

HYBRID HEATING TRIAL



CASTLECOOLE CASE STUDY

Location

20 Castlecoole Park, Belfast, BT8 7BE

Building Type

Domestic mid-terrace house - EPC Rating D

Average Outside Temperature

9.3°C

ABOUT THE TRIAL

PROJECT BACKGROUND

The aim of this project is to evaluate the effect of a hybrid heating system on the housing market in Northern Ireland, with a specific emphasis on the retrofit market, which faces unique challenges related to decarbonisation solutions. As part of this trial project a heat loss survey was conducted on the property, and an Alpha E-Tec Hybrid system was installed, comprising an air source heat pump and a combination boiler, along with a comprehensive monitoring system.

A heat loss study (1) established building heat loss was 4583W, (demonstrated in Figure 2) with correctly sized radiators for a 62°C flow temperature.

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 (m²) 82.25

Average Watts per metre square (W/m²) heat loss 56

(Figure 2 - Heat Loss Output)

CASE STUDY DESCRIPTION

The case study completed lays out the optimal controls for a hybrid system, factoring in user comfort and cost. The system works similar to a full heat pump system, with a preset setback temperature. Setback temperature controls allow the homeowner to choose a minimum internal temperature at a time when heating is not set to reach occupied temperature preferences. This helps to conserve energy and support system efficiencies.

The initial trial data, recorded between December 15th and December 28th, 2023, used specific parameters with an Alpha E-Tech Hybrid (an 18°C setback, programmed with a 5 hour period at 21°C, 2 hours in the morning and 3 hours in the evening) - summarised in Table 1. The programmed temperature of 21°C was chosen for the living room, where the wireless controller is located. Public Health England recommends an internal temperature of 21°C as a minimum threshold in winter.

| Parameter | Setting |
|--------------------------|------------------------|
| Programmed Heating Times | 0600-0800 1800-2100 |
| Heating Temperature | 21°C |
| Setback Temperature | 18°C |
| Electricity Cost | £0.34 per kWh |
| Gas Cost | £0.115 per kWh |

(Table 1 - Trial Parameters)

MONITORING SYSTEM

The monitoring system consists of 2 heat meters which measure the key system metrics - delta T, flow rate, flow & return temperature, power, total heat energy and volume of the heating system.

One meter measured the outputs for the air source unit, while the other measured total heating output. Current transformers measured the electrical usage of the house, air source unit and the boiler. The volume of hot water was also measured and three thermometers recorded the outdoor, living room and bedroom temperatures.

AVERAGE TEMPERATURES

During the study the average outside temperature was 9.3°C, with a low of 2.7°C and high of 12.9°C. Using Met Office data from 1991-2020 the yearly average temperature for Belfast in December is 9.65°C (3).

USING THE HYBRID SYSTEM

Hybrid heat pumps provide a **unique & affordable solution** within the **home heating** market.



Energy security - cheapest fuel source



No need for a hot water tank



Backed up by combi gas boiler



No need to upgrade pipework



Operates at higher temperatures



Access to instant hot water

HYBRID HEAT PUMP USED

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

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

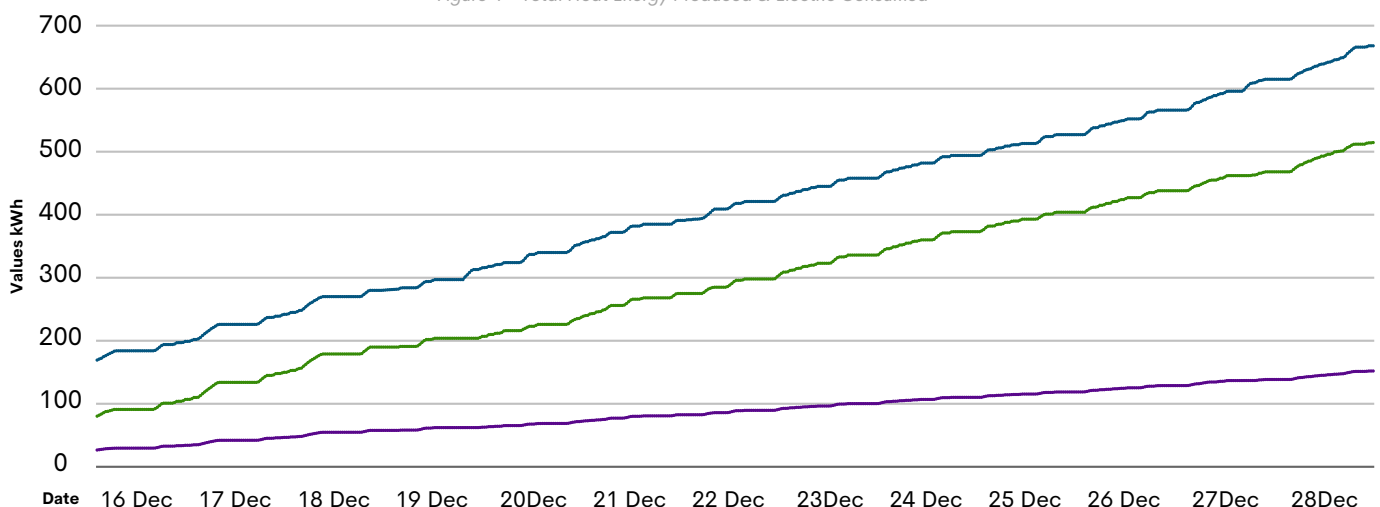
PERCENTAGE HEAT PROVIDED

A snapshot of the total heat output, air source heat output and electrical energy consumed is shown in Figure 4. The figures report that the total heat provided to the property during 15th - 28th December was 499kWh.

This is broken down into 434kWh from the heat pump and 65kWh from the boiler. Therefore, 87% of heat was provided by the air source heat pump, while 13% was provided by the boiler.

| Monitoring Values | 15th Dec | 28th Dec | Graph Key |
|--------------------------------|----------|----------|-----------|
| Total Heat Energy Output (kWh) | 169 | 668 | |
| ASHP Heat Energy Output (kWh) | 80 | 514 | |
| Electrical Consumption (kWh) | 26.5 | 152 | |

Figure 4 - Total Heat Energy Produced & Electric Consumed

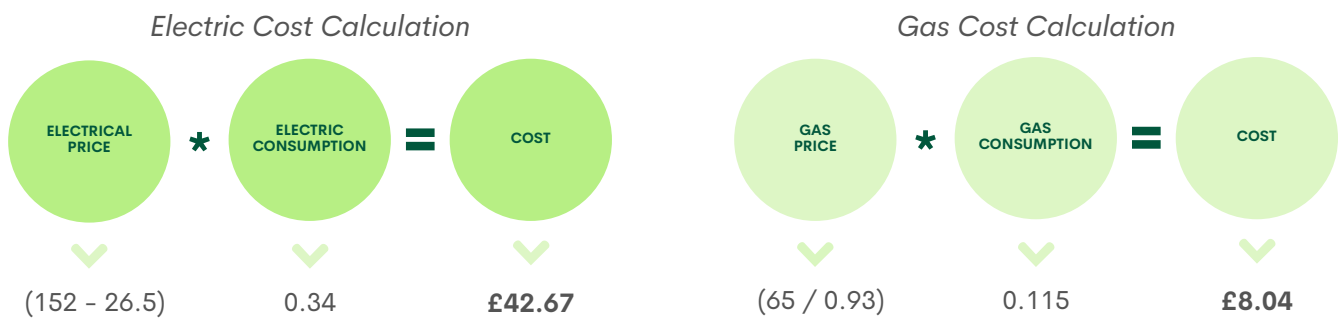


The combination gas boiler used as part of this trial is 93% efficient. Therefore, the amount of heat provided to the property is 93% smaller than the kilowatts of gas used by the boiler. Heat pumps have efficiencies greater than 1, known as a COP (Co-efficient of Performance). The COP of the heat pump during this trial was 3.46. This means that for every kW of electricity used, 3.46kW of heat was provided to the property.

COST & CARBON SAVINGS

AVERAGE HYBRID RUNNING COSTS

As part of the study we compared readings for electricity and gas consumption before and after to effectively calculate energy usage and costs. Heat energy costs for December 16th – 28th totaled £50.71.



During this trial the average daily running cost for heating was **£3.90** per day. If the same amount of heat was provided by a gas only system, fuel costs would have amounted to **£61.70** over the course of the trial period (using the same calculation formula). This means, daily costs for a gas only system would be **£4.75**, making the **hybrid system £0.85 cheaper per day**.

HOT WATER COSTS

As part of this trial, hot water was tested for one hour, including gas meter readings. The amount of gas consumed during the hour-long test was 16.794 kWh. The amount of hot water used, (0.335m³) was compared to the average amount of hot water used in a property per day according to Measurement of Domestic Hot Water Consumption in Dwellings Report (4). Costs per day are displayed in Table 3.

| Number of Occupants | Amount of Hot Water Used (m ³) | Workings Out | Cost Per Day |
|---------------------|--|--------------------|--------------|
| 1 | 0.072 m ³ | (0.072/0.355)*1.93 | £0.41 |
| 2 | 0.098 m ³ | (0.098/0.335)*1.93 | £0.56 |
| 3 | 0.124 m ³ | (0.124/0.335)*1.93 | £0.71 |

(Table 3: Cost Per Occupant)

CARBON IMPACT OF HYBRID HEATING

The carbon intensity of gas and electric as taken from the SEAI website is 184gCO₂/kWh and 332gCO₂/kWh retrospectively (5). This allows us to work out the carbon savings of a hybrid heat pump compared to a gas only system. Using statistics from the trial property, a gas only system would have emitted 98,727g of carbon, while the hybrid system emitted just 54,526g during the two week trial period. If replicated over the course of one year, this would lead to a **saving of 1.2 tonnes of carbon**.

CONCLUSION

Hybrid heat pumps are cheaper and easier to install than traditional air source heat pumps, offering lower running costs than gas boilers and significantly cut carbon emissions.

The initial phase of this hybrid heating trial demonstrates the hybrid heat pump is viable within the Northern Irish market and keeps homes warmer throughout the day with a higher setback temperature.

REFERENCES:

(1) Joshua Rowe (October 2023), 20 Castlecoole Heat Loss Study. (2) Minimum temperature threshold for homes in winter – gov.uk (2014) Minimum home temperature thresholds for health in winter – A systematic literature review. (3) Belfast Newforge (county antrim) UK climate averages (no date) Met Office. (4) Energy Monitoring Company and Energy Saving Trust (2008) Measurement of Domestic Hot Water Consumption in Dwellings. Energy Savings Trust. (5) Conversion factors (2022) Sustainable Energy Authority Of Ireland. For full reference information, contact us on 028 9099 3485.