HYBRID HEATING TRIAL 2025

Refresh

10TH JULY - 28TH AUGUST 2025

CASTLECOOLE CASE STUDY 4.0

Measuring the impacts of hybrid heating & solar PV in Northern Ireland's retrofit market.

- 20 Castlecoole Park, Belfast, BT8 7BE
- Home Occupied x1 Adult
- Mid-Terrace House EPC Rating C71
- 16.2°CAverage Outside Temperature

- Operates at higher temperatures
- Access to instant hot water
- Energy independence
- No need to upgrade pipework
- Backed up by combi gas boiler
- Increased home value

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ABOUT THE TRIAL

PROJECT BACKGROUND

The aim of this project is to assess the impact of adding a solar & battery system to a renewable heating system in Northern Ireland's retrofit market, which faces unique challenges in terms of decarbonisation solutions.

As part of the trial, an Alpha E-Tec Hybrid Heat Pump was installed, including an air source heat pump, a combination boiler and a comprehensive monitoring system in November 2023. A heat loss study was conducted on the property (*1*), establishing a heat loss of 4,583 W with correctly sized radiators for a 62°C flow temperature, as shown in Table 1.

Multiple studies were completed on the hybrid heat pump, but in this next evolution, a Sunsynk solar and battery system has been added with six 435W panels and a 5.3kW battery. This system has an expected production of 2133 kWh a year and self-consumes 1642.56 kWh per year, as evidenced in the Predicted PV Performance Output (Table 2). A mockup of the system design can be seen below (Image 1).

(Image 1)- Solar PV system mockup design)

Property Details	
Year built	Pre 2000
Design Data	
Outside Design Temp - ODT (ºC)	-4
Degree Days (DD)	2360
Mean air temp - MAT (ºC)	9.4
Altitude (m)	46
Building Requirements	
Space Heating load (W)	4583
Total area of building (m^2)	82.25
Average Watts per metre square (W/m^2) heat loss	56

(Table 1 - Heat Loss Output)

A. Installation data		
Installed capacity of PV system	**2.61**	**kWp**
B. Performance calculations		
Shade Factor (SF) Estimated annual output	**0.966**	
(kWp x Kk x SF)	**2,133**	**kWh**
C. Estimated PV self-consumption - PV Only		
Assumed annual electricity consumption, kWh	**3,388.00**	**kWh**
Assumed annual electricity generation from solar PV system, kWh	**2,133**	**kWh**
Expected solar PV self-consumption (PV Only)	**640**	**kWh**
Grid electricity independence / Self-sufficiency (PV Only)	**18.88**	**%**
D. Estimated PV self-consumption - with EESS		
Assumed usable capacity of electricity energy storage device, which is used for self-consumption, kWh	**4.78**	**kWh**
Expected solar PV self-consumption (with EESS)	**1,642.56**	**kWh**
Grid electricity independence/self-sufficiency (with EESS)	**48.0**	**%**

(Table 2 - Predicted PV Performance Output) (5)

CASE STUDY DESCRIPTION

This case study lays out optimal settings for a hybrid system, factoring in user comfort and cost. The system operates in a similar way to an air source heat pump, with a preset setback temperature. Setback temperature controls give homeowners the ability to set a minimum internal temperature during times when heating is not set to reach a preferred temperature. This helps conserve energy and support system efficiencies. The parameters were set in conjunction with the tenant.

Parameter	Previous Setting	Solo Tenant Settings
Programmed Heating Times	Mon - Sun 0600-0800 Mon - Sun 1800-2100	Mon - Sun 0700-2230
Heating Temperature	21°C	20°C
Setback Temperature	18°C	18°C
Electricity Cost	£0.34 per kWh	£0.30 per kWh
Gas Cost	£0.115 per kWh (Jan- Mar) £0.0868 per kWh (April)	£0.0868 per kWh

(Table 3 - Trial Parameters and System Settings)

MONITORING SYSTEM

The monitoring system consists of two elements: heat pump monitoring and solar monitoring. The heat pump used heat meters to measure outputs from the air source unit, as well as the total heating output. Current transformers measured the electrical usage of the house, the air source unit and the boiler. The volume of hot water used was also measured, while three thermometers recorded the outdoor, living room and bedroom temperatures. The solar output was measured using Sunsynk's monitoring software, which takes data from the inverter, battery and a Grid CT to measure import/export, battery charge/discharge, solar generation, house load and battery percentage.

EQUIPMENT SPECIFICATION

HYBRID HEAT PUMP USED

The system used an Alpha E-Tec Hybrid heat pump. Key features of this unit are:

- **Boiler automatically backs up after 1.5 hrs** if the house has not reached the desired temperature.
- **Boiler heats water instantly**, giving 24/7 access to hot water.
- System uses energy prices (based on current tariffs) and temperature to choose the most efficient energy source.
- System checks the heating flow temperature every 20 minutes to assess if boiler backup is required.
- 4kW Heat Pump
- 33kW Combi Boiler
- Smartech Plus Wi-Fi Controller

SOLAR & BATTERY SYSTEM USED

A Sunsynk battery and inverter were selected for this trial following a detailed system design and site survey. Key features of this unit are:

- **User-friendly app** allows customer to monitor the solar gains of their property
- Option to **charge the battery on an overnight tariff** to further **reduce costs**.
- System uses a grid CT to monitor the energy usage of the property. This allows the system to decide when the batteries get charged while covering the house usage.
- 3.6kW Sunsynk Inverter
- 5.3kW Sunsynk Battery
- 435W Longi Panels

USING THE SYSTEMS

HYBRID HEAT PUMP PERFORMANCE & USAGE STATS

The combination gas boiler used in this trial is 93% efficient. Therefore, 7% of the gas used by the combination boiler is lost due to boiler inefficiency. Heat pumps have efficiencies greater than 1, known as a COP (Co-efficient of Performance). The COP of the heat pump during this trial was 3.57, meaning that for every kW of electricity used, 3.57kW of heat was provided. **Total heat output, air source heat output and electrical energy consumed are shown in Table 4.**

The figures show that total heat provided to the property during the trial period was 1,394 kWh. This is broken down into 1,202 kWh from the heat pump and 192 kWh from the gas boiler. Therefore, **86% of heat was provided by the heat pump**, while 14% was provided by the boiler.

Monitoring Values	Usage
ASHP Electrical Consumption (kWh)	352.26 kWh
Gas Boiler Electrical Consumption (kWh)	32.56 kWh
ASHP Heat Output (kWh)	1240.00 kWh
Total Heat Output (kWh)	1456.00 kWh

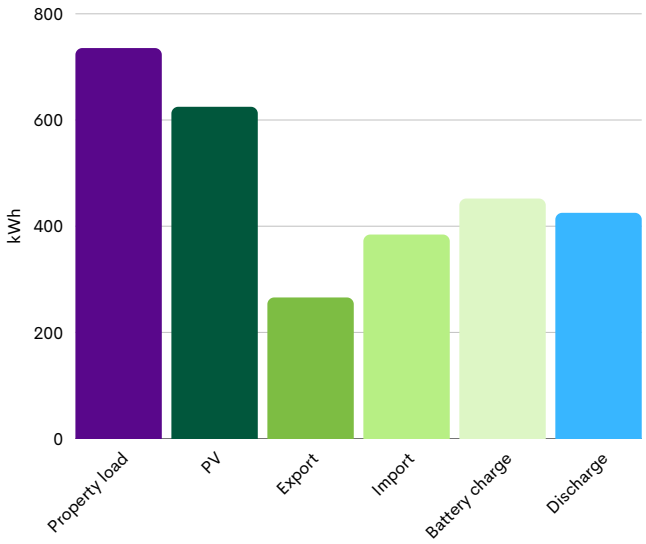
(Table 4 - Total Heat Energy Produced & Electric Consumed)

ELECTRIC PROVIDED BY SOLAR

The total solar generated, imported, and exported is shown in Table 5, as well as the energy usage of the house and the battery usage at the property.

The figures show that 624.9 kW of electricity was generated at the property. This generation is then used for different purposes. 265.8 kW of electricity was exported, and the rest was used within the property. The electricity the customer paid for is the import at 384.3 kW, and the total usage of the property is 735.5 kW.

This allows us to work out that the electricity provided to the property from solar is 351.2 kWh.



(Table 5 - Total Electricity Generated, Exported & Consumed)

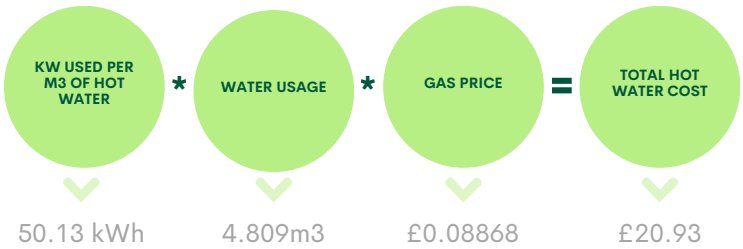
PERFORMANCE & COST SAVINGS

AVERAGE HYBRID RUNNING COSTS

During the study, we compared electricity and gas consumption before and after the trial to calculate heating usage and cost. Throughout the trial, the **total cost for heating was £126.29**, which averages to **£1.15 per day**. If the same amount of heat was provided by a gas-only system, the fuel costs would have totalled £138.84, or £1.27 per day, based on gas prices for the trial period. According to the total heat output (as shown in Table 4), divided by the boiler efficiency (93%), multiplied by the gas price (3), **the hybrid system proved to be £0.12 cheaper per day compared to the heating costs of a traditional gas heating system.**

HOT WATER COSTS

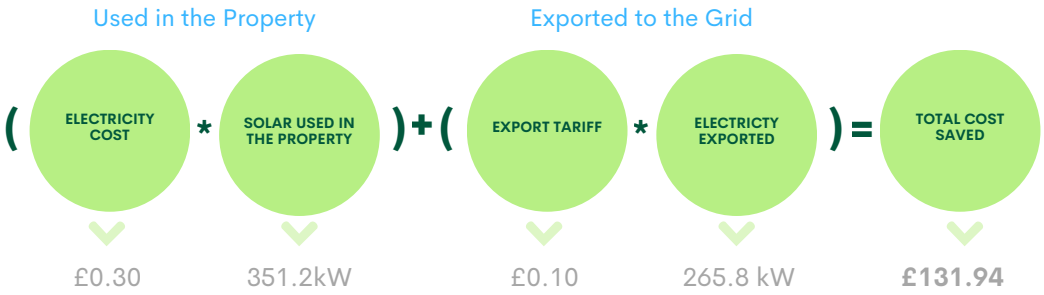
During the initial trial hot water was tested for one hour, including gas meter readings. During this time 16.794 kWh of gas was used to produce 0.335 m^3 of hot water, equating to 50.13 kWh of gas used per m^3. To determine the total hot water cost during this trial, the calculation shown here was used.



While the property was tenant occupied, hot water costs totalled £20.93, equating to £0.19 per day.

COST SAVINGS FROM SOLAR

After the solar and battery system had been added, the bill savings at the end of the 4-month period were £131.94, equating to £1.21 per day.



During the trial, the solar system saved £131.94 (£1.21 per day) by generating 351.2 kWh of electricity. Power used in the home offset costs at £0.30 per kWh, while 265.8 kWh exported to the grid earned £0.10 per kWh, highlighting strong savings from solar integration.

"I'd happily recommend this setup to other tenants or homeowners. It's efficient and easy to use, and it's great to know that I'm using my own clean power with the solar panels, rather than relying as much on the grid."

- Douglas Carson (20 Castlecoole Tenant)

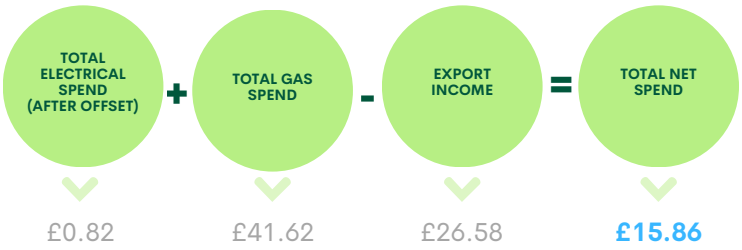
FINDINGS

The crucial finding is that the addition of solar power significantly boosted the system's efficiency and profitability, turning a heavy energy user into a net energy exporter. The overall running cost of the hybrid solar & heat pump system was calculated by factoring in all energy costs and export payments:

- **Electric Costs:** The system used **352.02 kWh of electricity** but **offset** almost all of this **by using 351.2 kWh of self-generated solar power.** The resulting net **electrical running cost** was just **£0.82**.
- Gas Costs: The **total gas used** for heating (£20.69) and hot water (£20.93) **was £41.62**.
- Export Income: **The property exported 265.8 kWh of surplus electricity** to the grid, generating an **income of £26.58**.

NET SPEND CALCULATION

AFTER 4 MONTHS



CARBON INTENSITY & CARBON SAVINGS

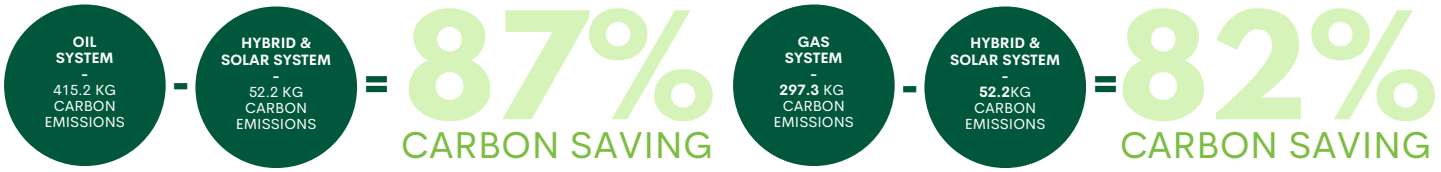
Figures taken from SEAI (4) and shown in Table 6 outline the carbon intensity of gas, kerosene and electricity. This enables us to calculate the carbon savings of a hybrid heating system when compared to both a kerosene-only and gas-only system.

Fuel Type	Carbon Intensity
Gas	184g Co2/kWh
Kerosene Oil	257g Co2/kWh
Electric	332g Co2/kWh

(Table 6 - Carbon Intensity of Fuel Types)

Based on the trial data, a kerosene oil-only system would have emitted 415.2kg of carbon, while a gas-only system would have emitted 297.3kg. Without solar the hybrid system emitted just 166.3kg of carbon but with the addition of solar the total carbon emissions of the hybrid system total 52.2kg with a carbon saving of 363kg over the same four-month trial period.

If replicated over one year, switching from oil to hybrid & solar would save 1.22 tonnes of carbon.



REFERENCES:

(1) Joshua Rowe (October 2023), Castlecoole Heat Loss Study. (2) Belfast Newforge (County Antrim), UK climate averages (no date) Met Office. (3) SSE gas prices 1st October 2025. (4) Conversion factors (2022) Sustainable Energy Authority Of Ireland. For full reference information, please contact Refresh NI on 028 9099 3485. (5) Predicted PV Performance Output (Table2) based on data from Joshua Rowe (July 2025) Castlecoole Open Solar Proposal