St. Jude's Church

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

1 Executive Summary 4

2 Project Details 6

2.1 Site Description 6

3 Energy Audit Methodology 7

4 Analysis of Current Energy Consumption 7

5 Action Plan 8

6 Detailed Recommendations 9

7 About GEP Environmental 18

8 About "EMphasis3 CO_2 Reductions" Project 19

Appendix 1 – Savings Calculations 20

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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 St. Jude's Church 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.

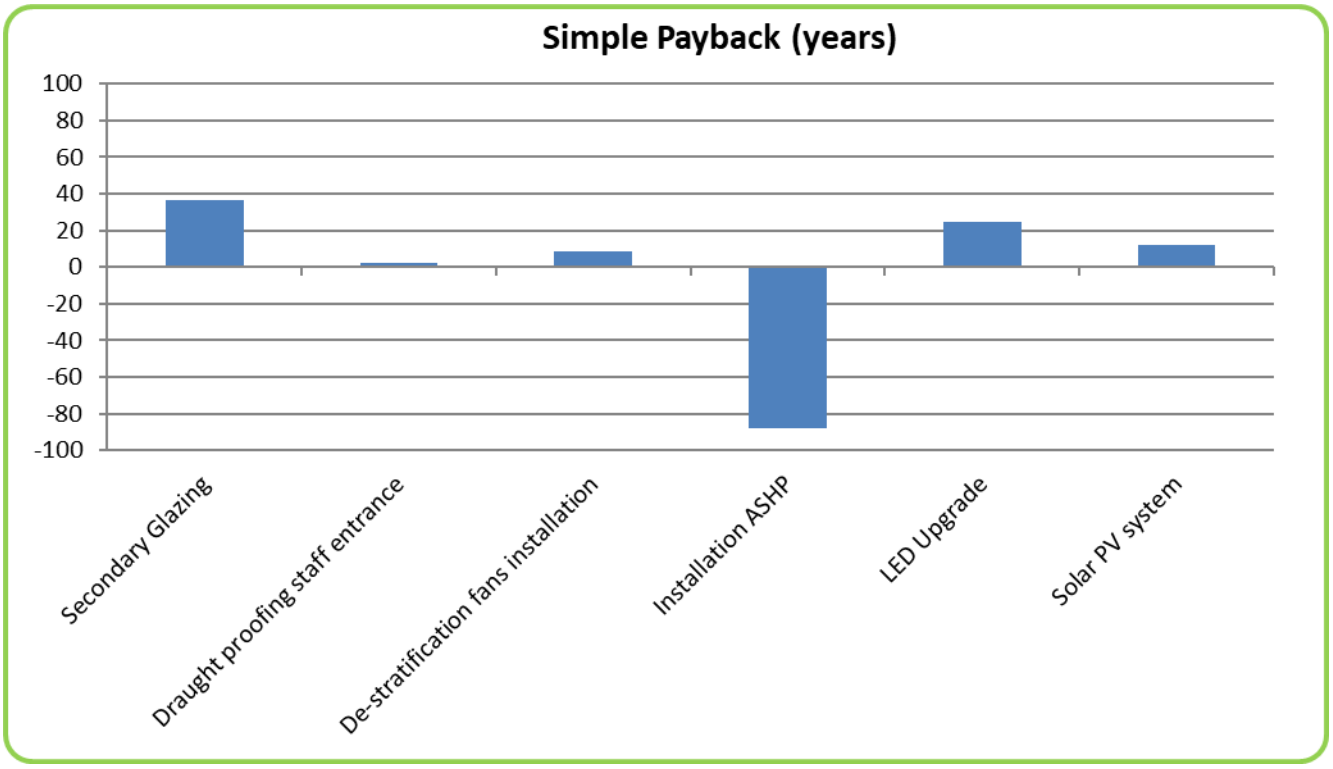
Project Name	Utility Saved	Annual Consumption saving (kWh)	Annual Total £ saving[1]	Annual tCO_2e saving	Capital Expenditure £	Simple Payback (years)
Secondary Glazing	Natural Gas	16,713	418	3.1	15,244	36.5
Draught proofing staff entrance	Natural Gas	3,154	117	0.6	275	2.4
De-stratification fans installation	Natural Gas	15,513	331	2.6	2,738	8.3
Installation ASHP	Natural Gas	56,226	-1,220	7.9	107,680	-88.3
LED Upgrade	Electricity	2,154	283	0.6	6,934	24.5
Solar PV system	Electricity	17,299	1,983	4.8	23,256	11.7
Total ('Core' projects only)		**111,059**	**1,912**	**19.6**	**156,127**	**81.7**

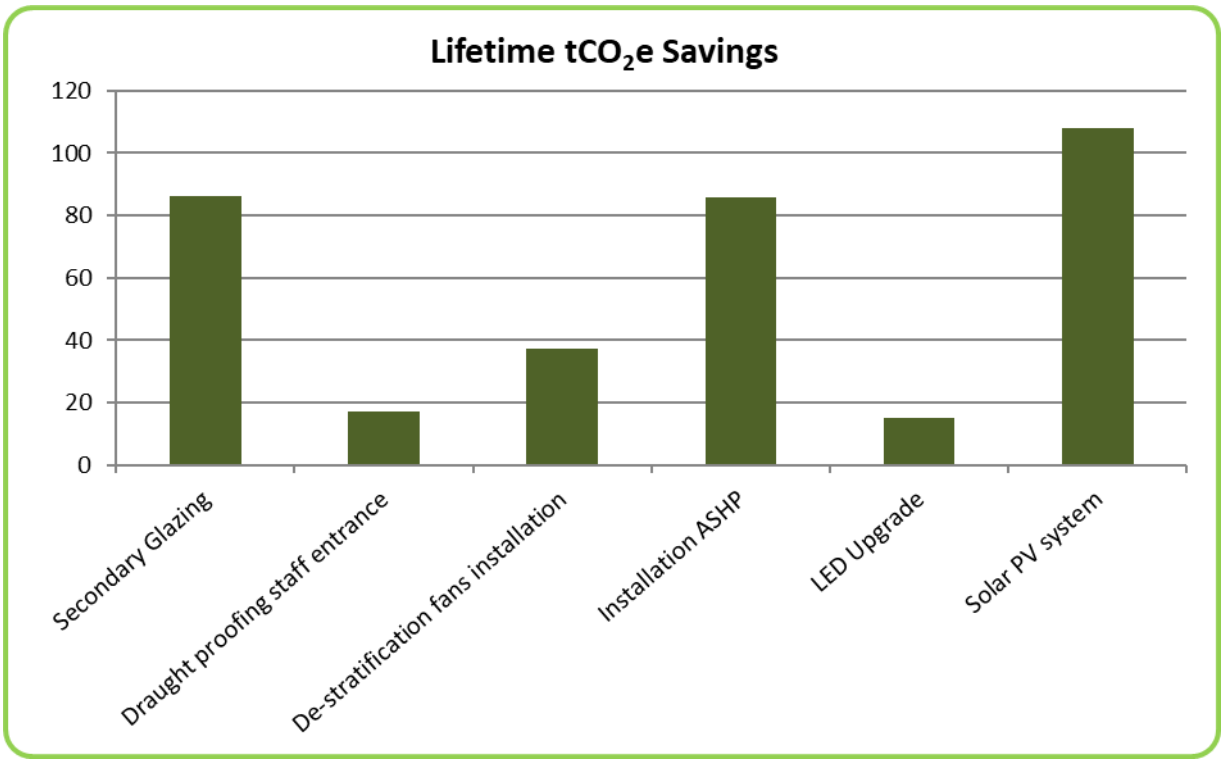
Note that the total Capital Expenditure may be reduced through an application to The EMphasis3 project which looks to part-fund SME energy efficiency projects through its grant scheme, up to an intervention rate of 36%.

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

Estimated Annual tCO2e Savings	19.6
Estimated Future Annual tCO2e	20.2

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




Lifetime tCO2e Savings
120
100
80
60
40
20
0
Secondary Glazing
Draught proofing staff entrance
De-stratification fans installation
Installation ASHP
LED Upgrade
Solar PV system

2 Project Details

Consultant Name:	Shamir Robinson
Email address:	Shamirr@GEPEnv.co.uk
Site Address:	Kent Rd, Southsea, Portsmouth, Southsea PO5 3EL
Site Visit Date:	8th September 2021

2.1 Site Description

The St. Jude's Church is an 1851 category II Listed Building, internally dived on the vestry, chapel north & south, west face of nave, and internal balcony to aisles. The church walls are mainly Flint and rock-faced stone with stone dressings. The ceiling is a Welsh slate high roof with north and south faces. The walls are very thick, and able to retain heat very well however the large church hall space requires a considerable heat input to raise temperatures to an acceptable level. This is not helped by the ornate, single glazed windows which will be contributing to the heat losses, however secondary glazing would be a suitable intervention, which would minimise these losses and improve the building envelope. The pitched roof of the church has a south-westerly facing roof which would be ideal for a solar PV array should the necessary planning permissions be granted, and the roof be deemed able to support one.

In a typical week the church is used on Thursday, Friday, and Sunday. The church also hosts shorter services with coffee/tea after. Additionally, St. Jude's Church offer a meeting room and an activities space for Young Adults which is utilised twice on Sundays. On Fridays, the church prepares and serves dinner for the elderly in the north hall. The users of the site and the occupancy times vary regularly, and users will also have differing needs and requirements from the space.

On the boilers plant room, pipework is fully insulated. Four Ferroli Econcept 50 A - 45kW gas fired wall hung boilers provide heat to a set of single line traditional radiators, water pipe on the middle of the Nave, and two hot water fans. There are additional electric heaters on some of the meeting rooms and second floor office.

On the Office, reception, north hall, and garden meeting room an air conditioning unit is installed with an external condenser being ground-mounted within the back garden area. It appears to be well maintained and without outward issue; pipework is insulated, air paths are not blocked, and finned surfaces appear clean. The Mitsubishi Electric Central air conditioning unit can provide an estimated 63.0kW Cooling or 69kW Heating and have a stated maximum Coefficient of Performance (COP) of 4.2; up to around 420% efficient (max). The internal wall cassettes are controlled by digital wall mounted controllers.

Internal lighting at the site is a mixture of T5 fluorescent lamps, compact fluorescent lamps (CFL), and halogen recessed luminaires. Our engineers undertook a summary survey of all the floors, and it is estimated that between 10% - 20% of the site's lighting has been upgraded to energy efficient LED fittings.

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

Electricity Cost #	13.20 p/kWh
Electricity Carbon Factor*	0.27730 $kgCO_2e/kWh$
Gas Cost #	3.70 p/kWh
Natural Gas Carbon Factor*	0.18385 $kgCO_2e/kWh$

*Based on 2019 DBEIS carbon factors.
Based on latest available bill.

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

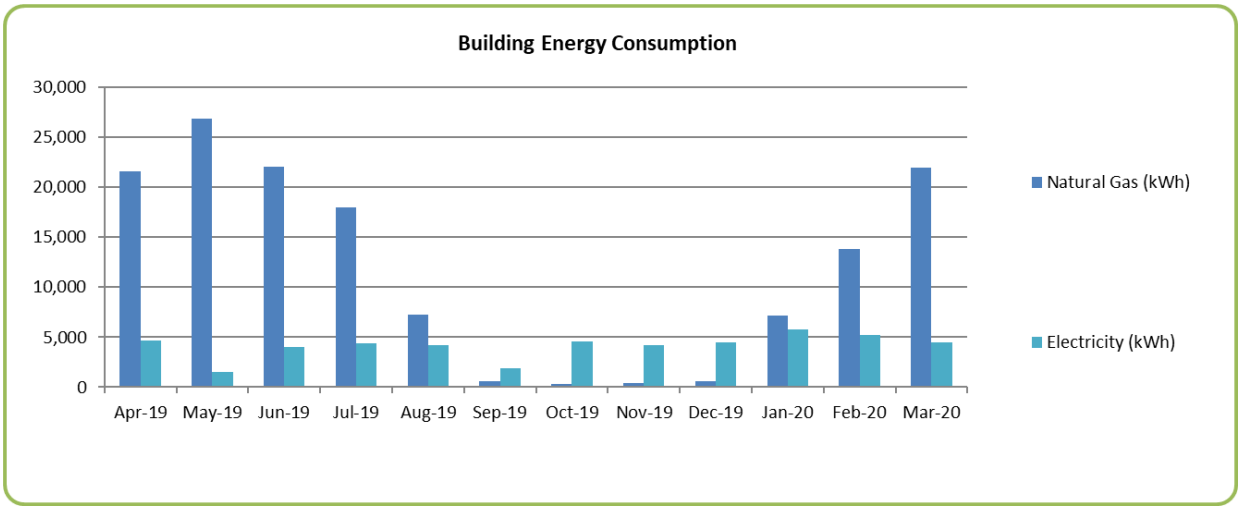
3 Energy Audit Methodology

Energy consumption data has been sourced for the 12-month period from April 2019 to March 2020. The Gas consumption data is sourced from the client data logs. Electricity consumption data was based upon monthly energy data provided by the client.

4 Analysis of Current Energy Consumption

The energy consumption at St. Jude's Church was for the 12-month period between April 2019 and March 2020 and is summarised below:

Month	Electricity (kWh)	Natural Gas (kWh)	Total Energy (kWh)
Apr-19	4,709	21,615	26,324
May-19	1,546	26,880	28,426
Jun-19	4,041	22,004	26,045
Jul-19	4,420	17,963	22,383
Aug-19	4,213	7,228	11,441
Sep-19	1,899	559	2,458
Oct-19	4,535	337	4,872
Nov-19	4,162	392	4,554
Dec-19	4,520	564	5,084
Jan-20	5,786	7,133	12,919
Feb-20	5,249	13,782	19,031
Mar-20	4,496	21,992	26,488
Total	**49,576**	**140,449**	**190,025**



Please note that the cost above is based on the basic cost per kWh including CCL where appropriate and doesn't include VAT or fixed elements such as standing charges so the values in this report may be lower than the invoiced energy values.

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)
Secondary Glazing	Natural Gas	16,713	418	3.1	15,244	36.5
Draught proofing staff entrance	Natural Gas	3,154	117	0.6	275	2.4
De-stratification fans installation	Natural Gas	15,513	331	2.6	2,738	8.3
Installation ASHP	Natural Gas	56,226	-1,220	7.9	107,680	-88.3
LED Upgrade	Electricity	2,154	283	0.6	6,934	24.5
Solar PV system	Electricity	17,299	1,983	4.8	23,256	11.7
Total ('Core' projects only)		**111,059**	**1,912**	**19.6**	**156,127**	**81.7**

[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 on Largest Windows	
Technology Type	Insulation - Building fabric: Secondary glazing	
Project Description	The site, especially the Nave and the Chancel, has large single-glass windows which will be contributing significantly to heat losses from that space. Installing secondary glazing internally will reduce the electricity consumed to heat the inhabited spaces and portable electric heaters will be less likely to be required during colder periods. The secondary glazing is more likely to be an acceptable intervention for a listed building as it will keep the character of the ornate stained-glass windows.	
Costs	Capital Costs:	£15,244
	Additional Annual Operating Costs:	£0
Annual Savings	Energy (kWh)	16,713
	Running Costs:	£418
	Greenhouse Gas (GHG) Emissions (tonnes CO2 equivalent)	3.1
	Other Cost savings:	£0
	Potential RHI / FiT Income:	£0
	Total £ Savings:	£418
	Simple Payback (years)	36.48
Lifetime Emissions savings	Lifetime GHG emission savings (tCO2e)	86.0

Calculations and assumptions

Refer to Appendix 1 of this report for savings calculations.
Pricing is aligned to domestic windows; commercial or safety aspects that are required will increase costs.
The cost of redecoration following the installation of the windows has been excluded.
Approximate dimensions were taken for window location 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.
Smaller windows should be inspected and included within an upgrade project as required.
It is assumed that any necessary planning permission for this measure will be approved.

Risks and Issues:

The installation would require the area immediately surrounding each window to be emptied.
Working at height from ladders/platforms will be invasive and put staff and site visitors at risk - it is likely that when work is in progress then it will affect the usability of the affected spaces.
Full RAMS will be required when quotations are submitted.

Implementation of Energy Saving Opportunities:

Survey the priority, larger windows to determine the optimal design for each replacement window.
Invite suppliers to quote for supply and fit with accompanying RAMS.
Schedule the installation with the agreement of the site users.
Monitor for and make any changes to the heating system as the need for heat should change.

Recommendation 2:		
Description	Draught proofing staff entrance	
Technology Type	Insulation - Draught proofing	
Project Description	The staff entrance located on the back access has an internal door as shown in the picture below than can be improve with new seals to reduce the cold air infiltration in winter months.  Implementing newly install door sealing internally will reduce the gas consumed to heat the inhabited spaces and portable electric heaters will be less likely to be required during colder periods. Additionally, by working on the inner's doors the external protected building fabric is not required to be changed.	
Costs	Capital Costs:	£700
	Additional Annual Operating Costs:	£0
Annual Savings	Energy (kWh)	3,154
	Running Costs:	£117
	Greenhouse Gas (GHG) Emissions (tonnes CO2 equivalent)	0.6
	Other Cost savings:	£0
	Potential RHI / FiT Income:	£0
	Total £ Savings:	£117
	Simple Payback (years)	6.0
Lifetime Emissions savings	Lifetime GHG emission savings (tCO2e)	17.0

Calculations and assumptions

Refer to Appendix 1 of this report for savings calculations.
Pricing is aligned to domestic doors; commercial or safety aspects that are required will increase costs.
The cost of redecoration following the installation of the windows has been excluded.
Approximate dimensions were taken for doors to allow for estimation and financial modelling. Quoting suppliers should take their own measurements to ensure the correct size for the install work.

Risks and Issues:

Working at height from ladders/platforms will be invasive and put staff and site visitors at risk - it is likely that when work is in progress then it will affect the usability of the affected spaces.
Full RAMS will be required when quotations are submitted.

Implementation of Energy Saving Opportunities:

Invite suppliers to quote for supply and fit with accompanying RAMS.
Schedule the installation with the agreement of the site users.
Monitor for and make any changes to the heating system as the need for heat should change.

Recommendation 3:		
Description	De-stratification fans installation	
Technology Type	Ventilation - Fans: High efficiency	
Project Description	A church is a perfect candidate for de-stratification fans. For St. Jude's church, the main high roof is approximately 25 meters high, When the heating is running, heat rises and accumulates at the ceiling of the building, increasing the temperature and rate of heat transfer at the roof. Destratification not only saves energy and increases comfort, but it can also speed up the conditioning of the space during a morning warm-up cycle before service. In this case, the rising warm air is being captured and delivered to floor level, providing an immediate increase in comfort. Without fans, the building would heat from the "top-down" as the heated air rises and collects in the ceiling. De-stratification fans are specifically designed to save costs and increase comfort. The fans continuously and gently mix the air, balancing temperatures (destratification) from ceiling to floor and wall to wall which helps the heating system maintain the desired temperature.	
Costs	Capital Costs:	£2,738
	Additional Annual Operating Costs:	£0
Annual Savings	Energy (kWh)	15,513
	Running Costs:	£331
	Greenhouse Gas (GHG) Emissions (tonnes CO2 equivalent)	2.6
	Other Cost savings:	£0
	Potential RHI / FiT Income:	£0
	Total £ Savings:	£331
	Simple Payback (years)	8.28
Lifetime Emissions savings	Lifetime GHG emission savings (tCO2e)	37.2

Calculations and assumptions

Refer to Appendix 1 of this report for savings calculations.
Pricing is aligned to estimated cost of the fans without inclusion of additional engineering work for supporting structure.
A 11% reduction in gas consumption has been modelled.
The cost of redecoration following the installation fans and any additional structure has been excluded.
High velocity fans were selected to allow installation on the high part of the 25-meter-high ceiling.

Risks and Issues:

Working at height from ladders/platforms will be invasive and put staff and site visitors at risk - it is likely that when work is in progress then it will affect the usability of the Church spaces.
Full RAMS will be required when quotations are submitted.

Implementation of Energy Saving Opportunities:

Survey the roof structure to determine the optimal design for each placement of the fans.
Invite suppliers to quote for supply and fit with accompanying RAMS.
Schedule the installation with the agreement of the site manager.
Monitor for and make any changes to the heating system as the need for heat will reduce.

Recommendation 4:		
Description	Install a hybrid High Temperature Air Source Heat Pump	
Technology Type	Heating - Heat Pump (Air source)	
Project Description	The site can take advantage of renewable Air-Source Heating to reduce carbon emissions. Such systems produce up-to 2.8 units of heat for each unit of electricity consumed. A two-stage High-Temperature Air Source Heat Pump (ASHP) will significantly reduce the consumption of gas at the site and has been modelled using a seasonal COP of up to 280%. An air to water heat pump will capture renewable heat from within the ambient air from external thermal collectors in the back garden. This raises the temperature of water in the intermediate thermal store to 35C and the second stage water-to-water heat pump will raise the temperature in the final thermal store to up to 70C. The existing heating distribution system and heat emitters will therefore be able to be retained. The existing gas LTWH boilers are retained to meet the peak load during colder temperature periods. The system will incorporate automatic controls to manage the boiler capacity as required based on a combination of thermal storage temperature and detected system demand. The system controls will also optimise such that reasonably high Heat Pump Coefficient of Performance (COP) values are maintained. This project would allow the site to rationalise the two heating systems in the Family Centre to just one system with the ASHP providing the baseload and an existing Gas Boiler assisting during peak demand periods. Additional reduction on the use of high peak gas boiler demand can be expected if the ASHP is used in conjunction with the de-stratification fans and the Infra-red radiant heaters. There are adequate internal and external spaces for the equipment and Solar PV Arrays are already in place to provide zero carbon electricity to power the ASHP system.	
Costs	Capital Costs:	£107,680
	Additional Annual Operating Costs:	£864
Annual Savings	Energy (kWh)	56,226
	Running Costs:	-£356
	Greenhouse Gas (GHG) Emissions (tonnes CO2 equivalent)	7.9
	Other Cost savings:	£0
	Potential RHI / FiT Income:	£0
	Total £ Savings:	-£1,220
	Simple Payback (years)	-88.28
Lifetime Emissions Savings	Lifetime GHG emission savings (tCO2e)	85.9

Calculations and assumptions

Refer to Appendix 1 of this report for savings calculations.

The driver for this project is the Carbon Saving rather than pure financial saving.

The model has 80% of the total annual heat being provided by the ASHP systems; detailed scoping and sizing will more closely determine what is possible and the costs entailed.

It is assumed that existing radiators will be retained, and a High Temperature Heat Pump System be installed. The existing Gas-Fired Boilers within the boiler room are proposed to be retained and their on-going good health has been assumed.

Financial calculations have assumed that all electricity used by the ASHP has been sourced from the National Grid rather than the solar PV arrays. Service costs are assumed to be £810 per system per annum.
Risks and Issues: The sizing of the ASHP systems is critical if correct operating regimes are to be achieved. A more granular analysis of the site's heating profile should be undertaken as a feed into both the physical and financial modelling of the ASHP systems. A full survey of all heating systems is recommended. Combining the separate existing systems within the Family Centre should be given adequate focus; this will determine the actual capital cost which may vary significantly from the estimated cost within this report. The site is considered secure and the external elements of the ASHPs are not seen to be at risk from vandalism. Obtain contractor work schedule including at least a generic RAMS which includes methods for internal and external work.
Implementation of Energy Saving Opportunities: Capture heat demand data for the site at an hourly or half-hourly resolution. Build a heat profile for the site and extend this to 12 months. Model ASHP performance against the heat profile to determine the optimal install specification. Conduct a procurement exercise based upon the developed ASHP System Specification and bill of materials. Select the most suitable quotation and schedule the installation.

Recommendation 5:		
Description	LED Upgrade	
Technology Type	LED Lighting – T5 and T8 to LED including new fitting	
Project Description	The centre has many different styles of luminaires and has seen upgrade to LED lamps in some situations. CFL lamps and LED panel luminaires are already in use within some areas. This project focuses on the remaining T5 lamps in the offices, Reception, Garden meeting room, Vestre, North Hall and Meeting rooms. The T5 lamps can be upgraded to LED to reduce the consumption of electricity. Within the Office setting it may be possible to rationalise the number of luminaires – this has not been determined during GEPs building energy efficiency survey. By installing PIR sensors and daylight sensors to control when the luminaires nearest the windows are required this will deliver optimal lighting conditions in the spaces.	
Costs	Capital Costs:	£6,934
	Additional Annual Operating Costs:	£0
Annual Savings	Energy (kWh)	2,1154
	Running Costs:	£283
	Greenhouse Gas (GHG) Emissions (tonnes CO2 equivalent)	0.6
	Other Cost savings:	£0
	Potential RHI / FiT Income:	£0
	Total £ Savings:	£283
	Simple Payback (years)	24.48
Lifetime Emissions Savings	Lifetime GHG emission savings (tCO2e)	14.9

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 including automation of control, but suitability not fully discussed with the Site Manager.
Luminaires as retrofitting LED lamps into bi-directional may require more specific LED lamps.
The operational hours in each location were assumed; settings such as the Meeting/Function Room are known to be less frequently used and the payback period here is longer, so it has been excluded from the LED upgrade project.
Burn hours are based upon 5hr per day, 4 days per week for 50 weeks per annum.
Electrician rate of £60 per hour with a fitting rate of 1 luminaire per hour.
The cost of redecoration has been excluded.

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 prior to committing to the upgrade. No costs have been included for remedial electrical works should the wiring be found to require upgrade.

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 6:		
Description	Install Solar PV Array	
Technology Type	Renewable Energy - Solar PV	
Project Description	Installing a Solar PV Array on the roof of the building will allow the site to self-generate a portion of the electricity it consumes. The array modelled here has been sized to maximise the use of the south facing roof available on top of the south Gallery. Possible excess generation that would be exported to the national grid has also been considered. By not oversizing a PV array the initial costs will be optimised and purely the site's own demand will be provided for. A 19.38 kW Solar PV Array has been modelled and presented here. It is anticipated to generate 19,221kWh (from modelling) of electricity annually which equates to 31% of the church's annual consumption. The PV Array has been costed at £1,200 per kWp installed along with an O&M cost of £20/kWp. There may be scope to install a larger array at the site subject to structural roof survey. The newly introduced Smart Export Guarantee (SEG) will typically pay up-to 5p/kWh of generation which is exported to the national grid. There are a number of electricity suppliers who will enter into a contract to pay for the exported generation. The site may benefit from this on weekend days and days when no production is taking place.	
Costs	Capital Costs:	£23,256
	Additional Annual Operating Costs:	£388
Annual Savings	Energy (kWh)	17,299
	Running Costs:	£2,275
	Greenhouse Gas (GHG) Emissions (tonnes CO2 equivalent)	4.8
	Other Cost savings:	£0
	Potential RHI / FiT Income:	£96
	Total £ Savings:	£1,983
	Simple Payback (years)	11.73
Lifetime Emissions savings	Lifetime GHG emission savings (tCO2e)	107.9

Calculations and assumptions

Refer to Appendix 1 of this report for savings calculations.
The site has been modelled with a low Unit Price for Electricity (13.20p/kWh).
No account has been made for higher unit costs during peak demand periods.
Assumed that 90% of the electricity generated will be used on site, with the extra 10% being exported to the grid.
Shading has been applied within the model – it is anticipated that arrays positioned closer to the tower will have the effect of shading on morning hours.
Edge protection may be required for working at heights during install and periodic maintenance of the array. This may require planning permission although less intrusive secure wire systems are available should planning be an issue. Costs for an Edge Protection system have been excluded.
It is assumed that there is the possibility to obtain authorisation from the council to install the photovoltaic panels on a visible roof of a listed building.

Risks and Issues:

The sizing of the PV array is critical, and a more granular analysis of the site's energy profile should be undertaken as a feed into both the physical and financial modelling of the PV array.

A structural survey of the roof is recommended.

There may be a minor risk for the building and the potential requirement for mitigation measures including roof CCTV, anti-theft paints and worst case, anti-theft security around the array itself.

Inverters must be located in easily accessible areas that are not surrounded by flammable materials.

SolarEdge systems should be specified for the array whereby an earth fault will create an insulation fault reaction that is designed to lead to system shutdown. In this eventuality, not only is the inverter disconnected, but the power optimisers are designed to shut down and enter safety mode, reducing the string current to zero Amps.

Solar PV technology is well understood and modelling using real climatic data eliminates over or under estimation of system yields.

DNO consent may be required via submission of a G99 application if the system is a single-phase design of > 17kWp or a three-phase design of > 50kWp. Consent should be acquired before procuring the system. The DNO will carry out a network study (which it may charge you for) to ensure that the local grid network can take the extra power that your solar PV system will generate. If the local grid network needs extra work before it can accept your connection, this will have to be done at your own cost.

Obtain contractor work schedule including at least a generic RAMS which includes methods for internal and external working at height.

An Edge Protection system will be required to protect workers during installation and future O&M of the Solar Array; costs associated with this have been excluded.

Implementation of Energy Saving Opportunities:

Capture electrical and heat demand data for the site at Half-Hourly resolution.

Build an electrical profile for the site and extend this to 12 months.

Model arrays and equipment against the electrical profile to determine the optimal install specification.

GEP have developed PV specifications and bill of materials for similar sized projects throughout the UK and can develop such a specification including general engineering / M&E specifications in liaison with St. Jude's Church.

Conduct a procurement exercise based upon the developed PV specification and bill of materials.

Select the most suitable quotation and schedule the installation.

7 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/

Our Technical Capabilities

We pride ourselves on our ability to deliver practical long-term solutions that create financial benefits and add value to our clients' services, buildings, portfolios and credentials. Our technical capabilities include:

- 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);
- Sustainability Reporting (FTSE4Good, CDP, GRESB, EPRA, CRC, ESOS, SECR);
- Waste Management Auditing and Compliance Support;
- IEMA Certified Training (IEMA Approved and IEMA Certified Training Courses);
- 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.

8 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
Secondary Glazing	Insulation - Building fabric: Double glazing v	15,244			Natural Gas	16,713.4310	kWh	417.84	3.073		

Temperature Differential	12	° C
Heating system efficiency	75%	

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
1	Nave 2nd level- Single Glazed	1	0.5	12	6.00	5	2.2	0.202
2	Nave 3rd level- Single Glazed	1	0.75	2	1.50	5	2.2	0.050
3	Nave 1st level- Single Glazed	1	0.5	4	2.00	5	2.2	0.067
4	Nave Ground level- Single Glazed	0.75	0.5	2	0.75	5	2.2	0.025
5	Vestres- single Glazed	0.25	1.25	1	0.31	5	2.2	0.011
6	Jouth halls - Single glazed	1.75	1	2	3.50	5	2.2	0.118
7	Meeting room south - Single Glazed	1	0.75	2	1.50	5	2.2	0.050
8	Office top Floor skylitghs	0.75	0.5	2	0.75	5	2.2	0.025
9	Small windows (Toilet and hallways)	0.25	0.25	10	0.63	5	2.2	0.021
			Total	37	16.94			0.569

Calculations:		
Heating consumption	119,382	kWh
Heat Loss Proportion (%)	25%	%
Heat Losses	29,845	kWh
Heat Loss Saving	**16,713**	**kWh**
Window Area	17	m2
Unit Cost	900	£/m2
Glazing Cost	£15,243.75	£
Additional Cost (Optional)	£0.00	£
TOTAL Cost	**£15,243.75**	£
Energy Reduction	14.0%	

Split Gas	
Heating & cooling	85%
Lightning	0%
Other	15%
TOTAL	**100%**

Revised heat loss	
Roof	22%
Windows	25%
Skylights	0%
Walls	9%
Floor	9%
Vent & Inf	35%
Total	**100%**

Note: The building currently have double glazing in almos 25% of all windows.

Single glazed	100%

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
Draugth proofing staff entrance	Insulation - Draught proofing	700			Natural Gas	3,154	kWh	116.65	0.58			6.00

Temperature Differential	12	° C
Heating system efficiency	80%	

Type		Height (m)	Width (m)	Number of Doors	Area m^2	Old U-Value (W/m^2K)	New U-Value (W/m^2K)	Saving kW	Cost	Hours	Saving kWh
1	Staff access Door	2.25	2.5	1	5.63	5	2.6	0.162	500	8,760	1,774
2	Internal Doors	2	0.75	5	7.50	4	2.6	0.126	200	8,760	1,380
			Total	6	13.13			0.288	700		3,154

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
De-stratification fans installation	Ventilation - Fans: High efficiency	£2,738			Natural Gas	15,513	kWh	£331	2.61			8.28

Description	Technology Type	Utility	Units	Base Consumption	% reduction	Reduced Consumption	Consumption saving	Cost Savings	tCO2e saving	Capital Cost
4xDe-stratification fans installation	Ventilation - Fans: High efficiency	Natural Gas	kWh	120,582	15%	102,495	18,087	£669	3.325	£2,400
aditional electricity consumption	Ventilation - Fans: High efficiency	Electricity	kWh	-2,574	100%	0	-2,574	-£338	-0.714	£338
						0	0			
Total							15,513	£331	2.612	£2,738

Recommendation 4:

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
Installation ASHP	Heating - Fossil Fuel to Heat Pump (Air	£72,320	£810		Natural Gas	52,712	kWh	-£334	7.43		£0	-63.24

Existing boiler efficiency	88%	
Heat Requirement	90,195	kWh
Present Fuel Usage	102,495	kWh
% replaced by new ASHP	75%	
New ASHP Capacity	135	kW
Heat generated by new ASHP	67,646	kWh
New ASHP efficiency	280%	
New electricity requirement	24,159	kWh
New electricity cost	£3,177	
New electricity emissions	6,699	kgCO2e
Residual boiler fuel usage	25,624	kWh
Residual boiler fuel cost	£948	
Residual boiler emissions	4,711	kgCO2e
Present fuel cost	£3,791	
Present fuel emissions	18,844	kgCO2e
Emissions Saving	7,433	kgCO2e
RHI annual income	£0	

Recommendation 5:

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 - Halogen to LED including new fitting	£6,934			Electricity	2,154	kWh	283.26	0.60			24.48

Zone	Existing				Replacement				Capital Cost	Saving			Payback (yrs)
	Lamp Type	No.	Hours	Controls Reduction	Lamp Type	No.	Hours	Controls Reduction		kWh	£	kg CO_2	
Offices	T5 (HE) 4' double	4	2,496		New 4' LED T8 double fitting (2x20W)	4	2,496		£533	200	£28	55	19.2
Front Office	T5 (HE) 4' double	4	2,496		New 4' LED T8 double fitting (2x20W)	4	2,496		£533	200	£28	55	19.2
reception	recessed CFL (1 x 26W)	8	2,496		1 x retrofit 2/4-pin 8W LED lamps	8	2,496		£462	379	£53	105	8.8
Garden Meeting Room	recessed CFL (1 x 26W)	9	2,496		1 x retrofit 2/4-pin 8W LED lamps	9	2,496		£520	427	£59	118	8.8
Tower	recessed CFL (1 x 18W)	2	2,496		1 x retrofit 2/4-pin 8W LED lamps	2	2,496		£115	55	£8	15	15.1
Chancel Below	Led Spotlitgh 40w	4	2,496			4	2,496						
Nave	Led Spotlitgh 20w	20	2,496			20	2,496						
Vestre	T5 (HE) 4' double	3	2,496		New 4' LED T8 double fitting (2x20W)	3	2,496		£400	150	£21	42	19.2
Staff access area	T5 (HE) 4' double	2	2,496		New 4' LED T8 double fitting (2x20W)	2	2,496		£267	100	£14	28	19.2
North Hall	T5 (HE) 4' single	5	624		New 4' LED T8 single fitting (20W)	5	624		£439	31	£4	9	101.3
Kitchen	T5 (HE) 4' double	5	624		New 4' LED T8 double fitting (2x20W)	5	624		£666	62	£9	17	76.8
Toilets GF	Standard CFL 18W	7	416		LED bulb style 16.5W	7	416		£397	4	£1	1	654.1
South Gallery	2D CFL 28W	12	1,248		New LED 2D fitting 11W	12	1,248		£770	300	£42	83	18.5
West Gallery	2D CFL 28W	8	1,248		New LED 2D fitting 11W	8	1,248		£514	200	£28	55	18.5
Meeting Room south	T5 (HE) 4' single	6	312		New 4' LED T8 single fitting (20W)	6	312		£527	19	£3	5	202.5
Meeting Room North (jouth	T5 (HE) 4' single	9	312		New 4' LED T8 single fitting (20W)	9	312		£790	28	£4	8	202.5

Recommendation 6:

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
Solar PV system	Renewable Energy - Solar	£23,256	£388		Electricity	17,299	kWh	£2,275	4.80		£96	11.73

Key parameters in model:

Orientation	South
Inclination (tilt)	25
Solar Irradiance file used	PVGIS-SARAH
System size (kW peak)	19.38
Annual operating cost per kWp	£20
Import electricity price (£/kWh)	0.1315
FIT income tariff (£/kWh)	0
FIT export tariff (£/kWh)	0.05
% of generation exported	10%

Outputs from model:

Annual generation kWh	19,221
Annual self supply kWh	17,299
Annual export kWh	1,922
System efficiency	75.74%
Potential FIT payments	£96
Displaced electricity	£2,275
Financial position after year 1	£1,983
Capital cost	£23,256
Simple Payback (yrs)	11.73

System PV % Coverage:	**31%**
System PV(kWh/kW):	**991.82**

Calculation Data:		**Units**
Panel Rating:	380	Watts
Area Panel	1.82	M2
Cost per kWp (Pitch roof)	1200	£/kW
Annual Operating Cost	20	£/kW
System Irradiance file Used	PVGIS-SARAH	n/a
Panel Model:	LONGI SOLAR LR6-72HPH-380M 380W	

colour		
Areas	JC-001	JC-002
Type of roof	Pitched	Pitched
PV Orientation(°)	189	189
Angle(°)	25	25
Area (m2)	68.89	44.05
system size (kW peak)	11.78	7.6
Annual Generation	12,196.03	7,025.36
System Efficiency	80.0%	71%

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