

Energy Saving Recommendations Report

for

The Abbey Sutton Courtnay Ltd.

May 2019

Survey of The Abbey



ORGANISATION OVERVIEW

Report overview

EiE carried out a site visit and met with Linda Hull. All recommendations in this report are based on information and observations obtained prior to and during the site visit and information subsequently provided. The report is set out in order of recommended priority based on ease of implementation, carbon impact, cost and factors discussed on site.

Client details

Organisation name	The Abbey, Sutton Courtnay	Sutton Courtnay Abingdon, OX14 4AF
Contact name	Linda Hull	linda@theabbey.uk.com 01235 847401
Date of site visit	23/05/2019	Carried out by Moira Dorey and Michael Esvelt

Energy savings recommendations - summary

Below is a summary of the opportunities recommended in this report. Costs and savings have been estimated using available information; an explanation is provided in detail for each opportunity. Estimations have been made based on energy data provided.

Opportunity	Savings (kWh / yr)	Savings (£ / yr)	Cost (£)	Initial Payback (yrs)	Carbon Impact (tCO ₂ e / yr)
Match heating times to building occupancy	8,205	238	0	-	1.51
Install chimney balloons	820	24	140	5.87	0.15
Improve flow of hot water to kitchen sink	0	0	500	n/a	0
Replace gas boiler	10,162	295	2,500	8.46	1.87
Install secondary glazing	13,127	382	11,000	28.33	2.42
Add insulation above the ceiling	7,673	223	460	2.06	1.41
Add internal wall insulation	3,938	115	4,000	34.95	0.72
Improve billing accuracy	n/a	1,625	0	0	n/a
Add thermal blinds	2,625	77	1,089	14.1	0.48
Add Solar PV	5,838	748	12,600	16.8	2.41
Add Solar Thermal	4,826	550	5,000	9.0	1.99
TOTAL	57,214 kWh/yr	£4,277/yr	£37,289		12.96 tCO₂e / yr

Site details

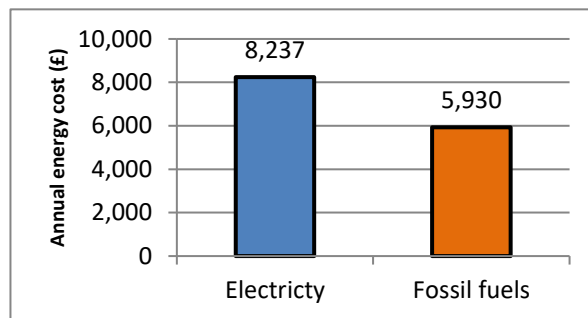
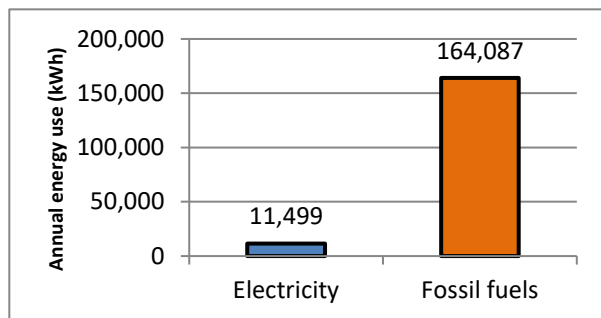
The Abbey was built between early to mid 1200s and late 1400s and is Grade 1 listed. The area is 780 m² over 3 floors. The building is heated by a gas central heating system with 3 boilers. The building includes a large meeting space (The Great Hall), three smaller meeting rooms (The Hearth, The Solar and The Library), kitchen, dining room and several bedrooms for both residential staff and visitors.

ENERGY PROFILE

Energy consumption annual profile

Fuel type	Annual Energy use (kWh)	Cost per kWh (p)	Standing charge (p/day)	Approx. annual cost (£)
Electricity	11,499	14.485	25	8,237
Gas	164,087	2.906	66	5,930

Energy profile breakdown for The Abbey consumption (left) and costs (right)



Consumption is based on the suppliers' projected figures for 2019.

ENERGY SAVINGS RECOMMENDATIONS

Match heating times to building occupancy

Energy saving (kWh)	Cost saving (£)	Cost of action (£)
8,205	238	0



The radiator in Sapphire was giving off heat at about 11am during the audit visit and it was reported that other radiators are sometimes on if the TRVs have been turned up. Heating is generally not required in the building during summer months. If heating is needed at all, it is likely only to be required first thing in the morning and in the evening if the weather is poor. Careful programming of the heating to ensure that visitors and residents do not have the ability to have their heating on throughout the day in warmer months will reduce energy usage and costs and enhance comfort levels.

For instructions on how to programme your controls see: <https://www.honeywelluk.com/Documents/User-Guide/pdf/871.pdf>



The following link provides instructions on how to set your Honeywell digital room thermostat in the office:

<http://www.honeywelluk.com/Documents/All/pdf/Simple-Guide-DT90E.pdf>

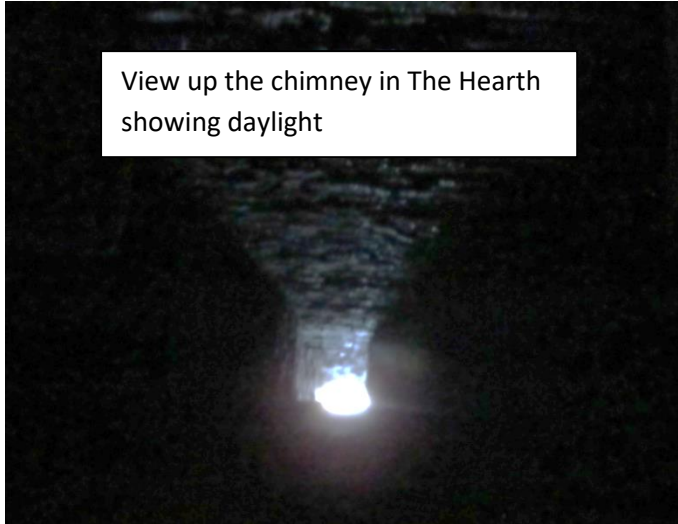
Actions

- Re-programme your heating to 'off' during summer months. There is normally no need to heat a building from early May to late September. If the heating settings on the boilers are set to off during this period there is no chance of radiators being turned on accidentally.
- If heating is required at either end of the day in the 'shoulder months' of May and September / October, programme the heating to only be available from, for example, 7am to 10am and again in the evening.

Savings calculations

Savings calculations are based on reducing the time that the heating is on annually by 5%. There is no cost to this action.

ENERGY SAVINGS RECOMMENDATIONS

Install chimney balloons		
Energy saving (kWh)	Cost saving (£)	Cost of action (£)
820	24	140
 <p>The image shows that there is no insulation up the chimney in The Hearth and it is believed that, similarly, the other chimneys in The Abbey are also uninsulated. Open chimneys allow warm air to be lost and pull in draughts resulting in an uncomfortable environment and a need for extra heating. We recommend adding chimney balloons to reduce heat loss and discomfort during colder months.</p>		
<p>Some possible products include: https://www.chimneysheep.co.uk/productcategory/chimney-draught-excluders/ or https://www.chimneyballoon.co.uk/</p> <p>Existing materials, such as crumpled newspaper, etc., may need to be removed before the chimney balloon can be inserted.</p>		
Actions <ul style="list-style-type: none">• Plug the chimney with a 'balloon' to help keep warm air in.		
Costs and savings <p>Costs for chimney insulation start from £20 for a medium fireplace. There are 7 fireplaces in The Abbey. Savings are based on reducing the heating demand by 0.5% overall.</p>		

ENERGY SAVINGS RECOMMENDATIONS

Improve flow of hot water to kitchen sink

Energy saving (kWh)	Cost saving (£)	Cost of action (£)
0	0	500

Although the hot water for the kitchen is provided by the condensing boiler situated in the toilet near the kitchen, the boiler heats the water which is maintained hot in the second floor tank. When hot water is demanded in the kitchen, therefore, it has to travel along pipework from the 2nd floor. The result of this is that considerable amounts of water are wasted waiting for the hot water to come through.

There are two possible solutions to this:

Option 1: Electric point-of-use hot water heater



Hot water for kitchen use could adequately be heated by an under-sink or over-sink plumbed in hot water heater. While a 15 litre tank is sufficient for most kitchen use, as you have high volumes of washing up and therefore a heavier demand for hot water, it is possible to install a larger 30 litre hot water tank at a cost of around £500 plus installation. For example:

<https://www.plumbnation.co.uk/site/ariston-andris-lux-unvented-water-heaters> or

<https://www.plumbnation.co.uk/site/crown-histore-unvented-water-heaters> or

<https://www.aquahot.co.uk/zip-ap330e-aquapoint-iii-unvented-water-heater-30l>

The second link has water heaters going up to 120 litres, however a larger size will both be more expensive to buy and to run. Adding a mixer tap so that the hot water is mixed with cold before the water comes out the tap is likely to make the hot water in the tank last longer.

In order to calculate kitchen hot water use before purchase, ask the kitchen staff to carry out an experiment involving calculating the volume of a washing up bowl in litres and recording how often this water is changed during a heavy washing up period. Once this is known, check with the suppliers of the hot water heaters to determine the length of time it takes to heat up the water again once the tank has been drained. According to the following link: <http://processheatingservices.com/water-heating-time-calculator/>,

it would take an empty 30 litre tank about 30 minutes to reach 60 degrees. Use this information to calculate the size of water tank required.



Option 2: Add a re-circulation pump

A recirculation or booster pump is a device that draws hot water from your hot water tank and replaces the cooled off hot water in your hot water pipes with hot water by sending what has cooled off back to the water heater via the cold water line where it is heated back up. <https://tinyurl.com/yysukxyp>.

In this way the hot water is always readily available close to the hot water outlets with a wait time for hot water around 60% to 80% faster than standard water heater configurations.


Actions

- Ask kitchen staff to calculate the amount of hot water for washing up they would normally use over a meal service (see above for method).
- Contact a qualified electrician to obtain a quote for the installation of a point-of-use heater.
- At the same time ask the electrician to quote for purchase and installation of a recirculation pump.
- We would suggest obtaining quotes from more than one contractor.
- Choose a preferred solution and contractor and arrange for the work to be carried out.

Costs and savings

A 30 litre unvented immersion tank, including installation, would cost in the region of £500. This is likely to be similar to the cost of installation of a re-circulation pump. There will be additional electricity cost from either the running of the pump or a new hot water heater however there should be savings in water costs.

ENERGY SAVINGS RECOMMENDATIONS

Replace gas boiler		
Energy saving (kWh)	Cost saving (£)	Cost of action (£)
10,162	295	2,500
<p>Your Potterton and Worcester boilers in the main building are both fairly new and efficient. The third boiler is a Valiant Thermo Compact 242 EH 29.6kW non-condensing conventional boiler. This type of boiler was no longer manufactured after 1996 therefore it is at least 21 years old and is only 72% efficient. A new condensing boiler to replace this boiler could be up to 91% efficient. See: http://www.homeheatingguide.co.uk/efficiency-tables.php?model=000779.</p>  <p>An inefficient boiler will waste energy by using more gas to heat the same area of building than a new, efficient boiler.</p>		
<p>Actions</p> <ul style="list-style-type: none"> • Obtain quotes from at least three qualified heating contractors for replacement of the Valiant boiler with a modern condensing boiler that is A rated and over 90% efficient. • Many contractors will over-specify a boiler. Ensure the output capacity (kW) matches the current and planned needs of the building. • As this boiler also provides hot water, ensure that the replacement boiler is separately programmable for heating and hot water. • Ensure that full training on programming the boiler is provided and instructions are left for users. • Programme the heating and hot water to match user requirements. 		
<p>Savings calculations</p> <p>Costs:</p> <p>A replacement A-rated boiler of the same size costs in the region of £1,500 plus programmer, thermostat and installation for a total of £2,500. A typical boiler installation using existing pipework would take about one day.</p> <p>Savings:</p> <p>Savings for boiler replacement are based on Energy Saving Trust estimates which include an A-rated boiler and adding a new programmer and room thermostat. Estimated savings are £295 per year. A useful guide to boiler efficiency ratings and replacement options can be found here: http://www.homeheatingguide.co.uk/efficiency-tables.html.</p>		

ENERGY SAVINGS RECOMMENDATIONS

Install secondary glazing		
Energy saving (kWh)	Cost saving (£)	Cost of action (£)
13,127	382	11,000
<p>The windows in the building are single glazed and installing double glazing may not be desirable or permitted. Secondary glazing however, installed inside of the single glazing, may be permitted and will reduce heat loss and draughts to help keep the building comfortable in cold weather. When considering secondary glazing you need to consider the impact of your Grade 1 listed status.</p> <p>“All Grade 1 listed properties have a number of limits - you will need to apply for building permission if you want to extend or alter a listed building in a way that will affect its character as a building of special architectural or historic interest.” (From https://www.houseprofessionals.com/ideas/archives/grade_1_listed.html)</p> <p>“Just because your property is listed does not mean that you cannot make changes to the building. Instead, property owners are required to apply for listed building consent, which allows the Local Authority to weigh the necessity of requested changes against the historic significance of the property. It is crucial for property owners to always contact the Local Authority before performing any work on windows. Those property owners who do not receive consent before carrying out work will be charged with a criminal offence.” (https://www.hugocarter.co.uk/about-you/listed-buildings-windows/). For more links to information on possible restriction on Grade 1 listed status buildings see Appendix 1.</p> <p><u>Glass secondary glazing</u> You are considering adding glass secondary glazing to the public areas to keep the heat in. Local suppliers who supply secondary glazing include: Bicester Glass: http://www.bicester-glass.co.uk/secondary-glazing C N Glass: http://www.cnglass.co.uk/double-glazing/secondary-double-glazing/ A and C Glazing: http://www.aandcglazing.co.uk/oxford-secondary-glazing</p> <p>There are a number of specialist companies that can advise on glazing improvements for listed buildings and those of historic interest and related issues such as avoiding condensation. These include: http://www.stormwindows.co.uk/sectors/churches https://www.selectaglaze.co.uk/sectors/heritage-listed-buildings https://lead-windows.co.uk/services/secondary-glazing</p> <p><u>Perspex Double Glazing</u> For the residential bedrooms you are interested in secondary glazing that reduces draughts at a lower cost than glass secondary glazing. One alternative is removable magnetic Perspex glazing. See: http://www.magneglaze.co.uk/index.php.</p>		
Actions		
<ul style="list-style-type: none">• Contact your local historic buildings advisor to determine what glazing will be permitted at The Abbey.• Obtain quotes from several glazing companies for the design and installation of secondary glazing.• Obtain quotes for the supply of Perspex glazing which may be installed by volunteers.• Choose preferred suppliers and arrange for the work to be carried out.		

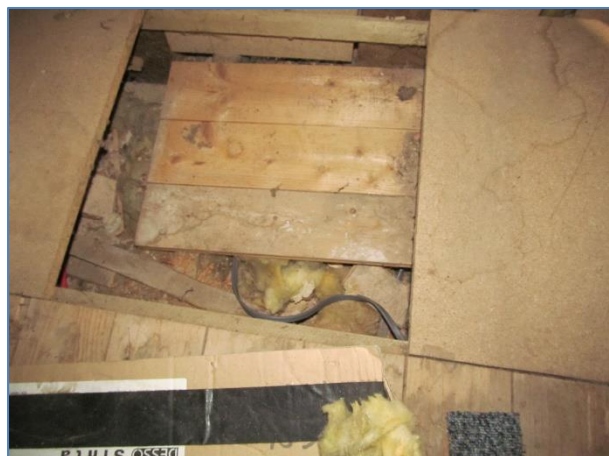
Costs and savings

An indicative quote of £10,000 has already been obtained for secondary glazing work. Magneglaze costs £100 per square metre. The cost for Perspex glazing for the bedrooms is estimated at £1,000 based on 10m².

Savings are dependent on the amount the rooms are heated but will reduce draughts and improve comfort, therefore improving the letting space for future hirers. As a guideline, the Carbon Trust estimate that upgrading windows can save 12% on your heating bill. As you plan to upgrade with secondary glazing a conservative 10% saving is used on 80% of your gas bill, which assumes that 20% of your gas is used for water heating.

ENERGY SAVINGS RECOMMENDATIONS

Add insulation above the ceiling		
Energy saving (kWh)	Cost saving (£)	Cost of action (£)
7,673	223	460



Visual inspection showed that there was low levels of mineral wool insulation (perhaps 100mm) in your loft adjacent to Sapphire. There are boards over the insulation to allow storage, restricting access to add insulation.

Up to 25% of your building's heat is lost through the roof if it is un-insulated. We recommend increasing insulation to 300mm. This will:

- Minimize heat losses in winter.
- Reduce heat gains in summer.
- Improve comfort levels for users.

- Reduce annual energy bills by reducing heating requirements.

For an example of 200mm insulation roll see; <https://www.wickes.co.uk/Knauf-200mm-Super-Top-Up-Loft-Roll-Insulation---5-61m2/p/109451>

Some historic buildings prefer to use a natural 'breathable' material such as sheep wool for their insulation <https://tinyurl.com/y6pswvmp> however it is more than double the price of synthetic mineral wool insulation which is already in use in this loft and many other parts of The Abbey.

As the loft is boarded out for storage, care will need to be taken not to condense the mineral wool as it reduces its insulation properties. It may be necessary to build up the joist using loft legs or wooden blocks. <https://www.loftleg.com/>

Ensure that insulation is laid evenly over the whole loft, including right to the edges, to avoid cold spots where heat can escape.

Actions

- Install mineral wool insulation to a recommended level of 300mm to maximise heat retention wherever possible in the building. Mineral wool insulation is readily available at DIY shops and costs of installation can be reduced by using volunteers to carry out this work.

Costs and savings

Cost assume a requirement for 20 rolls of 200mm loft insulation at a cost of £23/roll for a total of £460 with volunteers carrying out the installation. According to the Carbon Trust, up to 22% of the heat in your building will be lost through the ceiling. Savings are dependent on the lofts insulated and current levels of insulation. Some of your loft space is already insulated to 100mm while other spaces have no insulation. Saving are therefore based on Energy Saving Trust guidance giving savings of 89p/m² over an estimated 250m² = £223

ENERGY SAVINGS RECOMMENDATIONS

Add internal wall insulation		
Energy saving (kWh)	Cost saving (£)	Cost of action (£)
3,938	115	4000
<p>35% of your heat may be lost through solid walls. Increasing insulation will minimise heat loss in winter and improve comfort levels. Thermal imaging of your building makes it clear that some of the external wall in resident's rooms are very poorly insulated. We recommend adding internal wall insulation, particularly to residents bedrooms, where this is permitted by the building's listed status.</p> <p>Internal Wall Insulation (IWI) is suitable when rooms are spacious enough to afford some loss of area. IWI involves fitting rigid insulation boards to the wall, or building a stud wall filled in with insulation material such as mineral wool fibre. Depending on the type of insulation used, stud walls are usually of a greater depth and are therefore strong enough to support fittings such as radiators. When installing internal wall insulation in traditionally built properties it is recommended to use breathable (also known as vapour permeable) solid wall insulation materials as these allow continuous movement of air (vapour) and this helps reduce the possibility of moisture build up. The u-value that will be achieved by adding traditional stud walls would be approximately 0.30 Wm²K. (The u-value is a measurement of heat loss through a structural element of a building). Any alternative wall insulation is recommended to at least match this level.</p>		
<p>Actions</p> <ul style="list-style-type: none"> • Contact your local historic buildings advisor to determine what internal wall insulation will be permitted at The Abbey. • Obtain quotes from at least three suitably qualified contractors to install internal wall insulation. • Ensure that quotes include insulation which complies with building and fire regulations. • Choose a preferred supplier and arrange for the work to be carried out. 		
<p>Costs and savings</p> <p>Cost are dependent on the area to be insulated and the materials used. For an external wall area of 50 m² costs are estimated at £80/m² = £4000. Savings assume that the resident's rooms account for 10% of the buildings heating and heat loss can be reduced by 30% by taking this action.</p>		

ENERGY SAVINGS RECOMMENDATIONS

Improve billing accuracy		
Energy saving (kWh)	Cost saving (£)	Cost of action (£)
N/A	1625	0
<p>The majority of your bills are based on estimated readings. While some bills include VAT at 5%, others are showing VAT at 20% with different VAT rates charged from what appears to be the same meter. Financial savings can be made by improving the accuracy of your energy billing. Savings can be used to fund energy efficiency measures.</p> <p>Additionally, due to changes made in the 1970s, there are 5 electricity meters and 4 gas meters serving the main building, all of which attract a separate standing charge. Energy costs could be reduced by reducing the number of meters.</p>		
<p>Actions</p> <ul style="list-style-type: none"> • Contact your energy broker to discuss whether they can explain/adjust the anomaly in VAT rates. Incorrect VAT rate rebates can be backdated for 3 years. Aim for 5% VAT for the main house. You may have to pay 20% VAT on the guest house bills. • Arrange for meters to be read at the end of each month and call the meter readings through to your energy suppliers to ensure accurate billing. This will both allow you to budget for energy use more accurately and, by recording energy usage, identify when energy usage is uncommonly high or savings have been made. • Contact your electricity provider, Scottish and Southern Energy Power Distribution on 0345 026 2554, and gas provider SGN on 0800 912 1700, to discuss reducing the number of meters that you have on site for both electricity and gas down to one each in the main building. This will reduce the standing charges and the amount of time it takes to read the meters. Additionally, discuss with them whether they could also install 'smart' meters on your site which will send reading direct to the energy supplier. There may be a charge for smart meter installation. 		
<p>Savings calculations</p> <p>Based on reducing 5 electricity meters to one at an average standing charge of £95/year = £380</p> <p>Based on reducing 4 gas meters to one at an average standing charge of £415/year = £1245</p>		

ENERGY SAVINGS RECOMMENDATIONS

Add thermal blinds to bedroom windows		
Energy saving (kWh)	Cost saving (£)	Cost of action (£)
2,625	77	1,089
<p>There are no blinds on the bedroom windows and they are single glazed. Window blinds with sufficient thermal insulation properties, when closed, will reduce heat loss and uncomfortable draughts in winter and overheating in summer months.</p> <p>We recommend adding insulated window blinds and ensuring they are closed appropriately to help improve comfort levels.</p> <p>For examples of thermal blinds go to http://www.blinds-2go.co.uk/energy-saving-thermal-blinds.htm</p> <p>To reduce heat loss and draughts close the blinds when it gets dark and leave them closed until the morning.</p> <p>To reduce overheating from solar gain in the summer close them as the sun comes in through the windows to help keep the air at a comfortable temperature.</p>		
Actions		
<ul style="list-style-type: none">• Blinds can be ordered to measure and installed by staff. Alternatively a handyman can arrange to install the blinds.• Encourage staff and visitors to close window blinds overnight or when they feel cold. This could be promoted with signage or verbal reminders.		
Costs and savings		
<p>The cost for thermal blinds, based on your window sizes, is estimated to be £1089.</p> <p>Savings assume that the resident's rooms account for 10% of the buildings heating and heat loss can be reduced by 20% by taking this action. Although the savings are not great, this action will reduce draughts and make the bedrooms more comfortable.</p>		

ENERGY SAVINGS RECOMMENDATIONS

Consider adding solar PV panels

Energy saving (kWh)	Cost saving (£)	Cost of action (£)
5,838	748	12,600

Both your south and west facing roofs on the Guest House could potentially be used to site solar PV panels to provide electricity for your business. By using the sun's energy to provide electricity you will reduce the amount of power you draw from the grid and therefore save money on your energy bills. Additionally, although at lower levels than in previous years, there is still a Government subsidy for solar PV that pays both for every kW of power generated and for the electricity exported back to the grid when it cannot be used on site.



Actions

- Solar panels will need to be installed by a specialist company who will both price up a system and assess the practicality of PV panels on your roof, e.g. will your roof would bear the weight? Will summer tree cover block out the sun on the panels?
- Contact three solar panel contractors to obtain quotes – see links below
- There may be an opportunity for the Low Carbon Hub to install solar panels on your roof at no charge. In this case part of the savings in electricity, along with the Government subsidy, is used to re-pay investors and invest in the local community.
- See these useful links for more information:

<http://lowcarbonhub.org/> - Low Carbon Hub.

<http://www.r-eco.coop/> - Oxfordshire solar installer and worker cooperative.

<http://www.solartech.org.uk/> - Oxfordshire based.

<http://www.solarcentury.com> – Large London based well-known installer.

Savings calculations

Costs:

Roof areas estimated at 4m x 3m south facing and 3m x 16m west facing - panel calculations from <http://www.solarguide.co.uk/solar-pv-calculator>= £12599

Savings:

The calculations use subsidies for this size of solar array. If the subsidy was not applied for before the cut-off date of 31/03/2019 this will alter the calculations. Accurate costing will be provided by the contracting companies. Savings using solar calculator = £748/year 5838kW /year for a 8kW array

ENERGY SAVING RECOMMENDATIONS

Consider adding solar thermal panels		
Energy saving (kWh)	Cost saving (£)	Cost of action (£)
4,826	550	5,000
<p>A solar thermal system (also known as a solar water heating system) uses the sun to heat hot water free. Solar thermal panels qualify for the Government's Renewable Heat Incentive (RHI) that pays for every kW of heat generated. Eligible installations receive quarterly payments over 20 years based on the amount of heat generated. Once fitted, solar panels emit no pollution.</p> <p>The guest house uses hot water for showers, washbasins and the kitchenette. Both your south and west facing roofs on the guest house could potentially be used to site solar thermal panels to provide some of this hot water. The ideal location is on an un-shaded roof at an angle of 30° against the horizontal plane.</p>		
<p>Actions</p> <p>A solar thermal system will need to be installed by a specialist company who will both price up a system and assess the practicality of PV panels on your roof e.g. will your roof would bear the weight? What are the costs of a replacement hot water tank to suit your requirements?</p> <p>Contact three solar thermal contractors to obtain quotes. The following companies are Oxfordshire based:</p> <p>http://www.solartech.org.uk/ - Oxfordshire based</p> <p>http://www.simssolar.co.uk/ - Oxfordshire based</p> <p>http://www.soloheatinginstallations.co.uk/ - National</p>		
<p>Savings calculations</p> <p>The calculations use the current subsidies for this size of solar array. Accurate costing will be provided by the contracting companies</p> <p>Indicative Costs:</p> <p>According to The Eco Experts http://www.theecoexperts.co.uk/solar-thermal-panels a 6m² solar thermal system would cost approximately £5000 fully installed.</p> <p>Savings:</p> <p>You could save 50-70% of the energy required to heat your hot water. For the above system savings are estimated at £550/year.</p>		
<p>Further info:</p> <p>For helpful general information on solar thermal technology read the Carbon Trust report here: http://www.solarthermalworld.org/sites/gstec/files/Carbon%20Trust.pdf</p> <p>Or the Which? Guide to Solar Water Heating here: http://www.which.co.uk/reviews/solar-panels/article/how-to-buy-solar-panels/how-does-solar-water-heating-work</p> <p>For an easy Guide to the non-domestic Renewable Heat Incentive go to: https://www.ofgem.gov.uk/system/files/docs/2016/07/es957_easyguide_to_ndrhi_2016.pdf</p>		

FURTHER RESOURCES

Funding

Possible sources of funding for the recommendations in this report:

OxFutures – 25% funding towards the cost of energy reduction and generation measures. Contact Alison Grunewald. E-mail: alison.grunewald@lowcarbonhub.org.

Carbon Trust Green Business Fund - <https://www.carbontrust.com/client-services/programmes/green-business-fund>

The Trust for Oxfordshire's Environment - <https://www.trustforoxfordshire.org.uk/>

Appendix 1 – Grade 1 Listed Building Status

Useful Links:

- 1) <https://historicengland.org.uk/advice/your-home/owning-historic-property/listed-building/> (General Grade information)
- 2) <https://historicengland.org.uk/listing/the-list/list-entry/1052729> (The Abbey Grade 1 information)
- 3) https://www.houseprofessionals.com/ideas/archives/grade_1_listed.html (General Grade Information)
- 4) <https://www.heritage-consulting.org/listed-windows> (Glazing Info for listed buildings)
- 5) <https://historicengland.org.uk/advice/your-home/making-changes-your-property/types-of-work/alter-my-windows/> (Window works in listed buildings)
- 6) <https://www.hugocarter.co.uk/about-you/listed-buildings-windows/> (Window works in listed buildings)
- 7) <https://www.marlinwindows.co.uk/replace-listed-building-windows.html> (Window works in listed buildings)
- 8) <https://www.lpoc.co.uk/pdf/Double-Glazing-in-Listed-Buildings.pdf> (Glazing info for listed buildings)