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EES:ABS 2023/24 – Case Study 1

Evanton, Highland

Installation of Air Source Heat Pump and Solar Photovoltaic Panels with Battery Storage

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1. Introduction

This report outlines the project undertaken to improve the energy performance and energy efficiency of a two-bedroom end-terraced property in Evanton, Easter Ross. The aim was to showcase effective methods and materials to enhance the building's efficiency, reducing energy consumption and costs. It provides a detailed comparison of the property's energy performance before and after the upgrades, along with the anticipated benefits of the applied interventions for the property and its occupants.

2. The Site

The subject property is a two-bedroom end-terraced house constructed in the 1980s, located in the village of Evanton, Easter Ross. Due to its exposed location, the property is particularly vulnerable to severe weather conditions, including heavy rainfall and snowfall during winter months. The building features cavity walls with existing insulation, electric storage heaters for heating, and PVC double-glazed windows.

3. Pre-intervention Performance

Prior to the installation of energy efficiency measures, the property held an Energy Performance Certificate (EPC) rating of D57, indicating moderate energy efficiency, and an environmental impact rating of E43, reflecting the property's high carbon emissions. These ratings highlighted the need for significant improvements to reduce energy consumption and environmental impact. The complete pre-installation EPC report can be found in Appendix 1.

4. Implemented Improvements

To significantly enhance the property's energy efficiency and energy performance, two key interventions were made, the installation of an air source heat pump (ASHP) to improve heating efficiency, and the addition of solar photovoltaic (PV) panels with battery storage to reduce electricity consumption. These upgrades were designed to optimise energy use, reduce carbon emissions, and lower the homeowner's energy bills. The details of each improvement are outlined below.

4.1 Air Source Heat Pump

To enhance the heating efficiency of the property, a Grant Aerona HPID10R32 Air Source Heat Pump (ASHP) and a 201L Pre-Plumbed Hot Water Cylinder were installed. The ASHP located in the rear garden of the property. This system provides a reliable, consistent heat supply through newly installed radiators and pipework, with heating managed by a programmable thermostat. This allows heating to be regulated, reducing unnecessary energy consumption.

Prior to the installation, all insulation measures were upgraded to prevent heat loss. Heat loss calculations were conducted for each room, ensuring that the radiators were appropriately sized to meet the target temperatures. This guarantees efficient heat distribution throughout the home, reducing energy waste and minimising running costs.

Figure 1 – ASHP and tank

4.2 Solar Photovoltaic Panels and Battery Storage

In addition to the ASHP, a solar photovoltaic (PV) system was installed to further reduce the property's electricity consumption. Solar PV provides a clean, renewable energy source, helping to reduce reliance on grid-supplied electricity. For this project, a 6 panel PV system was installed, producing an estimated 2,000 kWh annually.

Figure 2 - Solar Photovoltaic panels post install

A battery storage system was also incorporated, allowing surplus energy generated during daylight hours to be stored for later use. This setup maximises energy utilisation and further reduces reliance on grid electricity, especially during peak periods. The installation of the solar array and electrical components was completed within one day, with more complex installations sometimes requiring additional time.

Figure 3 below shows the percentage of self-consumption, exported to the grid and imported from the grid, highlighting the reduced reliance on the grid as only 17.3% of the properties load consumption was imported from the grid. The systems social contribution is shown in figure 4, compounding the benefits of installing energy efficient technologies.

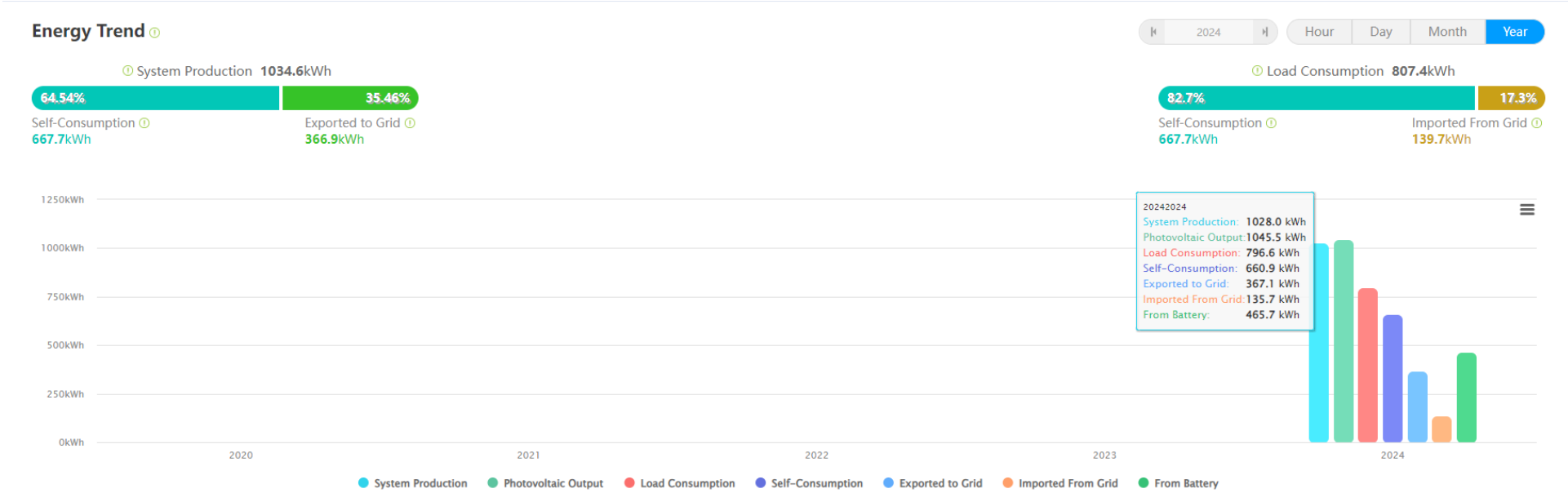


Figure 3 – Energy Trend for the property.

Figure 4 – Social contributions from PV and Battery installation

5.Post-intervention Performance

Following the implementation of the energy efficiency upgrades, including the installation of the air source heat pump, solar photovoltaic panels, and enhanced insulation. The property achieved a significant improvement, with the EPC rating rising to an outstanding A96 for energy efficiency, and the environmental impact rating improved to A98. These ratings are indicative of a highly energy-efficient home, with minimal energy waste and a greatly reduced carbon footprint. The full post-installation EPC report can be reviewed in Appendix 2.

6. Conclusion

The energy efficiency measures implemented at this end-terraced property in Evanton demonstrate effective methods for improving energy performance, particularly through the installation of a modern heating system and renewable energy sources. The introduction of an air source heat pump, combined with solar photovoltaic panels and battery storage, will result in significant energy savings and reduced carbon emissions. These measures will not only improve the property's comfort levels but also lead to long-term cost savings for the homeowner.

Appendix 1 – Pre Energy Performance Certificate Extract

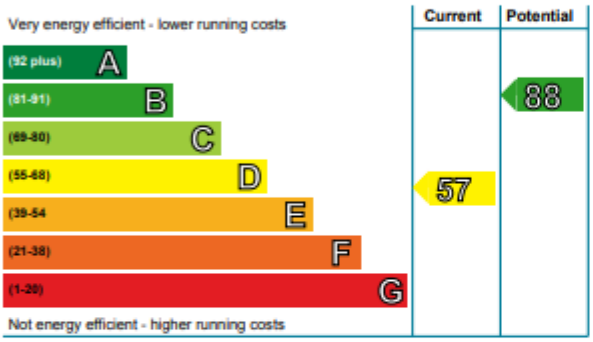
Dwelling type:	End-terrace house	**Reference number:**	[redacted]
Date of assessment:	12 March 2024	**Type of assessment:**	RdSAP, existing dwelling
Date of certificate:	25 March 2024	**Approved Organisation:**	Elmhurst
Total floor area:	62 m²	**Main heating and fuel:**	Electric storage heaters
Primary Energy Indicator:	522 kWh/m²/year		

You can use this document to:

- **Compare current ratings of properties to see which are more energy efficient and environmentally friendly**
- **Find out how to save energy and money and also reduce CO_2 emissions by improving your home**

Estimated energy costs for your home for 3 years*	**£6,543**	See your recommendations report for more information
Over 3 years you could save*	**£2,676**	

* based upon the cost of energy for heating, hot water, lighting and ventilation, calculated using standard assumptions

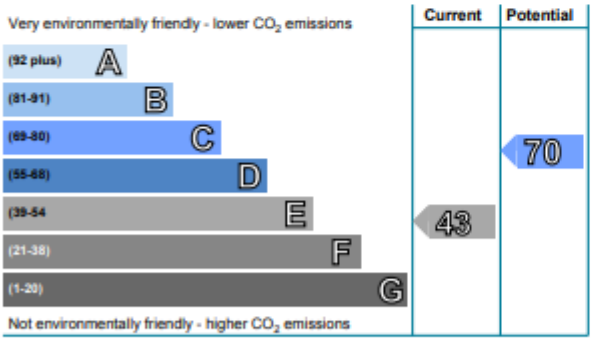


Energy Efficiency Rating

This graph shows the current efficiency of your home, taking into account both energy efficiency and fuel costs. The higher this rating, the lower your fuel bills are likely to be.

Your current rating is **band D (57)**. The average rating for EPCs in Scotland is **band D (61).**

The potential rating shows the effect of undertaking all of the improvement measures listed within your recommendations report.



Environmental Impact (CO_2) Rating

This graph shows the effect of your home on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating, the less impact it has on the environment.

Your current rating is **band E (43)**. The average rating for EPCs in Scotland is **band D (59).**

The potential rating shows the effect of undertaking all of the improvement measures listed within your recommendations report.

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years
1 Floor insulation (suspended floor)	£800 - £1,200	£528.00
2 Low energy lighting	£45	£222.00
3 High heat retention storage heaters	£1,200 - £1,800	£1635.00

Summary of the energy performance related features of this home

This table sets out the results of the survey which lists the current energy-related features of this home. Each element is assessed by the national calculation methodology; 1 star = very poor (least efficient), 2 stars = poor, 3 stars = average, 4 stars = good and 5 stars = very good (most efficient). The assessment does not take into consideration the condition of an element and how well it is working. 'Assumed' means that the insulation could not be inspected and an assumption has been made in the methodology, based on age and type of construction.

Element	Description	Energy Efficiency	Environmental
Walls	Cavity wall, filled cavity	★★★★☆	★★★★☆
Roof	Pitched, 300 mm loft insulation	★★★★★	★★★★★
Floor	Suspended, no insulation (assumed)	—	—
Windows	Fully double glazed	★★★☆☆	★★★☆☆
Main heating	Electric storage heaters	★★★☆☆	★☆☆☆☆
Main heating controls	Manual charge control	★★☆☆☆	★★☆☆☆
Secondary heating	Portable electric heaters (assumed)	—	—
Hot water	Electric immersion, off-peak	★☆☆☆☆	★★☆☆☆
Lighting	No low energy lighting	★☆☆☆☆	★☆☆☆☆

The energy efficiency rating of your home

Your Energy Efficiency Rating is calculated using the standard UK methodology, RdSAP. This calculates energy used for heating, hot water, lighting and ventilation and then applies fuel costs to that energy use to give an overall rating for your home. The rating is given on a scale of 1 to 100. Other than the cost of fuel for electrical appliances and for cooking, a building with a rating of 100 would cost almost nothing to run.

As we all use our homes in different ways, the energy rating is calculated using standard occupancy assumptions which may be different from the way you use it. The rating also uses national weather information to allow comparison between buildings in different parts of Scotland. However, to make information more relevant to your home, local weather data is used to calculate your energy use, CO_2 emissions, running costs and the savings possible from making improvements.

The impact of your home on the environment

One of the biggest contributors to global warming is carbon dioxide. The energy we use for heating, lighting and power in our homes produces over a quarter of the UK's carbon dioxide emissions. Different fuels produce different amounts of carbon dioxide for every kilowatt hour (kWh) of energy used. The Environmental Impact Rating of your home is calculated by applying these 'carbon factors' for the fuels you use to your overall energy use.

The calculated emissions for your home are 88 kg $CO_2/m^2/yr$.

The average Scottish household produces about 6 tonnes of carbon dioxide every year. Based on this assessment, heating and lighting this home currently produces approximately 5.4 tonnes of carbon dioxide every year. Adopting recommendations in this report can reduce emissions and protect the environment. If you were to install all of these recommendations this could reduce emissions by 2.4 tonnes per year. You could reduce emissions even more by switching to renewable energy sources.

Appendix 2 – Post Energy Performance Certificate Extract

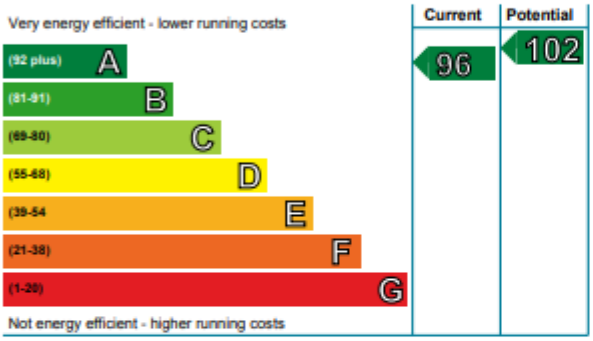
Dwelling type:	End-terrace house	**Reference number:**	[redacted]
Date of assessment:	12 June 2024	**Type of assessment:**	RdSAP, existing dwelling
Date of certificate:	25 June 2024	**Approved Organisation:**	Elmhurst
Total floor area:	62 m²	**Main heating and fuel:**	Air source heat pump, radiators, electric
Primary Energy Indicator:	43 kWh/m²/year		

You can use this document to:

- **Compare current ratings of properties to see which are more energy efficient and environmentally friendly**
- **Find out how to save energy and money and also reduce CO_2 emissions by improving your home**

Estimated energy costs for your home for 3 years*	**£2,838**	See your recommendations report for more information
Over 3 years you could save*	**£672**	

* based upon the cost of energy for heating, hot water, lighting and ventilation, calculated using standard assumptions

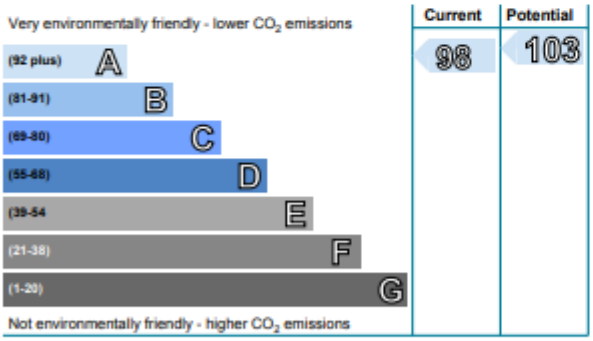


Energy Efficiency Rating

This graph shows the current efficiency of your home, taking into account both energy efficiency and fuel costs. The higher this rating, the lower your fuel bills are likely to be.

Your current rating is **band A (96)**. The average rating for EPCs in Scotland is **band D (61).**

The potential rating shows the effect of undertaking all of the improvement measures listed within your recommendations report.



Environmental Impact (CO_2) Rating

This graph shows the effect of your home on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating, the less impact it has on the environment.

Your current rating is **band A (98)**. The average rating for EPCs in Scotland is **band D (59).**

The potential rating shows the effect of undertaking all of the improvement measures listed within your recommendations report.

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years
1 Floor insulation (suspended floor)	£800 - £1,200	£141.00
2 Low energy lighting	£45	£213.00
3 Solar water heating	£4,000 - £6,000	£318.00

Summary of the energy performance related features of this home

This table sets out the results of the survey which lists the current energy-related features of this home. Each element is assessed by the national calculation methodology; 1 star = very poor (least efficient), 2 stars = poor, 3 stars = average, 4 stars = good and 5 stars = very good (most efficient). The assessment does not take into consideration the condition of an element and how well it is working. 'Assumed' means that the insulation could not be inspected and an assumption has been made in the methodology, based on age and type of construction.

Element	Description	Energy Efficiency	Environmental
Walls	Cavity wall, filled cavity	★★★★☆	★★★★☆
Roof	Pitched, 300 mm loft insulation	★★★★★	★★★★★
Floor	Suspended, no insulation (assumed)	—	—
Windows	Fully double glazed	★★★☆☆	★★★☆☆
Main heating	Air source heat pump, radiators, electric	★★★★★	★★★★★
Main heating controls	Programmer, TRVs and bypass	★★★☆☆	★★★☆☆
Secondary heating	None	—	—
Hot water	From main system	★★★☆☆	★★★★☆
Lighting	No low energy lighting	★☆☆☆☆	★☆☆☆☆

The energy efficiency rating of your home

Your Energy Efficiency Rating is calculated using the standard UK methodology, RdSAP. This calculates energy used for heating, hot water, lighting and ventilation and then applies fuel costs to that energy use to give an overall rating for your home. The rating is given on a scale of 1 to 100. Other than the cost of fuel for electrical appliances and for cooking, a building with a rating of 100 would cost almost nothing to run.

As we all use our homes in different ways, the energy rating is calculated using standard occupancy assumptions which may be different from the way you use it. The rating also uses national weather information to allow comparison between buildings in different parts of Scotland. However, to make information more relevant to your home, local weather data is used to calculate your energy use, CO_2 emissions, running costs and the savings possible from making improvements.

The impact of your home on the environment

One of the biggest contributors to global warming is carbon dioxide. The energy we use for heating, lighting and power in our homes produces over a quarter of the UK's carbon dioxide emissions. Different fuels produce different amounts of carbon dioxide for every kilowatt hour (kWh) of energy used. The Environmental Impact Rating of your home is calculated by applying these 'carbon factors' for the fuels you use to your overall energy use.

The calculated emissions for your home are 7 kg $CO_2/m^2/yr$.

The average Scottish household produces about 6 tonnes of carbon dioxide every year. Based on this assessment, heating and lighting this home currently produces approximately 0.5 tonnes of carbon dioxide every year. Adopting recommendations in this report can reduce emissions and protect the environment. If you were to install all of these recommendations this could reduce emissions by 0.5 tonnes per year. You could reduce emissions even more by switching to renewable energy sources.