Rowen Memorial Hall Energy Audit Overview Report

UK Government Wales
Llywodraeth y DU Cymru

CONWY
CYNGOR BWRDEISTREF SIROL
COUNTY BOROUGH COUNCIL

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Contents

Overview

Conwy Cynhaliol have commissioned Greener Edge Ltd to undertake Energy Audits on community buildings in rural Conwy. The current climate emergency and cost of living crisis present great challenges to community groups running essential community buildings. The energy audits will examine building energy efficiency and provide a report with advice and recommendations that could help community groups reduce their long-term costs and reduce carbon emissions. These Energy audits have been funded through the UK Community Renewal Fund.

This energy audit evaluation was prepared for Rowen Memorial Hall for the reporting year 01/01/22 – 31/12/22. The energy audit took place on the 23/11/22.

Organisation Background	Name: Rowen Memorial Hall Address: Rowen Memorial Hall, Llannerch, Rowen, Conwy LL32 8YA. Contact Person: Peter McFadden Contact Email Address: peterhoney914@gmail.com Contact Phone Number: 01492 650851	
Calculated Emissions	Scope 1: Direct Emissions:	5.48 tCO_2e
	Scope 2: Indirect Emissions from Energy:	0.00 tCO_2e

All information, intensity metrics and recommendations contained within this report are accurate at the date of issue.

Prepared by:

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Date: 09th December 2022

Approved by:

Stu Meades
Date: 09th December 2022

1 Infrastructure and Energy Use

1.1 Building Overview

During the energy audit on the 23/11/2022, the following observations regarding the infrastructure and energy use of the building were made.

1.1.1 Thermal Envelope

The building was built in the year 1980 and is believed to be built according to building regulations of the respective time. The construction type of the walls is cavity filled walls.

The windows are double-glazed throughout the building and draught proofing was observed on all windows and external doors.

The floor type is solid concrete construction with no insulation.

1.1.2 Heating and Domestic Hot Water

There is one central heating system within the building. The type of heating system is a 37 kW gas-fired condensing combi boiler (Vaillant ecoTec plus 825 H combi A) with TRV controlled radiators. The boiler is 6 years old and is regularly serviced. The heating controls available are a programmer with an inbuilt thermostat and the TRV on the radiators. The programmer is set every week based on the projected occupancy levels each day and will be turned on 2 hours before any activities to bring the building up to a comfortable temperature. There was also a hot air blower within the main hall which is powered electrically but with the central heating linked to provide heat. When the heating is off, this functions as a fan when activated. Within the snooker room, an old gas heater was observed which is no longer used but still has an active supply of gas, there is also another hot air blower which is powered electrically but with central heating linked to provide heat. This is controlled via a small remote with an inbuilt thermostat which is placed above.

The domestic hot water (DHW) within the building is electrically provided. There is a 3 kW electric point of use boiler below the sink in the kitchen to provide hot water for hand washing and dish washing. There is also a 3 kW commercial hot water boiler in the kitchen to provide hot water for drinks. Within the bathrooms, there are small point of use hot water taps for hand washing.

1.1.3 Cooling

There is no active air conditioning or cooling equipment in the building, as mentioned previously the hot air blower can function as a fan. The only cooling is passive cooling through opening windows and the thermal inefficiencies of the building

1.1.4 Lighting

The building had recently undergone a lighting upgrade with the majority of lights now LED. The non-LED's observed during the energy audit were the following:

- CFLs (11W) x 8
- 300mm T5 Fluorescent Tube (18W) x 1
- 1200mm T5 Fluorescent Tube (36W) x 1
- 1800mm T8 Fluorescent Tube (125W) x 1

1.1.5 Process and Small Power Equipment

The process and small power equipment within the building was minimal, the equipment of note was the projector, the 8 500W stage lights, speakers and a small standard kitchen including a gas cooker with stove, a small fridge, a small kettle, and microwave.

1.1.6 Renewables and Storage

There were no renewable or storage facilities within the building currently.

1.2 Annual Greenhouse Gas Emissions

1.2.1 Reporting Boundary

The reporting boundary identifies which emission sources have been reviewed.

- Scope 1: Direct Emissions are emissions from operations that are owned or controlled by the reporting organisation.
- Scope 2: Indirect Emissions from Energy are emissions from the generation of purchased or acquired electricity, steam, heating, or cooling generated by a third party and consumed by the reporting organisation.

1.2.2 Data Collection

Data was collected by the responsible party of the community building and reviewed by Greener Edge. All emissions were calculated by Greener Edge. The calculation method that has been used for quantifying the emission inventory was the emissions source activity data multiplied by the emissions factor as shown in the formula below:

$$Tonnes\ CO_2e = \sum ghg\ activity\ \times EF$$

Where $\sum ghg\ activity$ equals the sum of greenhouse gas activity and EF equals the emissions factor for the greenhouse gas activity. Multiplying these gives the total quantity of greenhouse gas emissions (kg CO_2e) per activity. For example, 4000 kilowatt hours (kWh) of electricity (the greenhouse gas activity) is multiplied by 0.00019 (the emission factor, tCO_2e per kWh of electricity) to equal 0.388 tCO_2e.

1.2.3 Emissions

The Scope 1: Direct Emissions consists only of emissions associated with onsite gas consumption. The consumers of gas within the building are the heating and the gas cooker.

Scope	Activity	Quantity (kWh)	Calculated Emissions (tCO_2e)	Percentage (%)
Scope 1: Direct Emissions	Gas Consumption – Heating and Cooking.	27,093.00	5.48	100%
Total		**27,093.00**	**5.48**	**100%**

Table 1: Rowen Memorial Hall's Scope 1: Direct Emissions

The dual reporting methodology has been used to report the associated emissions from electricity consumption. This reports two different figures; one figure using the location-based method, the other figure using the market-based methodology. The location-based method calculates the emissions using a national average emission factor for a specific geographic boundary that relates to the grid on which energy consumption occurs over a specific time-period. This reveals what the company is physically putting into the air. The market-based method calculates the emissions from supplier-specific data in the form of contractual instruments, such as REGOs (Renewable Energy Guarantees of Origin) and this reveals the emissions the company is responsible for through its purchasing decisions.

The total annual electricity consumption for the reporting year was 2,304.00 kWh. Due to the site being on a 100% REGO renewable backed tariff, the electricity consumption has zero associated emissions.

Scope	Activity	Quantity (kWh)	Calculated Emissions (tCO_2e)	
			Location-Based Total	Market-Based Total
Scope 2: Indirect Emissions	Purchased electricity	2,304.00	0.45	0.00
	Total	**2,304.00**	**0.45**	**0.00**

Table 2: Rowen Memorial Hall's Scope 2: Indirect Emissions from Energy

1.2.4 Key Metrics

During the energy audit, we were able to take measurements of the building to calculate the total floor area and volume of the room.

Below are the building measurements:

Reference	Measurement	Data Source
Total Ground Floor Area (m^2)	255.00	Measurements taken during energy audit.
Hall Floor Area (m^2)	240.00	Measurements taken during energy audit.
Hall Ceiling Height (m)	4.02	Measurements taken during energy audit.
Snooker Room Floor Area (m^2)	34.00	Measurements taken during energy audit.
Snooker Room Height (m)	2.40	Assumed average ceiling height following observations during energy audit.
Extensions Floor Area (m^2)	15.00	Measurements taken during energy audit.
Extensions Ceiling Height (m)	2.40	Assumed average ceiling height following observations during energy audit.
Total Building Volume (m^3) (Usable Space – excluding loft spaces)	**1061.10**	**Post energy audit calculations.**

Table 2: Building Measurements

Based on these measurements and the calculations in section 1.2.3 we have been able to calculate the following building metrics.

The heating (kW and BTU) metrics below have been calculated using a simple online calculator and are indicative in nature. They should not be relied upon for design purposes.

Metric Category	Intensity Metric	Calculation Method
Building Emissions Rate per Cube Meter of Usable Space	5.16445 kg CO_2e / m^3	Based on building measurements and carbon emission calculations
Electricity Consumption per Cubic Meter of Usable Space	2.17133 kWh / m^3	Based on building measurements and energy bills
Gas Consumption per Cubic Meter of Usable Space	25.53294 kWh / m^3	Based on building measurements and gas bills
Calculated Current Required Heating Output in Main Hall (BTUs)	123,357.00	BTU Calculator | Find The Perfect Radiator Size For Room (heatadviser.co.uk)

Calculated Required Heating Output in Snooker Room (BTUs)	5,931.00	
Calculated Required Heating Output across Extensions (BTUs)	4,569.00	
Calculated Required Heating Output in Main Hall (kW)	36.15 kW	BTU to watts (W) conversion calculator (rapidtables.com)
Calculated Required Heating Output in Snooker Room (kW)	1.74 kW	
Calculated Required Heating Output across Extensions (kW)	1.34 kW	
Calculate Total Building Required Heating Output (kW)	39.23 kW	Calculated based on above.

Table 3: Building Metrics

2 Roadmap

2.1 Target

Target: Optimise the energy performances and efficiencies of the systems and building and reduce financial costs of running the building.

We believe this can be achieved by Rowen Memorial Hall through undertaking the recommendations made below.

2.2 Recommendations

To decrease Rowen Memorial Hall's energy consumption and optimise the energy performance of the building, short-, mid- and long-term recommendations have been made which look at all areas within the building.

2.2.1 Short-term

Customer Engagement

We recommend having informative posters/stickers across the building at energy use locations. For example, next to every plug socket, a note to say turn off when not in use and to unplug from the wall as this save's energy also, this could save up to £30 in energy costs a year. (Energy Saving Trust)

Another example, as there are no measures to stop customers changing the individual radiator settings, it providing recommended radiator settings to reduce the associated emissions.

We recognise that having informative posters/stickers across the buildings doesn't appeal to everyone. In this case, we recommend compiling an energy use booklet for the building which customers can view whilst in the building. It's important to provide both examples and benefits of saving energy to reduce fuel and energy bills, as well as the buildings carbon footprints.

Energy Saving Trust provide free resources for employee/customer engagement on saving energy and energy efficiencies in the work place. Below is a list of this resources:

Employee-Engagement-Posters-energy-saving-trust.pdf (energysavingtrust.org.uk)

Employee_engagement_guide_2022v2.pdf (energysavingtrust.org.uk)

Energy-checklistv3.pdf (energysavingtrust.org.uk)

Employee-engagement-with-sustainability_presentation.pptx (live.com)

EE-stickers-small-1-page.pdf (energysavingtrust.org.uk)

Thermal Envelope

It was noted during the energy audit that the concrete floor within the main hall can be a very cold surface at times which can be uncomfortable for certain activities held such as yoga.

We believe there are a few options and directions to take to create a warmer floor whilst maintaining a solid surface for dancers. Below, are our recommendations with a series of options:

Initially install a rollout thermal carpet/matting to cover the floor for activities such as yoga whilst maintaining the solid concrete floor for dancers. This is a short-term low-cost solution, which may even lower the heating demand for certain activities. Following this, as a mid- to long-term recommendations, either:

1. Insulate the concrete floor by either attaching wood sleepers to the floor, filling the gaps with rigid-foam insulation, and then apply a hard finish flooring, or cover the floor with rigid-foam insulation, add two layers of plywood and then add the hard finish flooring. Both methods will raise the floor however we believe there is plenty of height within the space for this to have minimal impact. This will also ensure a solid surface remains for dancers whilst preventing a cold surface for activities such as yoga.
2. Alternatively, as a potentially more long-term efficient solution, underfloor heating could be installed. Since this is a solid concrete floor, we believe the tracking for the underfloor heating could be routed into the concrete floor. This will maintain the solid floor for dancers whilst creating a warmer surface for activities such as yoga. This solution will have a longer return of investment (ROI) however is a far more efficient solution in the long-term and will be compatible with a heat pump if and when the current boiler system is upgraded. Additionally, the surface of the floor will not be raised to the same degree, if at all, as option 1.

Internal Thermal Retention

It was noted that all of the main hall space is not always used for activities and that sometimes only half the space may be used. We believe it would be beneficial to install an insulated partition that can be completely opened when the full space needs using but closed otherwise to lower the heating demand of the space. As well as the energy efficiencies associated with this, this will also allow for two smaller activities to run at the same time by splitting the room so may add more flexibility to the timetabling of the space.

We believe the quickest and lowest-cost option is to install an insulated sliding curtain which can be sealed when closed. This will take up very little space when open and will significantly lower the heating demand for when only half the space is needed.

Pipe Insulation

It was noted during the audit, HW pipes throughout the building were uninsulated allowing for thermal loss. We recommend insulating the pipework throughout. Insulating HW pipes reduces heat loss and can raise water temperature 2˚f - 4˚f hotter than uninsulated pipes can deliver, allowing the water temperature setting to be lowered. This can lead to 3-4% energy savings annually. However, the ROI can be a long time if completed by a third party and the financial savings may not even be seen.

Do-It-Yourself Savings Project: Insulate Hot Water Pipes | Department of Energy

Undertaking this installation will create a more efficient heating system for the future use of the building.

Heating Systems

We recommend a multi-phase plan of review for the gas consumption for heating within the building with the idea to phase out gas and rely on electricity for heating and DHW.

The first phase of this would be to review heating controls. This would entail assessing the validity of the timer program and also the location and settings of the thermostats. Following the assessment, it would be possible to observe whether the heating is being used efficiently or not leading to potential changes including whether the primary thermostat is in an optimal location. To improve the efficiencies of the heating system, we recommend adding weather compensation controls and local time control. Weather compensated heating systems use a small outdoor sensor to adjust the system controls to compensate for changes in outdoor temperature automatically. As the weather gets colder the system works harder and produces more heat to the radiators, and as the weather warms up the system reduces the temperature to the radiators. The system runs more consistently feeding energy into the building gradually and efficiently over a longer period of time. The key benefits of this include,

- The heat source will modulate and run at a lower, more efficient rate.
- It maintains the fabric of the building at a steady consistent temperature and provides the occupants with increased levels of comfort.
- The need to turn off the heating system is removed. The heating will come on as required by the outdoor temperature. This means that on a cool, late summer evening the heating will automatically come on to provide some heat, and on a warm spring day the heating will not switch on at all.

The second phase of this plan would entail a boiler condition survey with a view the boiler is serviced and appraised for its life cycle condition. Along with this, we recommend a feasibility survey is undertaken for either an air-source or ground-source heat pump (ASHP or a GSHP). The life-cycle appraisal will allow for the future planning of the replacement of the boiler so that before the boiler becomes defective and an urgent like-for-like replacement is installed, a heat pump model can be designed and installed at the right time.

In order for a heat pump to be efficient, it must be ensured the building itself is thermally efficient and well insulated. A heat pump is also very compatible with underfloor heating, therefore, if this option for the solid concrete floor is adopted, this installation would go hand-in-hand.

It was noted within the snooker room, there is an old gas heater with a live supply of gas to it. We recommend that the gas supply to this is cut off and that the heater is replaced for an electric programmable panel radiator. When the other spaces of the building aren’t occupied, the boiler is off, and since the hot air blower in the snooker room is linked to the central heating system, there is no heating. Therefore, this electric programmable panel radiator can be used without requiring the boiler to be on just for one room allowing for more efficient heating and reducing gas-consumption.

Lighting Upgrade

We propose that the following replacements:

Number of Fittings	Current Light	Proposed Replacement Light
8	CFL Bulbs (11W)	LED 4pin/2pin Retrofit Lamp (10W)
1	300mm T5 Fluorescent Tube (18W)	LED Dune Disc Luminaire (15W)

1	1200mm T5 Fluorescent Tube (36W)	LED IP65 1200mm (16W)
1	1800mm T8 Fluorescent Tube (125W)	LED IP65 1800mm (36W)

Table 3: Light Replacement Proposal.

It is anticipated that the energy consumption from non-LED lighting will be reduced from 990 kWh per annum to 530 kWh per annum based on assumed average lighting use. This represents a potential saving of 460 kWh, a 46 % reduction in current non-LED lighting energy use, or up to a 20% reduction in overall electricity use.

An indicative cost for the supply and installation of the LED lights was sourced to be circa £584 inc VAT.

It is recognised that the electricity savings will not reduce the carbon emissions associated with the site but will generate cost savings.

2.2.2 Mid-term

Renewables and Storage

Preliminary desktop surveys indicate that there is potential for a roof-mounted solar PV array of approximately 15 kWp in size on the main roof space of circa 75m^2 (see below).

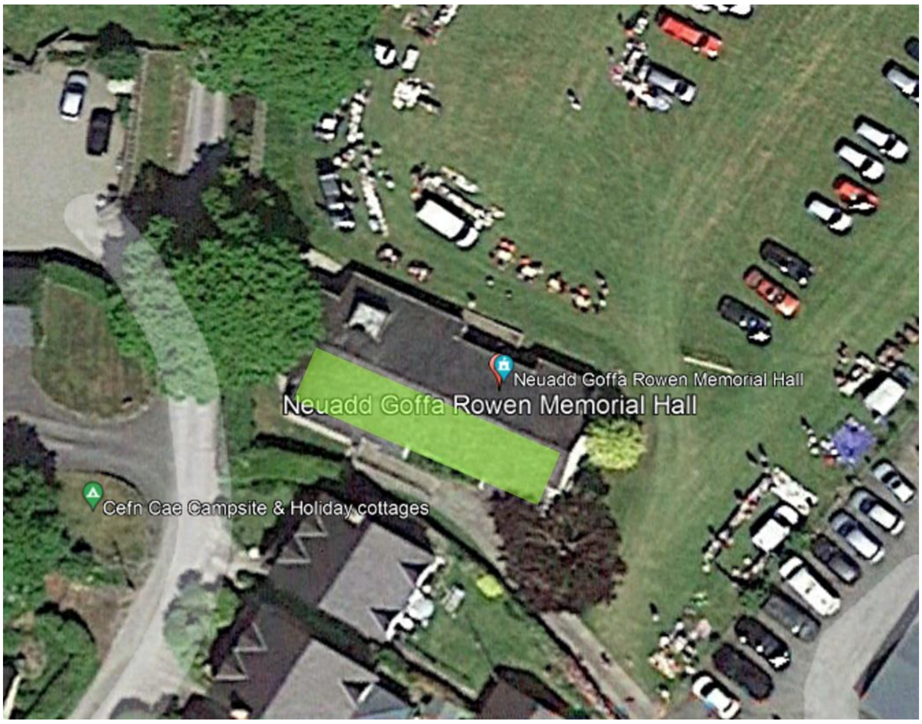

Figure 1: Proposed PV array location.

Indicative costs for PV installation are approximately £1,250 - £1,500 per kWp installed, meaning that the installations would be in the region of £18,750 - £22,500 + VAT.

It would be reasonable to expect an average yield of approximately 15,000 kWh per annum from the array, which is far greater than the annual average consumption of the building which is estimated to be in the region of 2,300kWh.

The PV array proposed would generate a surplus of electricity during the day and circa 12,500 kWh would be exported to the grid.

The Feed in tariff payment for the sale of surplus electricity has now been replaced by the Smart Export Guarantee.

Rates for this vary between different suppliers and it is possible to receive in the region of 5 to 7pence per kWh exported. For the PV installation on the current structure, this would mean a potential revenue of £625 - £875 per annum.

We believe an array of this size is over-scaled based off of the buildings annual energy consumption and needs to be scaled down appropriately, however we believe in combination with an appropriate level of battery storage it is possible to completely reduce the buildings need for grid-based electricity. We recommend an electrical profile monitoring over a 28 day "average" period to understand the buildings usage better, to ensure the array isn't over-scaled and achieve optimum balance of CAPEX versus return.

Any potential PV installation may need permission under planning regulations and independent planning advice should be sought as a first step in the process. A PV installation will also need permission to be granted by the Distribution Network Operator (DNO) to ensure that there is capacity in the grid to accept a complete export from the site.

The DNO covering the site is Scottish Power Energy Networks, their website is available at https://www.scottishpower.com.

We also recommend that a site-based feasibility survey for PV solar panel installation is undertaken for the roof mounted array to allow formal quotations for installation to be generated and returns on investment to be calculated. This will include a formal measurement of electrical consumption and modelling of current and future demand.

Thermal Envelope

We recommend installing internal wall insulation as this will increase the efficiency of the thermal retention of the building whilst lowering the heating demand. The installation of internal insulation is expected to cost circa £4,000 - £12,000. For an accurate cost, an inspection would be required. The installation of internal insulation would remove a marginal volume of space within the building however would have significant benefits and savings.

Internal Thermal Retention

A more efficient way to partition the main hall into two separate spaces for smaller activities would be to install an insulated folding wall which can either be hung from a ceiling track or supported by a low-profile surface mounted floor track and can be fitted with PVC seals all round to achieve greater thermal retention. These can be supplied as either a centrefold or endfold configuration to accommodate different requirements. All panels are continuously hinged and the lead panel is supplied as a pass door as standard. See the following for examples.

Folding Walls » Style Moveable Partition Specialists - the moving wall company (style-partitions.co.uk)

This will come with a higher cost rather than installing a thermal sliding curtain however will be more efficient at lowering the heating demand. It could be an option to install a thermal sliding curtain initially in the short-term to ensure thermal savings now and then upgrade to this in the long-term rather than delaying an instant installation of an insulated folding wall which is likely to have a lower cost than two stages of installation.

Both options will lower the heating demand for when all of the main hall is not required and will allow for more efficient heating lowering the gas consumption.

2.2.3 Long-term

Heat Management

Following the improvements of the efficiency of the buildings thermal retention, it would be appropriate to upgrade the heating system for either an ASHP or GSHP. The type of heat pump would depend on the outcome of the heat pump feasibility survey and would have to be weighed up financially as well as on the efficiency of each system.

The coefficient of performance (COP) of an ASHP is 2.5, which implies for every 1 kW of energy in, 2.5 kW of heat is outputted. Whilst the COP of a GSHP is 3.5 which implies for every 1 kW of energy in, 3.5 kW of heat is outputted. However, the cost associated with the installation of a GSHP is far greater than an ASHP. Both have a far greater COP than the current gas boiler which is likely to be 0.8 – 0.9.

Assuming the current boiler has a COP of 1.0, this implies the current heating output required for the building is 37 kW. Our indicative calculations based on measurements taken during the energy audit would suggest the required heating output for the building is circa 39 kW. Based on this, it would be reasonable to assume, that a 16 kW ASHP would need to be installed to match the current heating output or an 11 kW GSHP would need to be installed to match the current heating output.

However, taking into considerations the proposed improvements of thermal efficiencies within the building, the heating demand would be lower and these specifications for heat pumps would be the maximum energy demand.

Renewables and Storage

We recommend the installation of PV is phased. Initially an array large enough to produce enough electricity to cover the demand. Following this, if the demand increases for new infrastructure within the building, then it may be worth installing a second array to cover the new demand.

We believe the demand would increase through the installation of either a GSHP or an ASHP. As stated above, due to the Coefficient of Performance (COP) of both heat pumps, the demand would alter whether an ASHP or a GSHP were to be installed. Based on current heating demand and usage, if an ASHP were to be installed then the electricity demand would increase by circa 10,000 kWh annually, and if a GSHP were to be installed the demand would increase by 7,500 kWh annually.

If battery storage weren't to be been installed with the initial PV installation, it would be sensible to install appropriate battery storage with the second PV array installation. This is because the heating system would be electrically sourced and at night when the PV isn't generating, the heating could run from the batteries. (See Appendix 1 for batteries)

2.3 Action Plan

Figure 2 below demonstrates the suggested action plan for Rowen Memorial Hall to optimise the energy performances and efficiencies of the systems within the building and reduce financial costs of running the building.

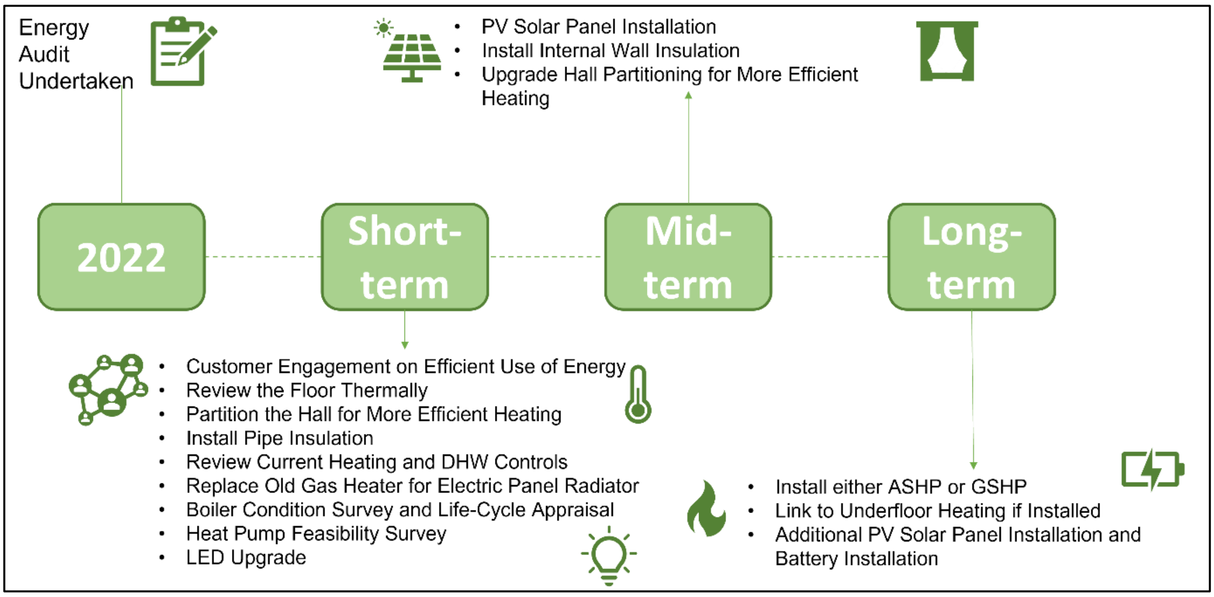

Figure 2: Action Plan.

Appendices

Appendix 1

Battery Storage

Greener Edge performed preliminary market research with a local North Wales provider who came back with the following indicative costs for the three battery storage options listed below.

Data sheets for the products are embedded.

Huawei Smart String Energy Storage System

5kWh Capacity (scalable)

£4,995.00 + vat

Datasheet attached

SolarEdge Energy Bank

10kWh Capacity

£6,995.00 + vat

Datasheet attached

Tesla Powerwall II

13.4kwh Capacity

£8900.00 + vat

8-month Lead Time

Datasheet attached

This document is prepared for information use only. Greener Edge do not endorse or support any product nor do they have any commercial relationships with any battery solution listed.

Prices accurate as of April 2022.

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