly specialised measure and there are a small number of suitable experienced installers within the UK. Each window may have uniqueness that may require a specific approach or solution. It is proposed that all windows are fitted with external secondary glazing. The U-value is estimated to be improved from 5.5 W/m^{2}K to 2.8 W/m^{2}K. An estimated 30m^2 of secondary glazing is required; this assumes that the existing windows do not require any significant remedial works.	
Costs	Capital Costs:	£44,175
	Additional Annual Operating Costs:	£0
Annual Savings	Utility saved	Gasoil
	Consumption Saving (kWh)	1,140
	Running Costs:	£86
	Greenhouse Gas (GHG) Emissions (tonnes CO_2 equivalent)	0.3
	Other Cost savings:	£0
	Potential RHI/ FiT Income:	£0
	Total £ Savings:	£86
	Simple Payback (years)	513.83
Lifetime Emissions savings	Lifetime GHG emission savings (tCO_2e)	2.3

Calculations and assumptions:

Refer to Appendix 1 of this report for savings calculations.

The cost has been allocated based on similar implemented projects. A cost of £1,500 per m² has been assumed for installation. The costs of each window are expected to vary, and the final project cost will be determined after a full survey by specialists.

The energy and carbon savings are based on an estimated theoretical U-value reduction (from 5.5 W/m²K to 2.8 W/m²K).

The heat loss via windows can be up to 26%. This project estimates a conservative 2% saving.

Approximate dimensions were taken for window locations to allow for estimation and financial modelling; quoting suppliers should take their own measurements to ensure units are manufactured at the correct size for the install work.

Risks and Issues:

Availability of specialist suppliers and installers may limit the speed with which this project can be realised.

There will be a slight alteration to the façade of the church when external secondary glazed is installed.

Installation of secondary glazing on the inside may introduce a condensation risk to the leaded glass as the temperature of the adjacent air will be reduced, and the airflow eliminated.

The external areas including used public pathways that immediately surround the church will be impacted during the works. The safety of the general public should be considered. No costs have been included for this.

Implementation of Energy Saving Opportunities:
Survey the existing single glazed windows and work with suitably experienced contractors to identify most suitable solution for each window location.

Invite contractors to quote for supply and fit with accompanying RAMS.

Consider what inspection and maintenance contract could be offered to ensure the church is fully protected.

Recommendation 2:

Description	LED Upgrade
Technology Type	Lighting Upgrades
Project Description	The site has a mix of luminaires: halogen spotlights, floodlights and LED bulbs This project focuses on upgrading all luminaires to LED lighting to reduce the consumption of electricity. See below a schedule of the existing lighting and the LED replacement:

Zone	Existing			Replacement
	Lamp Type	No.	Hours	Lamp Type
Church	70W Floodlight	16	1,400	LED (30W) Floodlight
Church	Halogen spotlight 35W	19	1,400	LED GU10 spotlight (4W)

Costs	Capital Costs:	£4,258
	Additional Annual Operating Costs:	£0
Annual Savings	Utility saved	Electricity
	Consumption Saving (kWh)	2,169
	Running Costs:	£325
	Greenhouse Gas (GHG) Emissions (tonnes CO_2 equivalent)	0.6
	Other Cost savings:	£0
	Potential RHI/ FiT Income:	£0
	Total £ Savings:	£325
	Simple Payback (years)	13.09
Lifetime Emissions Savings	Lifetime GHG emission savings (tCO_2e)	12.0

Calculations and assumptions

Refer to Appendix 1 of this report for savings calculations.
The main lamp types have been grouped for estimation of replacement costs. This recommendation does not include PIR motion or daylight sensors. Discussions with specialist lighting contractors may potentially identify further suitable options.
Operational hours are based upon an average of 4hrs per day, 7 days per week over 50 weeks.
This is a 'like for like' replacement without reduction of luminaire numbers. Careful lighting design may help reduce installation cost and increase savings while also improving lighting conditions over a straight 'like for like' replacement.
Replacement emergency lights are not included in the cost assessment.
Electricity tariff used is 15.00p/kWh.
The capital expenditure includes supply and install of new fittings.
A labour rate of £75 per hour has been used with typically an hour per fitting budgeted for. Additional costs for evening or weekend working are not included.
No allowance has been made should it be discovered that suitable Emergency lighting does not presently exist and requires upgrade as part of these works.

Risks and Issues:
For the project to succeed the current requirements of each space must be fully defined before determining suitable replacement lamps and luminaires.
The replacement works may have to be carried out outside of the service hours of the site to protect building's users and staff. No account has been made for any additional costs that result from this.
A survey of the existing wiring of lighting should be undertaken to ensure suitability before committing to the upgrade. No costs have been included for remedial electrical works should the wiring be found to require upgrade or redecoration.

Implementation of Energy Saving Opportunities:
Re-audit the existing lighting within the spaces identified for upgrade at the point of commencing a procurement process to ensure that all recent changes or upgrades etc have been logged prior to developing a scope of works.

Provide a scope of works alongside a general electrical engineering, control & luminance requirement specification (inc. any emergency lighting requirements) and commence a supply and install procurement process. GEP can assist in verification of the proposals received.

Obtain contractor proposals including control capability and RAMS.

Select the most suitable quotation and schedule the installation.

Recommendation 3:		
Description	HVO (Gas-Oil replacement)	
Technology Type	HVO (Gas-Oil replacement)	
Project Description	This project is to change the current use of mineral gasoil for HVO. HVO (hydrotreated vegetable oil) is a renewable diesel alternative and is one of the world's cleanest fuels on the commercial market. As a second-generation premium biofuel, it eliminates up to 75% of net greenhouse gas emissions. HVO is produced from renewable materials such as vegetable oils and animal fats making it 100% renewable. These oils are treated through a high-quality specialist hydrotreatment process to create high-quality paraffinic fuel that's almost chemically identical to fossil fuels. Due to this similarity the fuel can be directly changed without any additional work on the oil boiler. There is no issue with mixing HVO and mineral gasoil. HVO has a longer storage life than mineral gasoil.	
Costs	Capital Costs:	£0
	Additional Annual Operating Costs:	£0
Annual Savings	Utility saved	Gasoil
	Consumption Saving (kWh)	0
	Running Costs:	-£5,916
	Greenhouse Gas (GHG) Emissions (tonnes CO_2 equivalent)	11.1
	Other Cost savings:	£0
	Potential RHI/ FiT Income:	£0
	Total £ Savings:	-£5,916
	Simple Payback (years)	0.00
Lifetime Emissions savings	Lifetime GHG emission savings (tCO_2e)	222.1

Calculations and assumptions:

This recommendation only includes a change on fuel with no other change to the consumption.
An estimated HVO cost of 17.80p/kWh has been used for the calculations which is required to be confirmed with an approved supplier.
Existing boiler is to remain in place. Although consumption reduction from fabric improvement recommendations have been accounted for.
HVO can be mixed with the Fossil Diesel fuel in the tank with no issue.
Assumes the existing Oil Boiler is compatible with HVO fuel. HVO stores better than fossil diesel as it is nontoxic if any leakage were to occur it would have a minor effect on the ecosystem.

Risks and Issues:

This recommendation will increase the annual cost of the heating fuel used but result in decreased carbon emissions.
HVO fuel is only permitted for certain installations (not commercial systems) and the status of the operation would need to be confirmed before converting to the fuel type.

Implementation of Energy Saving Opportunities:

Just by changing the fuel for HVO it can be expected a reduction by 75% of the current carbon emission on site.
Discuss the supply of HVO with you existing fuel supplier.

7 Further Comments

Upgrade boiler:

Once the current boiler stops working, it is recommended to upgrade it with a new and more efficient one that would be able to work with HVO fuel, as suggested in Section 6 above. Upgrading the boiler would cost between £12k and £15k and the efficiency would improve at least 10%. However, there will be further work due to the chimney/flue of the current boiler to ensure compliance with current regulations.

8 About GEP Environmental

Our Service Offering

GEP Environmental are leading providers of environmental and energy consultancy services to clients across the United Kingdom & Ireland. We support organisations to identify, implement and maintain environmental, energy and training solutions. Our highly qualified project teams consist of environmental consultants, energy engineers and trainers with expertise in carbon management, ISO management systems, sustainable resource and waste management, energy efficiency, building surveying, low carbon building design and renewables.

Further information is available from http://www.gepenv.co.uk/

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- ISO 14001 Environmental Management Systems, ISO 50001 Energy Management Systems and ISO 9001 Quality Management Systems;
- Legislation & Compliance Services (Energy, Waste, Pollution Control, Buildings Operations, Permitting);
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- Waste Management Auditing and Compliance Support;
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- Feasibility Studies and Energy Efficiency Auditing;
- Implementation support including design, specification, evaluation and project management;
- Measurement and Verification (M&V);
- Programme Management and Technical Advisory.

Our teams maintain membership with professional bodies including the Institute of Environmental Management and Assessment (IEMA), the Institute of Environmental Sciences (IES) and the Energy Institute (EI).

Our Certifications

We are committed to service excellence and developing first class client relationships. Our quality and environmental standards are underpinned by our ISO 9001:2015 (QMS) and ISO 14001:2015 (EMS) certification.

9 About "EMphasis3 CO_2 Reductions" Project

EMphasis3 CO_2 Reductions (known as EMphasis3) is a European Regional Development Fund (ERDF) funded SME support project, led by the University of Portsmouth and delivered through the cleantech cluster Greentech South (GTS) based at the University of Portsmouth, in partnership with the University of Winchester.

EMphasis3 CO_2 Reductions aims to support the shift towards a low carbon economy in the Enterprise M3 (EM3) region and beyond, by promoting energy efficiency and renewable energy use in SMEs and promoting research and innovation in, and adoption of, low carbon technologies.

EMphasis3 will enable SMEs to reduce CO_2 emissions by using four funded interventions:

- Energy Efficiency Audits
- Energy Efficiency Grants (EEG) to part-fund energy saving/efficiency equipment or implement the recommendations of the audit
- Innovation Audits
- Innovation (Research and Development) Grants to enable SMEs to take low carbon innovations closer to commercialisation

The EMphasis3 project will run from 1st July 2019 - 30th June 2022 and will part-fund SME energy efficiency projects through its grant scheme, up to an intervention rate of 36%.

Appendix 1 – Savings Calculations

Recommendation 1:

Description	Technology Type	Capital Cost	Additional Annual Operating Costs	Other Costs (e.g. staff)	Utility Saved	Consumption Saving	Units	£ Saving	tCO2e Saving	Other Cost Savings	Potential RHI/ FiT Income	Simple Payback
Secondary Glazing	Insulation - Building fabric: Secondary glazing	44,175			Gas-Oil	1,140	kWh	85.97	0.29			514
						2%						

Temperature Differential 12 ° C
Heating system efficiency 75%

Unit Cost	£ 1,500	per m²

Type		Height (m)	Width (m)	Number of windows	Area m^2	Old U-Value (W/m^2K)	New U-Value (W/m^2K)	Saving kW	Cost	Hours	Saving kWh
1	Single Windows	1.5	0.4	5	3.00	5.5	2.8	0.097	4,500	896	116
2	Double Windows	1.5	0.7	9	9.45	5.5	2.8	0.306	14,175	896	366
3	Triple Windows	2	1	5	10.00	5.5	2.8	0.324	15,000	896	387
4	Stained Windows	3.5	2	1	7.00	5.5	2.8	0.227	10,500	896	271
			Total	20	29.45			0.954	44,175		1,140

Burning Hours		
	4	h/d
	7	days/week
	32	week/year
	896	h/year

Recommendation 2:

Description	Technology Type	Capital Cost	Additional Annual Operating Costs	Other Costs (e.g. staff)	Utility Saved	Consumption Saving	Units	£ Saving	tCO2e Saving	Other Cost Savings	Potential RHI/ FiT Income	Simple Payback
LED Upgrade	LED Lighting - Floodlighting to LED including new fitting	£ 4,258.04			Electricity	2,169	kWh	325.29	0.60			13.09

Zone	Existing			Replacement			Capital Cost	Saving			Payback (yrs)
	Lamp Type	No.	Hours	Lamp Type	No.	Hours		kWh	£	CO2	
Church	70W SON Floodlight	16	1,400	LED (30W) Floodlight	16	1,400	£2,640	1,344	£202	373	13.1
Church	halogen spotlight 35W	19	1,400	LED GU10 spotlight (4W)	19	1,400	£1,618	825	£124	229	13.1

Recommendation 3:

Description	Technology Type	Capital Cost	Additional Annual Operating Costs	Other Costs (e.g. staff)	Utility Saved	Consumption Saving	Units	£ Saving	tCO2e Saving	Other Cost Savings	Potential RHI/ FiT Income	Simple Payback
Gas-Oil to HVO Fuel	HVO (Gas-Oil replacement)	£0			Gas-Oil	0	kWh	-£5,916	11.10			0.00

Capital cost would be zero as there is not change required to the current system.

Existing boiler efficiency	75%	
Heat Requirement	43,245	kWh
Present Fuel Usage	57,660	kWh
% replaced by new fuel	100%	
Heat generated by new boiler	43,245	kWh
New fuel requirement	57,660	kWh
New fuel cost	£10,265	
Present fuel cost	£4,349	
Emissions Saving	11,104	kgCO2e

Accounted for Sec Glazing rec

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