

Case Study: Zero Direct Emissions Heat in New Build Affordable Homes

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Case Study: Zero direct emissions heat in new build affordable homes

Housing provider's rating of heating system:

9/10

Housing provider: **Link Group Ltd**
Location: **Dunbeg, near Oban**
Heating system: **Air Source Heat Pumps**

Development information

Name: Dunbeg Phase 3
Year completed: 2021 (80 of 300 units)
Size and unit types: 74x flats, 154x terraced, 72x semi detached homes (1-bed to 4-bed units)
Sustainability Level: Silver
Heating system: Mitsubishi Ecodan Air to Water Heat Pumps
Delivery: Low temperature radiators
Controls: Wireless zone thermostats, TRVs, Heat Pump programmers
Contact: csc@linkhalthd.co.uk

Overview

Link has been active since 1962, and provides affordable housing across Scotland. In Argyll and Bute, completed Link Group developments are managed by West Highland Housing Association (WHHA). The Group has c. 10 years of experience with Air Source Heat Pumps (ASHPs), as well as biomass boilers and ground source heat pump systems. For the Dunbeg Phase 3 development, ASHPs were the default consideration, but a consultant's options appraisal report confirmed them as the most cost-effective heating systems, over a biomass heat network.

Heating system installation

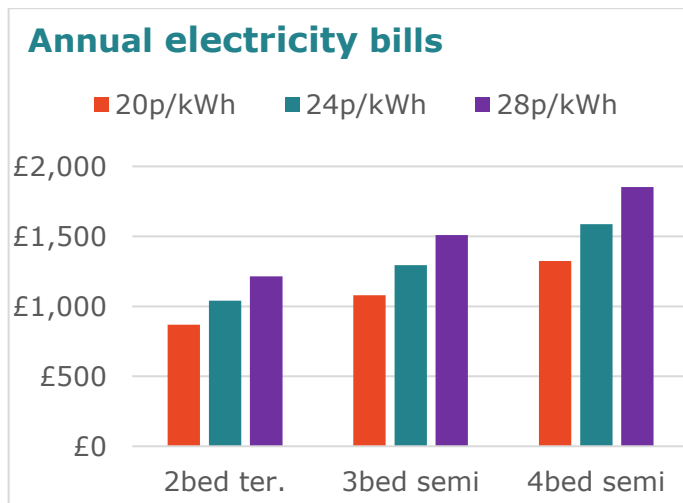
The development was funded by the Scottish Government, Argyll & Bute Council and Link Group Ltd. The main contractor (MacLeod Construction) specified and installed the ASHPs at a cost of **£4,900- £5,900 per unit**. There were no heat-related issues, although the development required two substations, at least one of which was due to the increased electrical demand of the ASHPs. For the flats, placement of the ASHP external units was challenging due to the nature of communal gardens. As a solution, these external units were grouped and fenced off.

Handover process

Ahead of handover day, the ASHP programmers were optimised for comfort and efficiency. Staff from WHHA, the contractor, and Macdonald and Cameron (development agents and Clerk of Works for Link) were present to assist tenants. New home manuals and quick-start guides for heating systems were also provided. Due to the Covid pandemic, there was less face-to-face handover support than usual. However, the handover was noted to be successful, partly because the ASHPs had been very well installed.

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Demand averaged from 9,4 & 1 home(s).

Tenant impacts

The response to the ASHPs at Dunbeg has been very positive. Only one issue arose initially, whereby a few tenants complained that their bath/shower water was not warm enough. A visit from the Clerk of Works found that the baths' thermostatic valves had been installed at the temperature pre-set by the manufacturer (41°C), so this was reset to the maximum allowed value (48°C). Since this was addressed, one tenant has complained that their heating systems are too loud. However, Macdonald and Cameron believe this is due to hot water cylinder noise and is not specific to ASHPs.

"The feedback on the heat pumps from our tenants has been positive and we're pleased that they can benefit from a warm and green option for heating their home. We wanted to ensure that these new homes had low carbon heating systems using renewable technology and air source heat pumps were our preferred option to achieve this."

Head of Development, Link Group

Technical performance

WHA has an in-house heating engineer who conducts cyclical ASHP servicing visits (once a year at most). There have been no unplanned maintenance requirements so far at Dunbeg Phase 3.

The technical team is confident in the performance of the chosen ASHP models, as they have a successful track record in other developments. It has also estimated that tenants currently consume on average 30% less energy for heat and hot water annually than their EPCs predict.

Lessons Learned

1. The location of ASHP external units requires careful consideration for flats, terraces and semi-detached homes with narrow passageways.
2. ASHPs need more internal space than homes with gas boilers. ASHPs typically have more wires and pipes compared to gas boilers, meaning that it is best to have them enclosed in cupboards. At Dunbeg Phase 3, the internal ASHP components are installed in large cupboards, to allow access for servicing.
3. It is important to confirm required temperatures of thermostatic valves with contractors, otherwise they may commission to an alternative specification.

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Housing provider's rating of heating system:

8/10

Housing provider: **Lochalsh and Skye Housing Association**
Location: **Broadford, Skye**
Heating system: **Air Source Heat Pumps**

Development information

Name: Suisnish Place

Year completed: 2018

Size and unit types: 8x 1-bed cottage flats, 8x 2-bed terraces, 2x 2-bed bungalows, 6x 3-bed semi detached

Sustainability Level: Bronze

Heating system: Mitsubishi Ecodan Air to Water Heat Pumps

Delivery: Low temperature radiators

Controls: Wireless zone thermostats, TRVs, Heat Pump programmers

Contact: energyadvice@LSHA.co.uk

Overview

Lochalsh and Skye Housing Association (LSHA) has been operating across Skye and Lochalsh since 1978. It has c.40 staff, including a large technical services and inhouse maintenance team. LSHA has been installing heat pumps since 2008 and has experience with ground source and biomass shared heating systems. Air Source Heat Pumps (ASHPs) were selected for this development to cost-effectively comply with energy requirements and to follow the Firm Foundations design brief widely used in the Highlands.

Heating system installation

The ASHPs were specified and installed by the heating subcontractor at an estimated cost of **c. £11,000 per unit**. The models installed were the preferred choice of LSHA as it felt they had a good track record, and it prefers that its own maintenance staff gain in-depth knowledge of a single system. Only one issue arose during installation, as the contractor had installed wired zone thermostats to save capital, but LSHA required these to be replaced with wireless units, so that these could be movable in order to give tenants more control over internal temperatures. This was resolved swiftly in time for the scheduled handover day

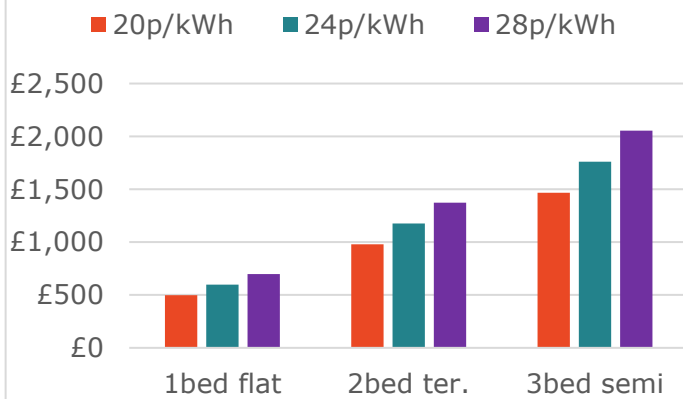
Handover process

Before tenants moved in LSHA energy advisors checked the heating system was set up correctly. Physical and email copies of welcome guides instructed tenants how to operate their system. Tenants were invited to arrange an in person instruction from LSHA energy advisors. This was not offered on handover day as LSHA feel there is too much happening for advice to be taken in effectively on this day.

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Annual electricity bills



Demand averaged from 9,4 & 1 home(s).

Tenant impacts

Initial concerns came from tenants who were not familiar with ASHPs. These required home visits to explain that radiator temperatures were designed to be low (and that the heating system is working if they don't feel 'hot'), and that the ASHPs were supposed to work continuously rather than be regularly switched on and off. After these initial visits, there have been very few issues and callouts.

LHSA finds that tenants are often nervous to touch their controllers, which can be a good thing if controls have been set up correctly.

Tenant satisfaction has been measured through a stock survey and is very high, with 100% of the tenants reporting that they are warm on a cold winters' day.

"Tenants need a package of support: the right heat pump model, someone to install it well, a good handover and then continuing support to help them use their system efficiently."

Energy Advisor, LSHA

Technical performance

The heating systems have performed well, with average **Seasonal Coefficients of Performance of 2.54**. Additionally, average annual energy bills (heat and electricity) for the development are £250 less than the Scottish average. As such, no issues have been raised around heat costs. In terms of maintenance, LSHA's inhouse team has performed annual services and there have been no unplanned requirements.

Based on the rest of their housing stock (which includes over 270 ASHPs of the same model – with only one ASHP failure), LSHA anticipates that the heat pumps will be replaced after c. 15 years.

Lessons Learned

1. LSHA finds that the heating systems at Suisnish Place work well, are easy and affordable for tenants to run, and offer good zone control.
2. Better communication with the contractor regarding the exact requirements for system control would have avoided the snagging issue that arose.
3. Tenants who have not had heat pumps before require support to understand how these systems differ in operation compared to high temperature fossil fuel boiler systems.

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Development information

Name: MacKenzie Avenue

Year completed: 2020

Size and unit types: 1x detached house, 1x bungalow, 48x semi-detached bungalows (1-bed to 4-bed units)

Sustainability Level: Bronze Active

Heating system: Mitsubishi Ecodan Air to Water Heat Pumps

Delivery: Low temperature radiators

Controls: Wireless zone thermostats, TRVs, Heat Pump programmers

Contact: info@hebrideanhousing.co.uk

Overview

Hebridean Housing Partnership (HHP) has been operating across the Outer Hebrides since 2007. It has c.45 staff and over 2200 properties and has been installing heat pumps since 2010. HHP has vast experience with both heat pumps (which are utilised in 52% of their homes) and direct electric systems (utilised in 25% of their homes). Air Source Heat Pumps (ASHPs) were selected for this development as fuel poverty is a major concern in the Hebrides and HHP deemed them to be cost effective for tenants on this basis.

Heating system installation

The development was designed and constructed under a traditional build contract, and features 50 unique units. The ASHP model was specified and installed by the main contractor, for **£9,100-£9,500 per unit**. Care was taken to locate the external units to: minimise pipework lengths to internal cylinders, minimise noise impacts (i.e., away from bedrooms), and satisfy planners (i.e., not at the front of the homes). There were no issues associated with installing the ASHPs and no impacts on grid connection costs.

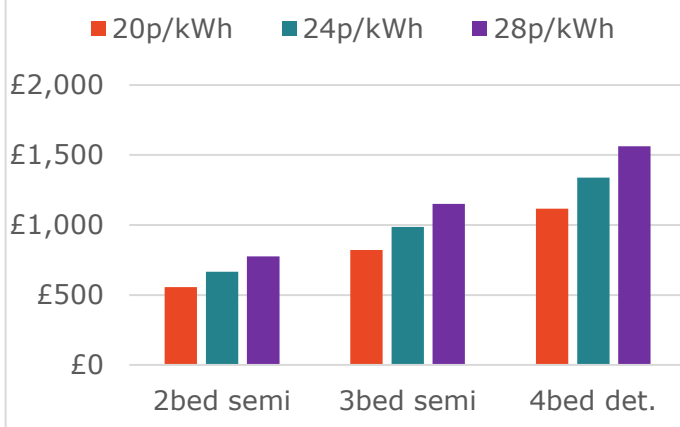
Handover process

Between completion and handover, HHP turned on the ASHPs to run at 12°C. At handover, HHP and the contractor were onsite to show tenants how to run their heating systems correctly. User guides were also provided, which advised tenants to use only the wireless zone thermostats to control the heating (and not the heat pump's inbuilt programmer). Tenants were also advised to call HHP if issues with heating arose, and to not attempt to fix these themselves.

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Annual heating bills



Demand from data for one of each unit.

Tenant impacts

In the Hebrides, ASHPs are common as only Stornoway is served by a gas grid, and there has been a drive to educate the population on heat pump principles. Therefore, tenants now expect these in new homes, and do not need as much handholding as previously.

Tenants are asked to feedback on their heating systems during annual visits, and over 95% are satisfied with their heating systems. No tenants have indicated they are unhappy with their bills.

Only one complaint has been raised, by a tenant in an open-plan bungalow who did not feel that all of their living area heating zone was reaching the thermostat's set temperature. This was resolved by advising the tenant to close doors to other rooms.

"We've got air source heat pumps down to a fine art, but don't take our word for it, learn from deploying heat pumps in a small initial scheme and make sure that the tenants are happy with them."

Investment Manager, HHP

Technical performance

The maintenance schedule consists of annual services by an external contractor, and the first of these was free as it was conducted during the defects period. There have been no unplanned maintenance requirements at MacKenzie Avenue.

HHP has found that it is important not to undersize heat pump capacity, as larger units will tick over and last longer than smaller ones always operating at maximum capacity.

Some of the ASHPs have 4G connections which allow HHP to see the output temperatures and status remotely. This has been very useful for ensuring performance and is expected to support future troubleshooting.

Lessons Learned

1. Tenants from older buildings appreciate that the costs of heat pumps in newbuilds are low, regardless of their previous heating technology.
2. Selecting the right heat pump is important: this model has an optional coating for salty air, making it suitable for the development's coastal setting.
3. Technical issues have been completely avoided due to close teamwork and trust between the housing provider, ASHP manufacturer, and the installer.

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Housing provider's rating of heating system:

7/10

Housing provider: **Osprey Housing**
Location: **Kincardine O'Neill, Aberdeenshire**
Heating system: **Air Source Heat Pumps**

Development information

Name: Kincardine O'Neill Phase 1

Year completed: 2020

Size and unit types: 2x 3-bed, 1x 2-bed, 4x 1-bed (all bungalows)

Sustainability Level: Bronze

Heating system: Mitsubishi Ecodan Air to Water Heat Pumps

Delivery: Low temperature radiators

Controls: Wired zone thermostats, TRVs, Heat Pump programmers

Contact:

enquiries@ospreyhousing.org.uk

Overview

Osprey Housing (OH) operates across Aberdeenshire, Moray and Aberdeen City. They have c. 40 staff and have been active for over 20 years. OH acquires its housing stock via purchasing Section 75 portions of larger developments. They have worked with Air Source Heat Pumps (ASHPs) since 2016, and these are now their preferred heating option for new developments, as they no longer accept properties off the gas grid with oil boilers. Hence OH requested that the developer install ASHPs at the Kincardine O'Neill housing development.

Heating system installation

The affordable homes at Kincardine O'Neill were purchased from the developer with funding support from the Affordable Housing Supply Programme. The cost for the design, supply and install of the whole heating systems were **~£8,000 for the 2-bed and ~£9,000 for the 3-bed units**. OH had limited input on the specification of the heating system (and its controls) and the commission process. However, no snagging issues occurred.

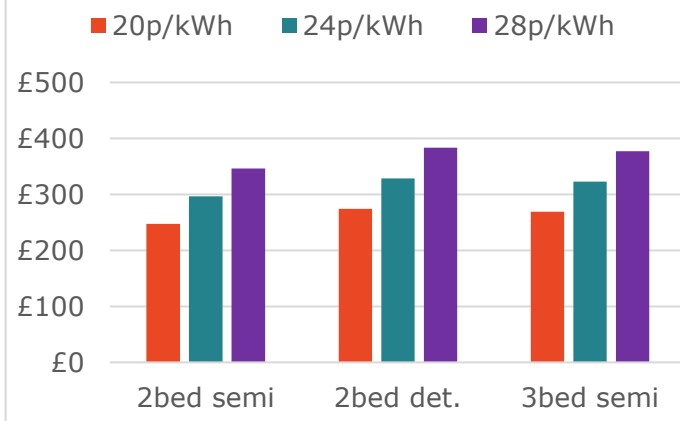
Handover process

OH noted that for Section 75 projects, different contractors engage with OH and tenants to varying degrees. In this case, the developer provided an information pack to explain the heating systems to tenants. The heating contractor also demonstrated the heating system to OH staff, who then provided this demonstration to the tenants on move-in day. OH encouraged tenants to avoid the main heat pump programmer, but to set the programmable room thermostat to suit their lifestyle (by adjusting the temperature profile for occupied, empty and night-time periods).

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Annual heating bills



Demand from data for one of each unit.

Tenant impacts

After tenants moved in, three requested follow-up visits from OH to help them build confidence in their heating systems. The main concerns were that adapting the thermostat program from the original settings to better suit their lifestyle might increase the heat pump's running costs. Further tenants wanted reassurance that their heating would not be expensive to run, compared to the gas bills they were used to.

To date, no tenants have raised complaints regarding their heat supply or their heating bills. Through conversations with tenants, OH is confident that satisfaction with heating systems is high.

"I think it's important to communicate that air source heat pumps do work over the long term, and that there are also a lot of experienced installation and maintenance contractors out there."

Sustainability Officer, OH

Technical performance

The maintenance schedule consists of annual services by an external contractor, and there have been no unexpected requirements for additional maintenance at Kincardine O'Neill. Although OH did not specify the heat pump model, it prefers to have systems from larger manufacturers (as in this case), as it is reassured that such models have proven life spans and established supply chains for spare parts.

Lessons Learned

1. Where the private sector builds affordable housing as part of a broader planning requirement, affordable housing providers will not always have the same level of control over detailed design and specification. However, OH experienced no problems in this respect.
2. A handful of tenants were initially nervous about the cost impact of their ASHPs and required additional support and reassurance. In future developments, OH is considering offering more online documentation, including how-to videos, to help build tenant confidence.
3. There have been no technical performance issues, and both OH and its tenants are satisfied with the ASHPs.

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Development information

Name: Wharton Square

Year completed: 2013

Size and unit types: 75x 1-bed, 86x 2-bed, 13x 3-bed (all flats)

Sustainability Level: Silver

Heating system: Heat network with heat interface units providing hot water to each flat

Delivery: High temperature radiators

Controls: Room thermostats, TRVs, heat and hot water programmers

Contact:

DConway@hillcresthomes.org.uk

Overview

Hillcrest Homes has been operating in the East of Scotland for over 50 years and has a stock of over 7000 homes. It has several district heating schemes and seven years of experience with these. At Wharton Square, which has a mix of social and midmarket rent housing, a heat network was selected over individual gas boilers in each flat, as this was deemed to be a safer, less carbon intensive option. It was also expected to be more efficient (for tenants) and require less maintenance than individual boilers.

Heating system installation

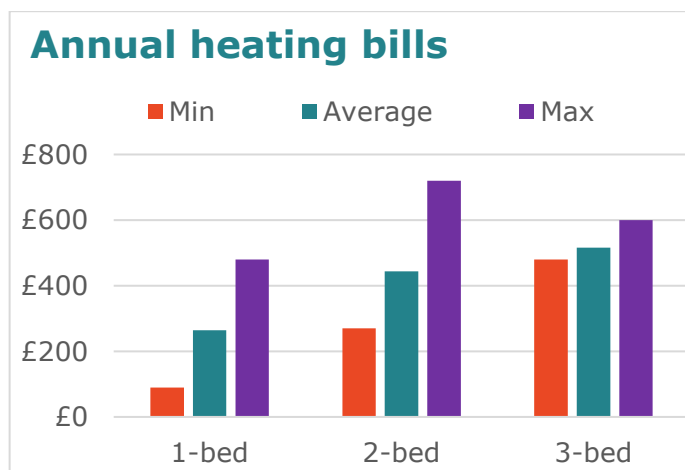
The development was partly funded by the Affordable Housing Supply Programme. The design process was collaborative between Hillcrest and the appointed contractors. There was a lot of discussion on the heat interface units (heat exchangers which provide hot water to each property), and how to meter and bill energy consumption. A Building Management System was installed, to allow monitoring by both Hillcrest and the maintenance contractor. There were no snagging issues to address post installation.

Handover process

The heat interface unit in each flat was pre-set to specific input levels to ensure that its efficiency was not compromised by user interference. Tenants were given handover packs containing a user guide to all systems within their flat. They were also given one-to-one advice by Hillcrest staff on how to use their heating system, as it was anticipated that heat interface units would be new to most tenants. Tenants were then contacted by a third party who was appointed to manage heat billing.

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Demand reported from 15 homes, paying c. 7.5p/kWh and c.21p/day in 2021. As of May 2022, these tariffs are under review.

Tenant impacts

On average tenants paid £30-40 per month in 2021 for heat and hot water. Generally, satisfaction with annual costs (compared to standalone gas and electric systems), ease of use, and heat delivery is high. Additionally, Hillcrest mitigate fuel poverty by ensuring that tenants don't go without a heat supply if they get into debt on their heating bills, and will absorb bad debt in certain cases.

Various tenants have advised that they don't like the concept of heat networks, as they can't change suppliers to get different tariffs. A few tenants have tried to compare tariffs with those for individual gas boilers, but Hillcrest has explained that these costs are not like for like, as their bills account for maintenance and administration. Administration of heat billing is a notable issue, with Hillcrest and tenants indicating that the third-party service is poor. Tenants find that they do not see

paper bills as often as they should (i.e., monthly) and that it is difficult to contact the customer services team to, for example, change account details.

"Heat networks can provide reliable heat at reasonable costs, but they require specialist teams to manage all aspects from billing to maintenance."

Contracts Manager, Hillcrest Homes

Technical performance

The system is maintained by an external contractor, who performs at least two services annually. Ahead of planned downtime periods, tenants are notified of a potential disruption to their heat supply. Unplanned maintenance has been required rarely, less than once a year. It is believed that there may be opportunities to improve the efficiency of the system. For example, a lack of insulation in the distribution pipework has resulted in very warm landings.

Lessons Learned

1. Whilst some tenants have objected to the concept of district heating due to lack of choice, they have been happy with their bills and heat provision at Wharton Square.
2. Third parties are available to maintain and manage billing for heat networks, but it is important to ensure customer service will be as expected.
3. Remote, wireless metering reduces physical components and allows accurate billing.



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