Refresh x Phoenix Energy

HYBRID HEATING TRIAL 3.0

1ST JANUARY – 30TH SEPTEMBER 2024

> We definitely recommend this. From cost benefits and the easy to use system, to managing the heating system, it makes regulating temperature around the house easy.
>
> *-Chloe Bowman & Thomas Walker (Castlecoole Tenants)*

CASTLECOOLE CASE STUDY 3.0

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

- Castlecoole Park, Belfast, BT8 7BE
- Home Occupied x2 Adults
- Mid-Terrace House EPC Rating C71
- 12.35°C Average Outside Temperature

ABOUT THE TRIAL

PROJECT BACKGROUND

The aim of this project is to assess the impact of a hybrid 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, combination boiler and comprehensive monitoring system. A heat loss study was conducted on the property (1) establishing a heat loss of 4,583W with correctly sized radiators for a 62°C flow temperature, as shown in Table 1.

Property Details	
Year built	Pre 2000
Design Data	
Outside Design Temp - ODT (°C)	-4
Degree Days (DD)	2360
Mean air temp - MAT (°C)	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)

Hybrid heat pumps provide a **comfortable, unique and affordable solution** within the **NI home heating** market.

- No need to upgrade pipework
- Operates at higher temperatures
- Access to instant hot water
- No need for a hot water tank
- Energy security - cheapest fuel source
- Backed up by combi gas boiler

CASE STUDY DESCRIPTION

This case study lays out optimal settings for a hybrid system, factoring in user comfort and cost. The system operates similarly 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.

Data for this trial was recorded between 1st January and 30th September 2024 and used specific parameters, including an 18°C setback temperature, programmed with a 5 hour period at 21°C, 2 hours in the morning and 3 hours in the evening (as shown in Table 2).

On 23rd February 2024, two tenants moved into the property, allowing for the system's feasibility to be assessed while occupied. The tenants agreed to continue with a five hour period at 21°C, however modified the timings slightly during the weekends to suit their individual needs (as shown in Table 2).

Parameter	Initial Setting	Tenant Settings
Programmed Heating Times	Mon - Sun 0600-0800 Mon - Sun 1800-2100	Mon - Fri 0600-0800 Sat - Sun 0800-1000 Mon - Sun 1800-2100
Heating Temperature	21°C	21°C
Setback Temperature	18°C	18°C
Electricity Cost	£0.34 per kWh	£0.34 per kWh
Gas Cost	£0.115 per kWh	£0.115 per kWh (Jan - Mar) £0.0868 per kWh (April)

(Table 2 - Trial Parameters and System Settings)

MONITORING SYSTEM

The trial monitoring system consists of two heat meters to measure key metrics (delta T, flow rate, flow & return temperature, power, total heat energy and volume of the heating system). One meter worked to measure outputs from the air source unit, while the other measured total heating output. Current transformers measured the electrical usage of the house, air source unit and boiler. The volume of hot water used was also measured, while three thermometers recorded the outdoor, living room and bedroom temperatures.

USING THE HYBRID SYSTEM

HYBRID HEAT PUMP USED

The Alpha E-Tec Hybrid heat pump was previously selected for this trial following the heat loss study. Key features of this unit are:

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

AVERAGE TEMPERATURE

12.35°C

Average outside temperature during the trial with a low of -1.2°C and a high of 24.77°C.

Using Met Office data from 1991-2020 the yearly average temperature for Belfast over this period is 10.6°C and the yearly average is 9.65°C (2).

PERCENTAGE HEAT PROVIDED

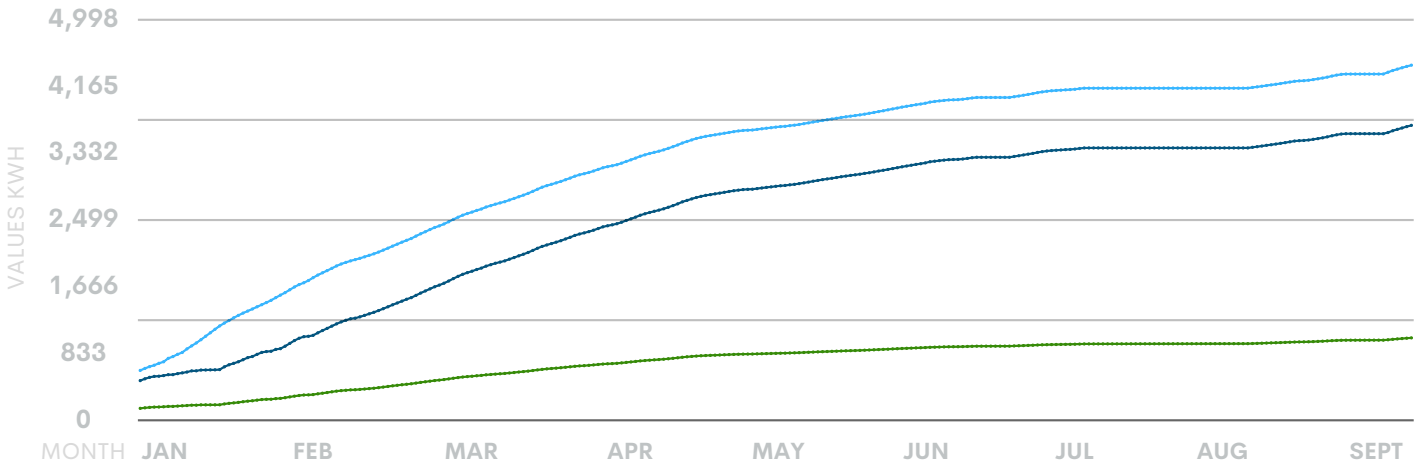
Total heat output, air source heat output and electrical energy consumed is shown in Table 4. The figures show that total heat provided to the property during the trial period was 6,286 kWh.

This is broken down into 5,208 kWh from the heat pump and 1,078 kWh from the gas boiler. Therefore, 83% of heat was provided by the heat pump, while 17% was provided by the boiler.

> "A main positive of using the system is the overall cost with not having to pay weekly for both gas & electric."
>
> *-Chloe Bowman & Thomas Walker (Castlecoole Tenants)*

Monitoring Values	Usage	Graph Key
ASHP Electrical Consumption (kWh)	1441.20 kWh	
ASHP Heat Output (kWh)	5208 kWh	
Total Heat Output (kWh)	6286 kWh	

(Table 3 - Total Heat Energy Produced & Electric Consumed)



> "We find it very beneficial and performs well in providing hot water and keeping the house at good temperature."
>
> *-Chloe Bowman & Thomas Walker (Castlecoole Tenants)*

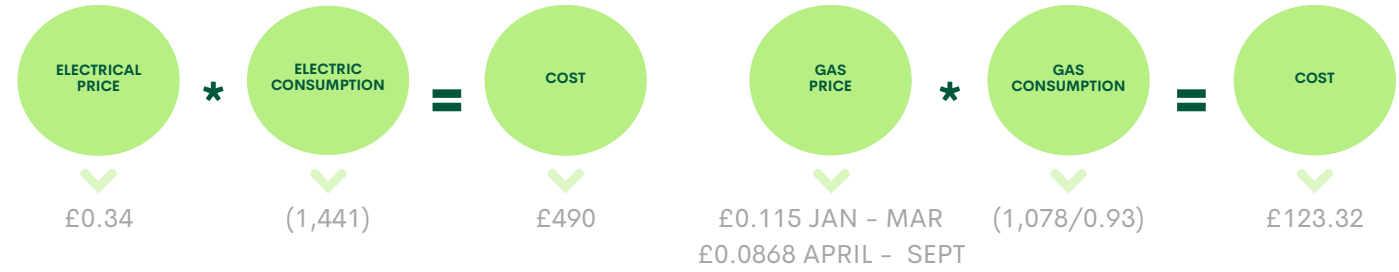
CO-EFFICIENT OF PERFORMANCE

The combination gas boiler used as part of 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 3.61, meaning that for every kW of electricity used, 3.61 kW of heat was provided.

COST & CARBON SAVINGS

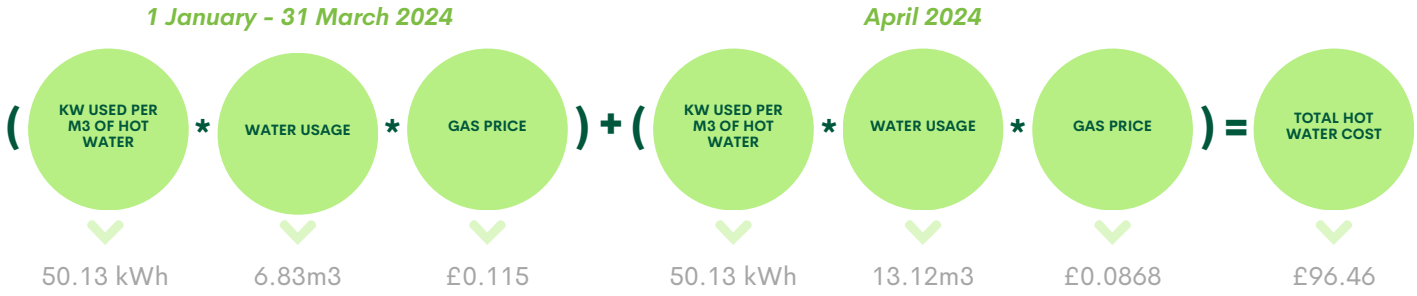
AVERAGE HYBRID RUNNING COSTS

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 £613.33**, which averages to **£2.24 per day**. If the same amount of heat was provided by a gas-only system, the fuel costs would have totaled £705, or £2.57per day based on gas prices for the trial period. According to the total heat output (as shown in Table 3), divided by the boiler efficiency (93%), multiplied by the gas price (3), **the hybrid system proved to be £0.33 cheaper per day compared to 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 16.794kWh of gas was used to produce 0.335m3 of hot water, equating to 50.13kWh of gas used per m3. To determine the total hot water cost during this trial the below calculation was used.



During the trial, hot water costs totaled £96.46 equating to £0.35 per day (4).

CARBON INTENSITY & CARBON SAVINGS

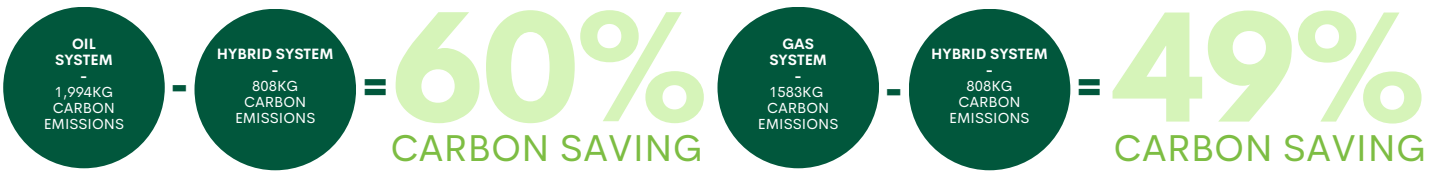
Figures taken from SEAI (5) and shown in Table 4 outline the carbon intensity of gas, kerosene and electric. This enables us to calculate the carbon savings of a hybrid heating system when compared to both a kerosene only and gas only system.

Based on the trial data, a kerosene oil-only system would have emitted 1,994kg of carbon, while a gas-only system would have emitted 1,583kg. On the other hand, the hybrid system emitted just 808kg of carbon, resulting in a 775kg carbon saving over the four-month trial period.

Fuel Type	Carbon Intensity
Gas	204g Co2/kWh
Kerosene Oil	257g Co2/kWh
Electric	255g Co2/kWh

(Table 4 - SEAI Carbon Intensity of Fuel Types)

If replicated over one year, switching from oil to hybrid would save 1.59 tonnes of carbon.



REFERENCES:

(1) Joshua Rowe (October 2023), 20 Castlecoole Heat Loss Study. (2) Belfast Newforge (county antrim) UK climate averages (no date) Met Office. (3) SSE Gas Price 1st January - 30th September 2024. (4) Hot water demand has been retrospectively added to January and February by applying average hot water use in the six months of tenant occupancy. (5) Conversion factors (2022) Sustainable Energy Authority Of Ireland. For full reference information, please contact Refresh NI on 028 9099 3485.