



Department for the
Economy
An Roinn
Geilleagair

www.economy-ni.gov.uk

ENERGY STRATEGY ACTION PLAN 2022

Replacing Fossil Fuels
with Low and Zero
Carbon Technologies
for Heating

**ACTION
15
REPORT
(UPDATE)**

The background of the page features a photograph of a residential building. The top portion shows a roof covered in solar panels. Below the roof, a brick wall and a window are visible. In the foreground, a white heat pump unit with a circular fan grille is mounted on the wall. The image is partially obscured by a large, white, curved graphic element on the right side of the page.

ACTION
15
REPORT
(UPDATE)

ENERGY STRATEGY

ACTION PLAN 2022

Replacing Fossil Fuels with Low and Zero Carbon Technologies for Heating

Action 15 focuses on the need to replace high carbon heating sources with low and zero carbon sources in households and businesses. The Action supports the central aim of The Executive’s Energy Strategy, which is to reduce energy-related carbon emissions, and is underpinned by the Energy Strategy principle to “Replace fossil fuels with renewable energy”.

The DfE Heat Policy Team has engaged with partners across the public, private and social housing sectors to understand the benefits and challenges of installing new low carbon technologies for space heating and hot water.

Case study reports for each of these projects have been developed to explore opportunities for low carbon heat. This report provides an opportunity for consumers and businesses who may be interested in rolling out similar projects in the future to access knowledge, partners, and resources to help prepare them for net zero targets.

For further information about any of the case studies featured in this report, or about specific decarbonised heating technologies, please visit our website www.economy-ni.gov.uk/topics/energy/energy-strategy

CONTENTS

ARBOUR HOUSING

4

BELFAST HSC TRUST

6

DAERA

8

SOUTH EASTERN HSC TRUST

9

QUEEN'S UNIVERSITY BELFAST

10

RURAL HOUSING ASSOCIATION

12

MID AND EAST ANTRIM BOROUGH COUNCIL

14

ARBOUR HOUSING

OUR PARTNER

Arbour Housing is a community based social housing association in Northern Ireland.

Arbour supports sustainable communities by building and maintaining high-quality homes that meet the long-term needs of its tenants.



CASE STUDY OVERVIEW

Arbour replaced the oil central heating systems of two semi-detached bungalows in Banbridge with Air Source Heat Pumps (ASHP). The bungalows were built in the 1950s and had an EPC rating of E pre-renovation.

A Viessman Vitocal 200 6kW system was installed in each property with the outside unit located in the back garden and connected to an indoor compressor unit and hot water tank. Space heating is provided via underfloor heating throughout the property. Each property has also benefited from replacement cavity wall, floor, and roof space insulation, raising their EPC ratings to C.

Additional room sensors which monitor humidity and temperature losses have been installed, to collect data and optimise system performance.

PROJECT PROGRESS

The programme of work was an opportunity to test the small-scale deployment of heat pumps, with associated lessons about approach and costs, including insulation and fabric upgrades.

The properties were emptied, which allowed more extensive works, including lifting floors, increasing floor insulation, and laying underfloor heating.

The heating systems are now fully operational, and the properties are ready for tenants to move in.

Arbour is planning to install Solar PhotoVoltaic panels onto the roofs of the bungalows in the near future. These will provide a renewable source of electricity to power the ASHP.

TENANT RELATIONS

Arbour recognises that there may be practical issues with tenants using heat pump technology, including the need for information and guidance on how best to operate them. Property managers will provide guided demonstrations for tenants before they move in.

Further, a prerequisite to signing a lease is that tenants share their heat consumption data which will allow Arbour to diagnose system faults remotely and identify opportunities to improve efficiency.

In line with best practice, Arbour will be considering further ways to engage with their tenants on the roll out of new technology within their tenant engagement strategy.

FUTURE WORKS

Arbour Management will monitor system performance continuously throughout the ASHP and have agreed to share data with DfE.

Insights from system data collection will inform future programmes of work for decarbonising Arbour's housing stock.



The hot water tank features an intuitive user interface for consumption insights, and fits comfortably in a boiler closet, out of sight.

Solar PhotoVoltaic Panels at site



Air Source Heat Pump Installation



BELFAST HSC TRUST

OUR PARTNER

Belfast Trust is one of five Health and Social Care Trusts in Northern Ireland and is the largest Integrated Health and Social Care Trust in the United Kingdom.

Belfast Trust delivers integrated health and social care to 340,000 citizens in Belfast and provides the majority of regional specialist services to all of Northern Ireland.



CASE STUDY OVERVIEW

The Trust manages Knockbracken Healthcare Park, a 275-acre site on the outskirts of South Belfast, providing a variety of mental health services for inpatients. The site contains several older, historic buildings that have complicated designs and poor energy efficiency ratings. Some also have listed status.

Recognising the complexities and high costs associated with retrofitting older inefficient listed buildings, the Trust opted to install Solar Assisted Heat Pumps (SAHP) in eight of their buildings to provide a zero-carbon solution for their hot water requirements. SAHPs are sealed units which are connected to a highly insulated hot water tank and do not require any other energy efficiency measures to be installed to be effective. Space heating continues to be provided by using conventional fossil fuel gas boilers, however the Trust estimates that around 35% of a building's gas load is used for hot water and they expect to see this saving reflected in future gas bills.

PROJECT PROGRESS

Buildings were chosen to understand and compare the performance of SAHP in different settings, for example domestic versus office use or newer buildings versus older. Monitoring of data outputs from each heat pump will allow the development of best practice and the identification of the most suitable building types for their deployment.

Estates Management noted that as the equipment is all relatively standard, any qualified and registered refrigerant engineer would be able to install and successfully maintain them. Five of the eight SAHPs were charged and commissioned in one morning. The remaining three are due to be commissioned and installed in due course.

The Trust will now monitor usage, carbon savings, and price reductions for a set period to inform their decisions about future decarbonisation strategy.

SOLAR ASSISTED HEAT PUMPS

By using an aluminium evaporator to absorb heat, ambient air temperature is used to change the refrigerant liquid circulating through the installed panel from a liquid state to a gaseous one.

The returning refrigerant, now heated and in a gaseous state is then compressed and heated further. The compressed refrigerant is then passed through a heat exchanger where the heat is transferred to the water, heating it up to 55 °C.

The majority of installations only require the use of one evaporator panel which is fitted to either an external wall or the roof. Where hot water demand is likely to be higher an additional evaporator panel can be added.

A SAHP offers flexibility and can be installed as single standalone unit or retrofitted to an existing hot water cylinder fed from a pre-existing oil or gas boiler system. Reduced carbon emissions are achieved by removing the hot water requirements from the oil or gas boiler system.



The SAHPs are available in 130, 200 and 300L cylinders.

They range in size from 1,290 x 550 x 550 mm, up to 2,000 x 650 x 650 mm (h x d x w).



DAERA

OUR PARTNER

The College of Agriculture, Food and Rural Enterprise (CAFRE) is a Division within the Food and Farming Group and part of the Department of Agriculture, Environment and Rural Affairs (DAERA).

The College is made up of three campuses across Northern Ireland: the Enniskillen Campus, the Loughry Campus in Cookstown, and the Greenmount Campus in Antrim. Approximately 1,800 students are enrolled across these three campuses, studying topics such as Agriculture, Food, Horticulture, Land-based Engineering, Veterinary Nursing, and more.



CASE STUDY OVERVIEW

The Greenkeeping and Golf Academy is located on CAFRE's Greenmount Campus and helps support Northern Ireland's Sportsturf Sector by training students in sportsturf and greenkeeping management to meet the wear and tear associated with sports use. In July, following the breakdown and decommissioning of the oil boiler serving the Academy's Driving Range Building, CAFRE, DAERA's Estate Sustainability and Energy Efficiency Branch and DoF Property Services Division considered a range of low and zero carbon alternatives and opted to install a LPG boiler that will use BioLPG in the building.

BIO LPG

BioLPG is a gaseous fuel that can come from production processes using renewable and organic feedstocks. Dependent on the production process, Bio LPG can produce up to 80% fewer carbon emissions than traditional LPG. Due to its identical chemical structure, BioLPG can be used as a drop in fuel for LPG, with no need for new infrastructure investment.

PROJECT DETAIL

DAERA had considered multiple low/zero carbon replacements to the previous oil boiler, in line with their Estate Sustainability Action Plan (Built Estate) 2022-2027. BioLPG was chosen as the preferred option due to the significant investment that would have been needed to adapt the building for use with a heat pump. Nine other buildings on the CAFRE Campus were already using BioLPG as heating fuel, however these were switches in supply from traditional LPG to the Bio version. As the two are chemically identical they combust in the same way, so no adaptations were required to introduce the lower carbon form. CAFRE have been pleased with the overall experience of replacing the oil boiler with a BioLPG unit, however, did note that alternative heating had to be provided in the interim due to the increased time needed to replace the whole system. The new 35 kW Bio LPG boiler has now been successfully installed, and Estates are monitoring the performance to understand carbon and cost effects.

SOUTH EASTERN HSC TRUST

OUR PARTNER

The South Eastern Health Trust (SE Trust) is one of five Health and Social Care Trusts in Northern Ireland, managing hospitals including the Ulster, Downe, Lagan Valley, and Ards Community.

Established in Spring 2007, SE Trust is an integrated organisation, incorporating acute hospital services, community health and social services, serving a population of approximately 345,000 people with a budget of almost £500 million.



Double Stacked Air Source Heat Pumps

CASE STUDY OVERVIEW

SE Trust are currently building an extension to Ward 27, on the Downshire Estate to provide more residential capacity. Ward 27 is a mixed model of care with six Psychiatric Intensive Care (PICU) beds and 10 Low secure nursing beds. It also provides longer term ow-secure for people with difficulties in community settings.

Space heating for the building will be provided by two, double stacked, Air Source Heat Pump system fitted to the building's exterior.

The Panasonic ASHPs are each 28 kW and will provide the space heat requirements via underfloor pipes – domestic hot water is being provided by their existing conventional fossil fuel oil boiler. Estates aren't planning on having a back up source for space heating. They will monitor the performance of the ASHP for a period to understand capacity and benefits along with overall coefficient of performance.

PROJECT PROGRESS

Construction is expected to complete by January 2023. The biggest installation difficulty was the supply chain delays, with Estates experiencing up to 10-week delays to receive hardware. Estates staff did not mention any difficulties with skills of installers when asked about the installation experience.

HEAT PUMP SPECIFICATION

The maximum electrical input is 12.4 kW, providing a cooling capacity of 23.2 kW and heating capacity of 28 kW. The heat pumps use an R-32 refrigerant, which carries heat at greater efficiencies and has a lower Global Warming Potential than the current most used refrigerant, R-410A.

QUEEN'S UNIVERSITY BELFAST

OUR PARTNER

Queen's University Belfast (QUB) is one of the leading universities in UK and Ireland, ranked in the top 200 globally.

Originally established in 1845, the university educates over 25,000 students from more than 96 countries.



CASE STUDY OVERVIEW

The university is near the final stages of constructing a new learning center at its Riddel Hall site for its School of Management, which will be heated via shallow geothermal energy.

The building, which will serve over 2,000 undergraduates and 600 postgraduates, is due for completion in early 2023. The new School of Management will utilise closed loop shallow geothermal energy to provide its heating.

Forty boreholes have been drilled to a depth of 125m below the surface. This has resulted in over 10km of pipework being installed in the ground. However, any surface disruption has since been covered and landscaped meaning the infrastructure doesn't visually impact the surrounding environment.

The geothermal heating system should provide a 10% reduction in life cycle costs compared to conventional gas boiler installation and in excess of 60% reduction in carbon emissions. The University will also benefit from an annual saving of c.£1,000 on maintenance costs.

SHALLOW GEOTHERMAL

The site features an overburden down to a depth of approximately 40m before the drills reached the targeted Sherwood Sandstones. Mud rotary drilling was used to enable further drilling down to the desired depth of 125 m.

As part of initial site suitability testing, two test boreholes were drilled towards the end of 2019. Each of these wells contained a single U-shaped 40 mm probe, which were used for Thermal Response Testing in early 2020.

Following successful Thermal Response Tests, the remaining 38 boreholes were drilled and fitted in the same way. The 40 boreholes are connected to a single connector device, which will be utilised by the building's central plant room.

The heat pumps, which will transport a 30:70 glycol and water solution at a rate of 23.2 m³ per hour, are due to begin operation in November 2022.

OTHER QUB GEOTHERMAL PROJECTS

The site at Riddel Hall is not Queen's first geothermal project, nor is it the only project in the local vicinity (the Lyric Theatre is only 300 m away and uses a single well cooling system from the same thermal reservoir).

The School of Biological Sciences, opened in 2019 and located on Chlorine Gardens, uses an open-loop system to provide overnight cooling requirements for its plant and equipment. Two 120 m deep boreholes were drilled, 80 m apart from each other, with one serving as an abstraction well, and the other as a reinjection well.

Due to a steep elevation difference across the site (approximately 8m height), contractors initially intended to use the higher borehole towards Lennoxvale as the abstraction well, and lower one closer to Chlorine Gardens for reinjection. However, following tests to understand the thermal reservoir, higher temperatures were achieved by the Chlorine Gardens borehole, meaning it was selected for use as abstraction.

Groundwater is pumped at six litres per second to serve two 20 kW CHP units in the building's plant room. This installation provides 44% of the overnight cooling demand and 20% of their overall requirements.

FUTURE WORKS

The university has invested over £10 million to date in over 80 energy efficiency projects and is currently developing the next stage of its carbon strategy.

The works at Riddel Hall are due for completion in the near future, and work will soon begin on engagement with students and staff on how to operate the new heating system. As the heating infrastructure will be nearly invisible, management are considering ways to showcase and explain the technology to relevant stakeholders.



RURAL HOUSING ASSOCIATION

OUR PARTNER

Rural Housing Association (RHA) was established in 1992 to provide “A supply of readily available and affordable accommodation for rural people in rural areas with a view to helping maintain and regenerate rural communities”. The Association currently owns and manages 545 units across all Council areas, excluding Belfast.



In March 2021, RHA began construction on a £1.8 million development in Randalstown that will provide 9 x 3P/2B general needs apartments, due for completion in early 2023.

CASE STUDY OVERVIEW

Rural Housing Association is building 9 x 3P/2B general needs apartments in the centre of Randalstown.

The apartments will be heated via two Ground Source Heat Pumps (GSHPs), providing space heating and domestic hot water via a communal system.

The GSHP will be a closed-loop system, with six boreholes drilled to a depth of 140 m transferring heat to a central collector for distribution throughout the building.

The site is located within the town’s designated Conservation Area. As a result, RHA’s architects designed a sympathetic scheme which replicates the characteristics of the surrounding buildings and area to fulfil the criteria as set out in Randalstown Conservation guide.

CONSUMPTION BENEFITS

Management estimate that tenants will have annual bills of £1,500 for space heating and domestic hot water.

CONSERVATION AREAS

Randalstown Conservation Area comprises 20 hectares of land, containing 40 listed buildings and structures.

Guidance dictates that “New buildings must take account of the character of their neighbours”, and “Building materials must be of a quality, texture and colour that are compatible with the character of the area”.

PLANNING PERMISSIONS

The proposed scheme to deliver the 9 apartments was granted planning permission in February 2020. The proposal to use a GSHP system for the scheme did not require further planning considerations to drill the boreholes necessary for the system.

RHA opted to use Ground Source Heat, in part, because of the space efficiency of using the system.

SHALLOW GEOTHERMAL

The Ground Source Heat Pumps are connected to six boreholes, utilising shallow geothermal energy.

Boreholes were drilled down to a depth of around 140 m, with casing between 6 and 12 m fitted in each. Drillers encountered an unexpectedly high water table, and so it was necessary to plug each of the boreholes to prevent surface flooding.

As the system is a shallow geothermal system, and closed-loop, the local geology is not a significant factor when considering heat yields.

The thermoconductive fluid that will be circulated through the boreholes is a standard water and glycol solution, composed of a ratio around 75:25.

The development's plant room will have two buffer tanks connected to the thermal collector, which in turn will have separate pipe systems for provision of heat to the apartments; one for space heating and one for domestic hot water.

PLANNING PERMISSIONS

The proposed scheme to deliver the 9 apartments was granted planning permission in February 2020. The proposal to use a GSHP system for the scheme did not require further planning considerations to drill the boreholes necessary for the system.

RHA opted to use Ground Source Heat, in part, because of the space efficiency of using the system.

OUTCOME

The Association completed the apartment block in Randalstown and the communal system is delivering increased energy efficiency and cost savings to the tenants.

An engagement programme was developed by the housing association to provide awareness to tenants on how the GSHP system will deliver heat and hot water to their apartments and on using the heating controls effectively.

You can see the results of this good news story on the Department's [GEO Energy NI pages](#) under [Rural Housing Association NI Case Study](#).



MID AND EAST ANTRIM BOROUGH COUNCIL

OUR PARTNER

Mid and East Antrim Borough Council is one of the eleven local councils across Northern Ireland.

After a successful bid led by the Council to the UK Government's *UK Community Renewal Fund*, the Hydrogen Training Academy Pilot Project was completed in 2022. The project is the first of its kind in the UK and Ireland.



CASE STUDY OVERVIEW

The H2 Gas Safe Lab, funded by the Department for Infrastructure through the Department for Communities Covid Recovery Revitalisation Programme and supported by the UK Government Community Renewal Fund, is a mobile ATEX lab currently located at Silverwood Industrial Estate in Ballymena. It provides practical competence testing space for working with commercial H2 and CH4/H2 blend, particularly aimed at Northern Ireland's Gas Safe Plumbing and Heating Industry.

The equipment available for use at the lab comprises three unique boilers and various sources of head loads, allowing active demonstration to trainees. Each boiler is capable of using the H2 blend mix.

HYDROGEN BLENDING

A key concept that the Hydrogen Training Academy is investigating is the capabilities of hydrogen blending with natural gas. This concept involves mixing up to 20% of hydrogen in with the existing natural gas mix. Domestic cookers and boilers are designed so that they can already safely accommodate up to 20% hydrogen blending. Hydrogen has a lower calorific value than CH4, however a 20% blend of the fuel mix could reduce domestic carbon emissions by as much as 7%.

The UK Government is aiming to reach a policy decision in 2023 on whether hydrogen blending into the gas grid will be allowed.

EQUIPMENT FITTED

- Whitt gas mixer
- Sime Advance boiler
- Powrmatic mixed gas air heater
- Sime Revolution hybrid gas combi and heat pump boiler
- Yazaki absorption chiller and dry air cooler

The Hydrogen Training Academy also comprises the Hydrogen Fuel Cell Skills Lab, which is based at Northern Regional College, Ballymena. The practical training lab includes a suite of hydrogen training equipment, assisting in the teaching of electrolysers and fuel cell system use.

USERS

Academic Providers such as Further Education Colleges Northern Regional College and Belfast Metropolitan Colleges, Higher Education providers Queens University Belfast and Ulster University and a wide range of industry sectors.