Market Opportunities for Scottish Direct Electric Heat Manufacturing

An assessment delivered on behalf of Scottish Enterprise

March 2023

Market Opportunities for Scottish Direct Electric Heat Manufacturing

Version control

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Acknowledgements and disclaimer

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A full list of stakeholders is provided on page 11.

We would also like to offer thanks to the members of the steering group for this project,

- Neil Kitching, Scottish Enterprise
- Rachel McCaw, Scottish Enterprise
- Alan Shaw, Scottish Government

Disclaimer

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Executive Summary

What are the Scottish manufacturing capabilities in the direct electric heat sector?

Context of the assessment

Decarbonising heat will play a crucial role in meeting Scotland's net zero targets. Scottish Government is aiming to install over one million domestic low carbon heating systems and over 50,000 non-domestic by 2030.[1]

This is an ambitious target and will require a variety of solutions, including direct electric heat technologies. The aim of this study is to assess Scotland's manufacturing capability, market trends and growth potential in direct electric heat, distinct from delivery of heat from heat networks and heat pumps. The results will be used to inform how Scottish Enterprise and other public sector organisations can better support companies in the sector.

Carbon Limiting Technologies were commissioned by Scottish Enterprise in January 2023 to undertake this assessment of the current state of the market for direct electric heat solutions up to 2030 in Scotland.

What is meant by direct electric heat?

By direct electric heating, we mean heating provided directly from electricity, many of which do not rely on the use of a wet-based radiator system to transfer and circulate heat throughout a property. The category includes infra-red heating, storage heaters, underfloor heating, air-to-air source heat pumps and electric boilers.

We are differentiating direct electric heat from the dominant heating solutions in the market, e.g. gas boilers, individual heat pumps, building-level heat pumps and communal heat boilers and district heat networks.

Although some heat pump solutions, such as air-to-air source heat pumps, would also qualify under this definition, heat pumps are covered extensively in other literature and are therefore excluded in this assessment of direct electric heating.

Executive Summary

Through interviews with leading manufacturers and desk research, we assess the current and projected market for direct electric heating up to 2030

Scope of the assessment

This assessment was conducted using a mix of primary and secondary research including interviews with key manufacturers of direct electric heat (DEH) solutions in Scotland. This includes DEH solutions within the context of domestic and commercial properties, including both retrofit and new-build. Industrial properties were not a focus, but information has been included where relevant.

This assessment aims to provide as complete a view as possible of Scottish manufacturing capability in DEH. This includes market statistics and opportunities including technology trends, drivers, barriers, market size, and growth.

We summarise recommendations on how Scottish companies and stakeholders can take advantage of the market opportunities and how Scottish Enterprise and the public sector can support skills and employment growth in the DEH manufacturing base.

What are the other green heat solutions?

The Scottish Heat in Buildings Strategy (2021) identifies individual heat pumps and low carbon heat networks as the two primary green heat solutions deployed up to 2030 [1,2].

District heating

The Heat Networks (Scotland) Act 2021 includes a target to deliver a total combined output of 6 TWh of heat through heat networks by 2030, equivalent to around **650,000 homes** [2,3]. For context, the Committee on Climate Change (CCC) estimates low carbon heat networks could deliver 40 TWh of heat across the UK by 2030.

Heat pumps

There is no explicit target for heat pump deployment in the Heat in Buildings Strategy but there is an expectation that at least 50% of the current building stock will switch from fossil fuel heating to zero emission heating systems by 2030, equivalent to approximately **1 million homes** [2].

In contrast, the Strategy estimates there are currently **262,000 homes** using electricity-based heating systems (including storage heaters and heat pumps).

Executive summary

Recommendations and opportunities for the direct electric heat market in Scotland

HIGHLIGHT 1
There is a severe lack of awareness and understanding of direct electric heat technologies

HIGHLIGHT 2
There are 160,000 customers on legacy storage heaters with potential tariff increases from March 2024

HIGHLIGHT 3
DEH manufacturers rarely interact with each other or participate in the same forums/networks

HIGHLIGHT 4
The role for DEH in the decarbonisation of commercial and industrial sites could be significant

Core recommendations and opportunities extracted from interviews and desk research

1. **An education initiative targeting installers, electricians and training and skills programme providers** to provide neutral, robust and transparent information of the benefits and drawbacks of direct electric heat across property types, improving consumer choice and whole building energy transformation programmes.
2. Before the imminent shutdown of the existing radio/tele metering facility (expected March 2024) for legacy zero emissions storage heating systems there needs to be **a support programme for the roughly 160,000 Scottish homes** on these systems to transition to more modern applications of the existing system or a full replacement with an alternate solution.
3. There is a need to **facilitate introductions, connections and networking** across the local supply-chain and supporting ecosystem for direct electric heat technologies to develop a cohesive customer proposition.
4. Further research and understanding of the market size and potential deployment of DEH technologies in the **commercial and industrial sectors** is required, including restaurants and pubs, hotels, wellness facilities and industrial facilities requiring decarbonised high-temperature heating solutions.

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Project background and objectives

This assessment provides Scottish Enterprise with an overview of the Scottish direct electric heating manufacturing sector and recommendations on how best to support stakeholders active in the sector

Project background

Decarbonising heat will play a crucial role in meeting Scotland's net zero targets. The Scottish Government is aiming to install over one million domestic and over 50,000 non-domestic low carbon heating systems by 2030. There are currently an estimated 262,000 homes in Scotland using electric heating (including heat pumps) [1].

For the wider context for the assessment, in October 2022, Scottish Enterprise launched the 'Green Heat Hub Grand Challenge'. This hub will act as a focal point for collaboration, innovation and inward investment across the Green Heat supply chain and to help position Scotland as a leading location for Green Heat manufacturing.

The focus of this assessment is on the Scottish direct electric heat manufacturers active in the sector, to provide recommendations to Scottish Enterprise and the public sector on how to support the wider ecosystem in the transition to net zero.

Key Objectives

Specific objectives of this assessment were to:

- Provide as complete a view as possible of Scottish manufacturing capability in direct electric heat and companies active in the sector.
- Summarise market statistics and opportunities in the direct electric heat market including technology trends, drivers, barriers, market size, and growth.
- Provide recommendations on how Scottish companies and stakeholders can take advantage of the market opportunities.
- Provide recommendations on how Scottish Enterprise and the public sector can support skills and employment growth in the direct electric heat manufacturing base.

Project methodology

Three phase methodology blending interviews and desk-based research to reveal key insights

Stages	1 Baselining Scottish direct electric heat manufacturing	2 Technology and market trend identification	3 Achieving Scottish success in direct electric heat manufacturing
Research activities	• Identification of key stakeholders in the sector to contact (manufacturers, suppliers, and trade organisations) • Desk research to assess and gather information on the manufacturing companies • 16 semi-structured interviews with stakeholders	• Complementary desk research on different DEH technologies • Review of existing DEH literature covering Scotland and UK • Review of market size and forecast report on the DEH market	• Synthesis of interview and desk-research. • Assessment that the results from the two research methods align • Updated list of company information list. Information verified by companies during interviews
Key outputs	• A list of companies with a brief description of their current capabilities and assets • A preliminary view on the DEH sector based on feedback from stakeholders	• View on the pros and cons of each DEH technologies and their use cases • Analysis of the current market size and growth of the DEH sector	• Summary report including technology overview, market statistics, opportunities, challenges and recommendations. • Updated database of companies with verified information

Stakeholder interviews

Interviews covered 16 organisations involved in the manufacture, installation and delivery support of direct electric heating solutions in Scotland

#	Name of Organisation	Type
1	Turnbull & Scott	Heating equipment supplier and manufacturer
2	Flexel	Infrared heating products manufacturer
3	Logicor Scotland	Distributer of Logicor Group manufactured heating and hot water products
4	Connected Response	Monitoring and optimisation technology for thermal storage heaters
5	Glen Dimplex	Large manufacturer and supplier of electric heating and cooling technologies (Multinational)
6	Sunamp	Thermal storage technology manufacturer
7	Electric Heating Company	Direct electric heating and hot water products supplier
8	McDonald Water Storage	Water storage system manufacturer for commercial and industrial applications
9	Thermaflow	Manufacturer of electric combi-boilers to work with heat pumps and solar thermal
10	Exergy3	Early-stage company developing high temperature thermal storage that can be used for space heating
11	BE-ST	Delivers the HeatSource programme on behalf of Scottish Enterprise
12	Energy Skills Partnership	Provides support to colleges to developing their energy skills capability, capacity and curriculum
13	Energy Saving Trust	Independent organisations providing advice on energy efficiency and clean energy solutions
14	Thermal Storage UK	Trade association for thermal storage manufacturers
15	BEAMA	Trade association for energy equipment manufacturers including heating
16	Wheatley Group	Scottish housing, care, and property-management group

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Overview of direct electric heat technologies considered in this assessment

The technologies below* are included in this assessment and described in further detail in the following pages.

CLT CARBON LIMITING TECHNOLOGIES

Electric infrared heaters

Infrared heaters (which for indoor use are flat panels) generate heat by converting infrared light into heat absorbed by solid objects, including humans.

Electric storage heaters (excl. water cylinders)

High thermal mass bricks are heated overnight by electric heating elements, with heat discharged through the day.

Electric boilers

Electric boilers use electricity to heat and circulate water or other fluids to wet space heating or wet underfloor heating systems, and operate using a heating element, thermostat, and control system.

Electric water cylinders

Electric water cylinders often feature two immersion elements, one for peak and one for off-peak use, and are used to heat and store hot water.

Electric radiators and panel heaters (excl. infrared)

Electric radiators and panel heaters use electricity to heat an internal heating element, which then radiates into a room or space. Panel heaters are usually flat and slim and transfers heat directly from the element to the air; radiators often contain oil or water as a thermal transfer fluid.

Electric underfloor heating

Electric underfloor heaters consisting of resistive elements installed on a room-by-room basis under the main floor covering.

Direct electric control systems

Supplementary control system working in conjunction with storage heaters, electric water cylinders, electric boilers etc. to shift electric charging and heat delivered.

*Note that there is no consistent definition of direct electric heating in the industry.

Electric infrared (IR) heaters

Infrared heaters (which for indoor use are flat panels) generate heat by converting infrared light into heat absorbed by solid objects, including humans.

Overview

- **How it works:** converts electricity into radiant heat, e.g. heat-transfer via light that gets absorbed by objects—same as direct sunlight. Contrasts with conduction (heat transfer by direct contact/touching a hot object) or convection (when a fluid, e.g. air, touches the hot object and carries the heat away).[11]
- **Technology segmentation:** IR underfloor, IR panels, IR wallpapers. Can operate on both gas and electric.[5,6] Used for space heating, requires supplementary technology for hot water.
- **Markets served:** IR saunas/wellness, other commercial indoor/outdoor, domestic indoor/outdoor, industrial zone heating.

Fig. 1: Infrared light generates heat at the objects (rather heating the air) via radiation. Source: Surya Heating

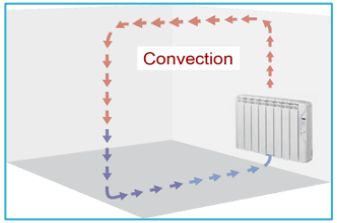

Fig. 2: "Standard" heating products delivers heat via air. Source: Heater Shop

Benefits [7,8]

- Lower comfort heating level required (feels like direct sunlight), such that less electricity is required to deliver the same perceived level of heat.
- Heat is transmitted/felt instantly, no warm-up needed.
- Can be used for localised heat, good for commercial outdoor spaces (restaurants, nightclubs, etc.) or large indoor spaces (warehouses, factories, etc.).
- Simple to install and operate.

Challenges [8]

- Newer market, relatively immature technology for some segments (especially for domestic use).
- Must be in direct line of sight of heated objects; not suitable for all room shapes.
- Doesn't provide any drying of air, humidity may be an issue without other systems involved.
- Unclear how IR impacts internal building fabric with prolonged use. [9,10]

Electric storage heaters (excl. water cylinders)

High thermal mass bricks are heated overnight by electric heating elements, with heat discharged during the day.

Overview

- **How it works:** storage heaters use electricity to store heat in ceramic or metal bricks. This stored heat is then released gradually into the room during the day. [12]
- Originally developed to use cheaper night-time electricity generated from nuclear power plants. [13]
- **Technology segmentation:** single type, limited variation. Used for space heating, requires supplementary technology for hot water.
- **Markets served:** off-gas–grid homes, holiday homes that are only used part-time, domestic retrofits and new builds, commercial retrofits and new builds. [12]

Off-peak electricity heats coils, which in turn heats bricks that store heat

Stored heat is then delivered via air (convection) during the day

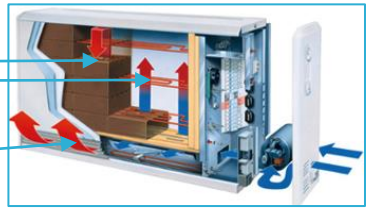

Fig. 3: Electric storage heaters

Benefits [9]

- The gradual release of stored heat ensures efficient heat distribution, allowing a room to stay warmer for longer and reducing the need for frequent heating.
- The units are simple to install as they require no special ventilation (flues/chimneys), allowing them to work in many homes.
- Suitable to work with flexible / off-peak tariffs.
- Converts electricity to heat with a 1:1 ratio.

Challenges

- The upfront costs for the units themselves are higher than some other options, e.g. IR panels. [8]
- Because the release of heat from the unit is so gradual it can be difficult to quickly change room temperature, and therefore temperature control is quite limited. The thermal output depends on the specific product.
- Temperature control has been described by customers as being unreliable or imprecise; the units require regular monitoring and adjusting. [9, 14]

Electric boilers

Electric boilers use electricity to heat and circulate water or other fluids to wet space heating or wet underfloor heating systems, and operate using a heating element, thermostat, and control system.

Overview

- **How it works:** An electric boiler is essentially tied to a wet central heating system, behaving like a gas boiler, but using electricity. Once the water has been heated by a heating element in the boiler, it's then circulated through a series of pipes to radiators or an underfloor heating system. The warm water heats the room, and cooled water is returned to the boiler to be reheated. [13,15]
- **Technology segmentation [16]:** Immersion boilers (consist of an electric immersion heater placed inside a hot water cylinder), storage boilers (similar to immersion boilers but also include a storage tank which can be used to store heated water generated at off-peak hours). Provides both space heating and hot water.
- **Markets served:** residential and commercial retrofits and new builds, rural and remote areas, off-gas-grid

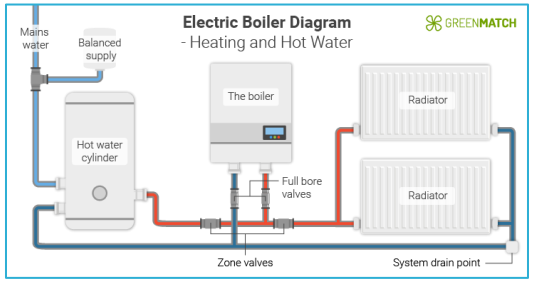

Fig. 10: Full electric boiler system

Benefits [14,17,18]

- Low space requirement (small unit, no flue/chimney/ventilation required).
- Installation fairly simple with a qualified electrician and can match household single phase or three phase electricity supply.
- Can replace existing gas boiler system on a like-for-like basis (no change to existing radiators or temperature).
- Converts electricity to heat with a 1:1 ratio.

Challenges [14,17,18]

- High energy/operational costs compared to non-electric alternatives or heat pump-based systems.
- Limited heating capacity linked to household electricity supply, not ideal for larger properties.
- Heating times can be problematic during peak periods when demand for hot water is high (particularly for households with single-phase electricity supply).

Electric water cylinders

Electric water cylinders often feature two immersion elements, one for peak and one for off-peak use, and are used to heat and store hot water.

Overview

- **How it works:** electric water cylinders use electricity to heat water, which is then stored in the cylinder for later use. The heating element is usually located at the bottom of the cylinder, and the water is heated as it circulates through the element (can be controlled). Electric water cylinders deliver water directly to taps and showers as needed. Direct cylinders heat water with an electric heating element in the cylinder, while indirect cylinders heat water by passing boiler flow through the water intake.[19, 36]
- **Technology Segmentation:** Direct cylinder, indirect cylinder. [19] Primarily used for hot water but some systems may be connected to radiators for space heating.
- **Markets served:** domestic, off-grid, seasonal homes, commercial properties

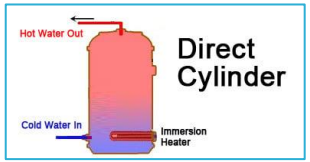

Fig. 3: Direct EWC

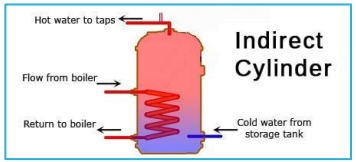

Fig. 4: Indirect EWC

Benefits

- Cost effective electric solution if one can take advantage of available off-peak electricity tariffs to generate hot water.
- The gradual heating of the water and long storage times (typically several hours before the need to reheat) often reduces the need for frequent or lengthy periods of heating (although this is dependent on usage).
- Again, no special ventilation required, making installation straightforward. However, vented cylinders require an additional cold water tank.

Challenges [14, 20]

- Relatively high energy/operational consumption and not cost-competitive with gas/oil systems at current electricity prices.
- Water volume space requirement limits market; cylinders generally not appropriate for larger commercial properties with significant demand.
- Temperature control is limited in many units.
- Takes longer to heat water than in boilers.

Electric radiators and panel heaters (excl. infrared)

Individual heaters which can be wall-mounted or free standing. Radiators contain a thermal transfer fluid while panel heaters heat the air directly.

Overview [14, 21]

- **How it works:** Electric panel heaters and radiators function the same, containing a heating element that is powered by electricity and generates heat. Heat generated by the element is transferred via air (convection).
- **Technology segmentation:** Convection heaters, oil-filled heaters (contains a heating element surrounded by oil), fan radiators.
- **Markets served:** residential, commercial, rentals/temporarily occupied homes, personal portable heating (generally oil-filled), industrial (typically only large fan heaters which blows hot air throughout a room), portacabins, caravans etc.
  - Often supplements central heating for domestic use. [22, 23]
  - Used for space heating only, requires additional technology for hot water.

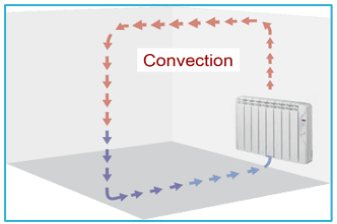

Fig. 5: Electric panel heaters use convection heat

Benefits [12, 21, 24]

- Simple to install, no special ventilation required.
- Easily integrated with flexible control options.
- Heats rooms quickly.
- Capable of heating specific areas/zones. Free standing elements can be moved according to need.
- Slimmer wall-mounted radiators than traditional wet-based radiators.
- Converts electricity to heat with a 1:1 ratio.

Challenges [12, 21, 24]

- High energy/operational costs relative to gas boiler or heat pump driven radiators and may provide lower thermal comfort than radiant heat.
- Limited heating capacity: generally, only suitable for small-to-medium sized rooms/areas unless supplemented with other heating options.

Electric underfloor heating

Electric underfloor heaters consist of resistive elements installed on a room-by-room basis under the main floor covering.

Overview [25, 26, 27, 28]

- **How it works:** Consists of a thin electric heating element made of a conductive material such as carbon fiber or wire that is embedded in the floor. When electricity is supplied to the heating element, it generates heat which is then distributed evenly across the floor.
- **Technology segmentation**: Loose wire systems (a series of electric heating wires laid out in a grid pattern, mat systems (pre-made mesh-like material with wires installed), infrared film. (All dry stems).
- **Markets served:** residential, commercial, new construction, retrofits, DIY systems. Used for space heating only, requires supplementary technology for hot water.

Fig. 6: Loose wire system

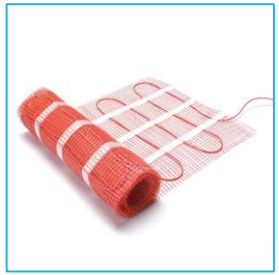

Fig. 7: Mat system

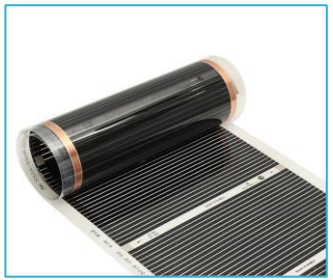

Fig. 8: Infrared film system

Benefits [5, 29, 30]

- Comfortable and evenly distributed heat, ideal for tile, stone, or laminate floors.
- Takes up no floor or wall space.
- Simpler to install than equivalent wet-based underfloor heating system.
- Converts electricity to heat with a 1:1 ratio.

Challenges [5, 29, 30]

- High energy/operational costs relative to gas-based or heat pump-based wet underfloor system.
- Potentially high installation cost for some retrofits, depending on floor covering.
- Incompatible with some floor coverings, especially suspended timber.

Direct electric control systems

Supplementary control system working in conjunction with storage heaters, electric water cylinders, electric boilers etc. to shift electric charging and heat delivered to match availability of off-peak tariffs.

Overview [31, 32, 33]

- **Tech segmentation and how they work:**
- **Thermostatic control systems:** controls temperature of a space by regulating flow of electricity to heating elements based on a set temperature.
- **Proportional control systems:** uses a control algorithm to adjust flow of electricity to heating elements in proportion to changes in the room temperature. These are highly precise and often used in industrial spaces where precision is important.
- **Time-based control systems:** Controls the flow of electricity to heating elements based on a pre-set schedule or timer, e.g. to charge storage heating systems when off-peak tariffs are available.
- **Markets served:** add-on technology to enable flexibility in thermal storage systems for space heating and/or hot water.

All used in conjunction with other smart control technologies (voice input, tariff tracking, etc.) depending on end use needs

Fig. 11: Domestic smart heating remote system user interface mockup

Fig. 12: Industrial infrared heating control system user interface example from Ceramicx

Benefits [34, 35, 37]

- Allows for centralized control and monitoring of heating and water systems to manage and optimize energy use.
- Autonomously recognizes low-energy tariff periods and inefficiencies. Automated processes and heating schedules etc. eliminate the need for manual interventions. Substantial savings on energy use and cost.

Challenges

- Dependent on the system, some require more support for installation, monitoring and usage as the system adds a layer of complexity to an existing thermal storage system.
- Some control systems are relatively immature and may cause malfunctions/disruptions particularly in more complex commercial and industrial applications.

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Current Scottish direct electric heating manufacturing capability

Overview of findings for DEH manufacturers in Scotland – there was strong alignment across responses, including the role DEH technologies have in the transition to zero emissions heating.

HIGHLIGHT 1
Fragmented supply chain tailored to each company's specific products

HIGHLIGHT 2
Interest in engaging with Scottish Enterprise and Scottish Government

HIGHLIGHT 3
Manufacturing landscape mix of established and emerging companies

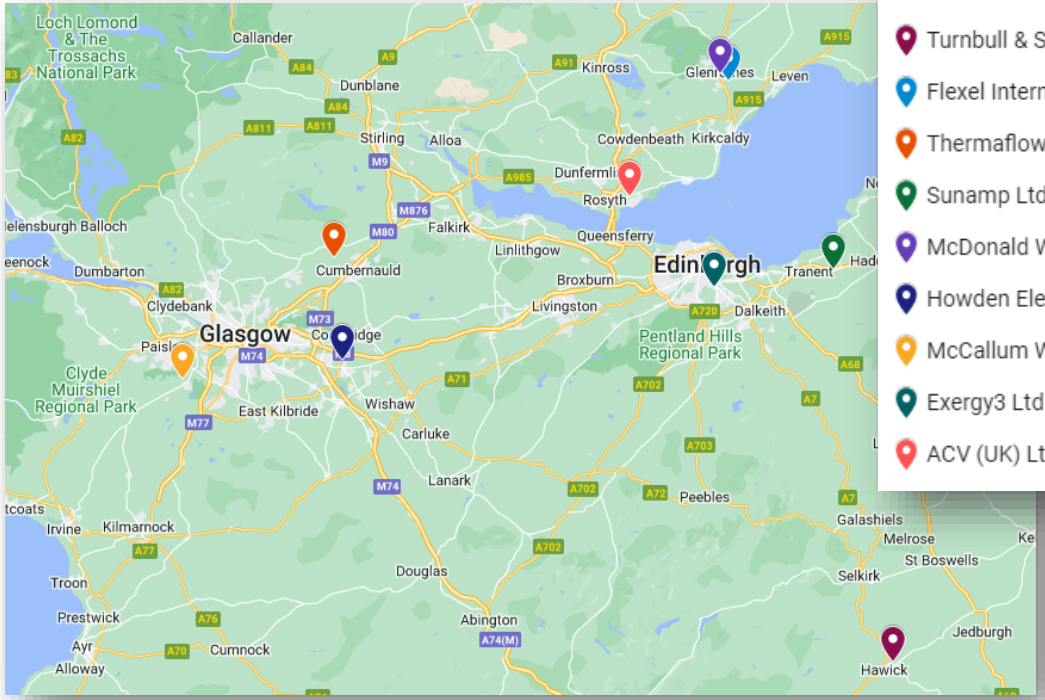
HIGHLIGHT 4
Interest in building out Scottish supply chain

- The distinction between onsite manufacturing, onsite assembly and supply of components/product from parent company is difficult to make without compromising commercially sensitive information for individual manufacturers.
- Most companies interviewed indicated **a mixed supply chain** across the UK, Europe and the Far East.
- For all interviewed DEH manufacturers except one, manufacturing bases comprised of a combination of assembly and onsite manufacturing. The outlier classified themselves strictly as an assembler of components.
- Most companies expressed an **interest in finding Scottish suppliers of components** but highlighted previous attempts had resulted in offers that were too high cost, low quality, slow to deliver or unable to accommodate small orders (for e.g. research and development testing).
- Most manufacturers indicated they had never previously been approached by a public sector organisation and were **relieved that there was some interest at a policy level in DEH technologies** and their role in the transition to net zero and protection of vulnerable customers.
- The sector is built on both established and emerging companies who see **a continued role for DEH solutions supplementing the wider roll-out of heat pumps and district heating** and addressing niche markets.
- All companies were aware of the **embodied carbon** element of their manufacturing process, linked to the low carbon intensity of the Scottish electricity system and onsite processes for manufacturing.

Direct electric heat manufacturing bases in Scotland

DEH manufacturing bases are spread across Scotland with limited clustering of activities in any town/city and region.

Click here to view and interact with the map.



DEH manufacturing sites

- Turnbull & Scott Ltd
- Flexel International Ltd
- Thermaflow Ltd
- Sunamp Ltd
- McDonald Water Storage
- Howden Electric
- McCallum Water Heating
- Exergy3 Ltd
- ACV (UK) Ltd

Other notable companies owned by Scottish companies with manufacturing bases elsewhere:

- **Connected Response Ltd.** Acquired by Warmworks Scotland LLP. Provide a direct electric control system which can be retrofitted onto existing storage heaters to control charging times and match off-peak tariffs.
- **Resideo Technologies Inc**. Registered under Ademco1 in the UK and spun out of Honeywell, they operate a research and development and testing facility for control solutions linked to energy use at Newhouse Industrial Estate in Motherwell.

Direct electric heat manufacturing bases in Scotland by technology

Matrix of technologies offered by company based on the classification of DEH technologies considered in this assessment, with most manufacturers specialising in one or two types of DEH technology.

	Electric radiators and panel heaters	Electric infrared heaters	Electric underfloor heating	Electric boilers	Electric storage heaters*	Electric water cylinders	Direct electric control systems
Supplementary or whole-system heat solution (space heating and/or hot water)	Space heating	Space heating	Space heating	Space heating and hot water	Space heating	Predominantly hot water only	Supplementary to DEH technologies
Turnbull & Scott Company Ltd.	✓	✓					
Flexel International Ltd.		✓	✓				
Thermaflow Ltd.				✓		✓	
Sunamp Ltd.					✓		
McDonald Water Storage Ltd.						✓	
H.D. Howden Ltd.				✓		✓	✓
McCallum Calorifiers Ltd.						✓	
Exergy3 Ltd.					✓		
ACV U.K. Ltd.				✓		✓	✓
Connected Response Ltd.**							✓

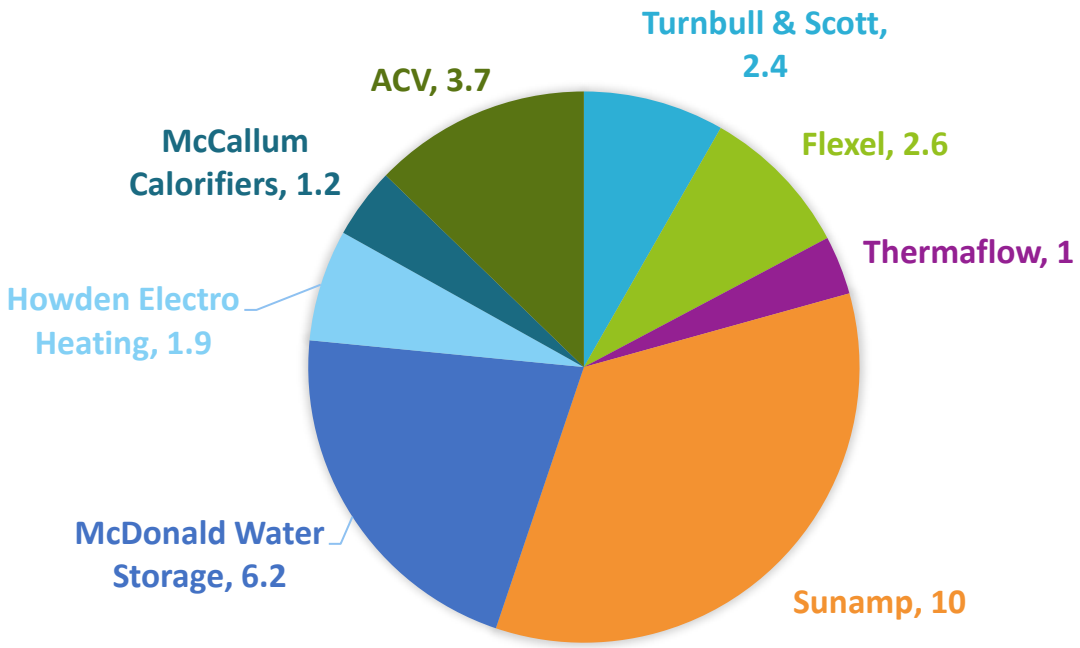
**Note that both Exergy3 and Sunamp manufacture innovative thermal storage technologies not strictly linked to the electric storage heater category. Exergy3 is at pre-commercialization stage so not included on the following pages for turnover or staff*

***Owned by Scottish parent company and active in Scotland but without manufacturing base in Scotland.*

Direct electric heat manufacturing bases in Scotland by employees

Turnovers of DEH manufacturing companies show that they are all small to medium in size, ranging from £1m to £10m annually.

Scottish DEH manufacturer annual turnover (in millions of pounds)



Total turnover:
£29m

Note this turnover is the total for the business based on the latest reported figure in annual accounts or provided directly through interviews with the company. From the interviews, the proportion of activity delivered in Scotland represents approximately 8%-50% of total reported turnover.

In addition to the manufacturers listed here, some larger multinational manufacturers also operate in Scotland but the total annual turnover for DEH sales in Scotland is uncertain.

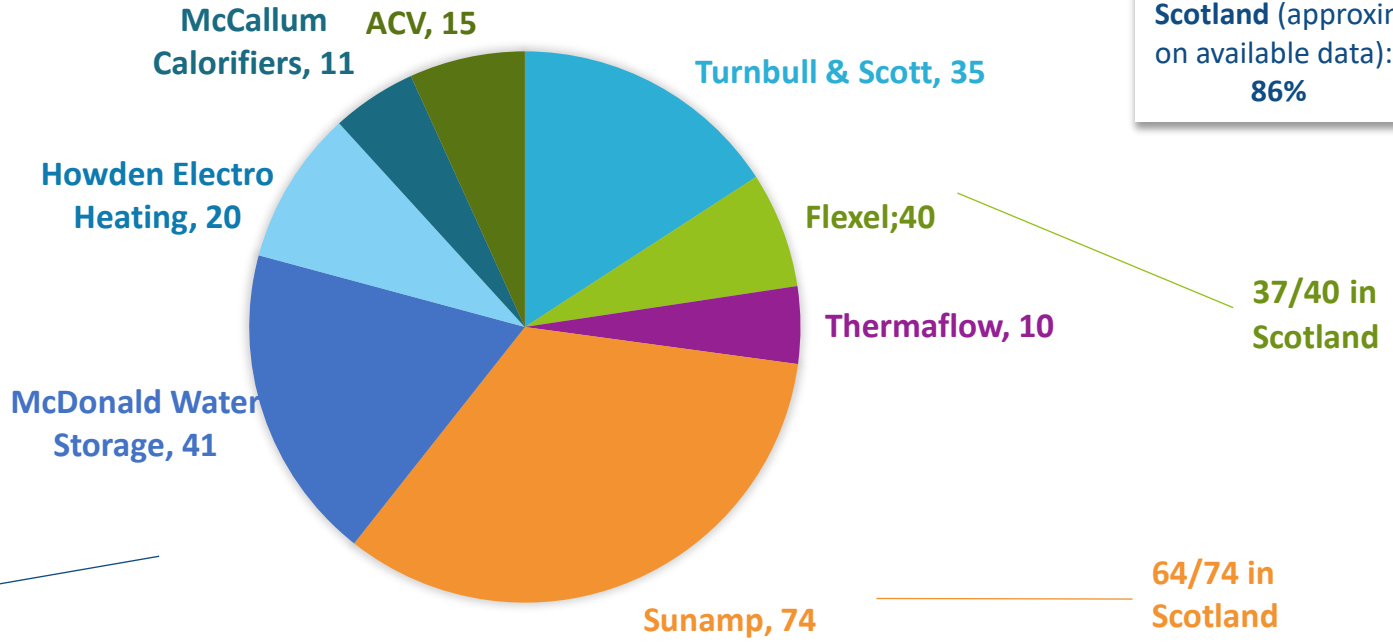
Direct electric heat manufacturing bases in Scotland by turnover

Employee counts of DEH manufacturers in Scotland are all relatively small to medium, with Sunamp leading the way with 74. Based on direct data available and desk research insights, >80% of employees are based in Scotland. [38]

Scottish DEH manufacturers' total employees*
*Number of employees based in Scotland listed where data is available.

Total DEH employees:
221

Scaled % of employees based in Scotland (approximation based on available data):
86%



Overview of Scottish assets and support ecosystem for direct electric heat manufacturing

Stakeholders	Sectors	Activities	Link to DEH
BE-ST	Construction	BE-ST is delivering the HeatSource programme , supporting DEH companies through introductions, training, testing facilities, research and demonstration.	Provide installation training services and technical support of DEH as one solution.
BEAMA	Electrical infrastructure products and systems	Trade association to support the UK electrotechnical and energy equipment industry to promote innovation, tackle regulatory issues and drive competitiveness for its members.	The association deals with the full range of DEH technology manufacturers.
Thermal Storage UK	Thermal Storage	Trade association to promote the use of smart thermal storage in the heating and hot water systems of buildings in the UK and other countries.	Smart thermal Storage; members include companies using DEH solutions such as Sunamp
Energy Saving Trust	Energy	Organisation that deliver energy programmes for governments and support businesses with energy efficiency strategy, research and assurance.	Manages a service that is open to anyone in Scotland for heating system & energy advice, deals with a range of DEH technologies.
Energy Skills Partnership	Engineering, Construction & STEM	Support colleges in developing their capability, capacity and curriculum by establishing appropriate Training Networks to enable knowledge transfer and peer network.	Provides training where there is a need, focussed on colleges and the domestic sector.
Others, from interviews	Scottish Manufacturing Advisory Service (SMAS), Hot Water Association, Local Energy Systems Scottish Industry Network (LESSIN), Scottish and Northern Ireland Plumbing Employers' Federation (SNIPEF), Heat Pump Federation, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), EU Heat Pump Association, Scottish Engineering.		

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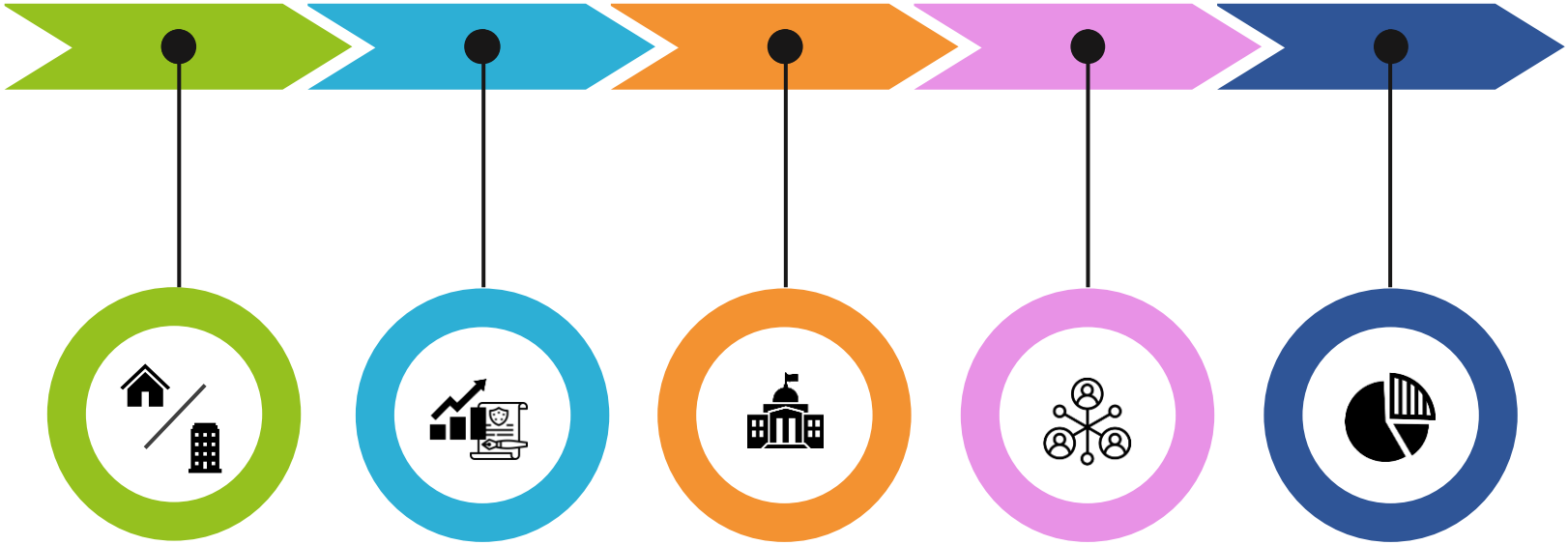
Direct electric heat market sizing and forecasting

To conduct market sizing and forecasting, a stepwise approach to various sources and approaches has been used



Market segmentation
What segmentation is needed for a full picture of the market?

Market drivers and relevant policies per segment
What is driving (or inhibiting growth of) the DEH market in Scotland?

Public data on the DEH market
What public data on the Scottish DEH market exists?

Stakeholder data on the DEH market
What do stakeholders in Scotland say about the DEH market?

Market sizing
How possible is market sizing per segment, and what estimates can we make with existing data?

Market drivers for each segment

Due to the simplicity of installation and use of electric heating products, there are possibilities across all market segments for their growth. However, operating costs from high electricity prices are a barrier across all segments.

Non-domestic Retrofit

- The current Scottish SME energy efficiency scheme provides **cashback for a range of DEH measures**, including radiant heating units, underfloor heating and heating controls.[41]
- Retrofitting space heating for smaller properties is an installation/operational cost question. DEH has the advantage that it can easily be used to heat specific rooms / zones, e.g. outdoor spaces in pubs, waiting areas in stations.

Domestic Retrofit

- DEH is **generally easier and cheaper to install** for retrofits relative to heat pumps and heat networks. New technologies have in-built flexibility that may lower operating costs.
- The **Home Energy Scotland provides grant and loan support for some types of DEH**, including thermal storage and electric heating systems.
- Heat pumps will be difficult to fit in apartments that are protected, constrained by noise regulations, or constrained by physical space (to other flats, e.g.). Either communal heating systems or DEH is likely to be the preferred option for these retrofits.

Non-domestic New Build

- For larger properties **heat pumps or heat networks will probably be the preferred option** due to operating costs, except where heating is for specific rooms / zones.
- For smaller properties such as pubs, hotels, shops etc. Some may prefer DEH as it is easy to control and can heat individual rooms / spaces. 95% of UK non-domestic properties are less than 100 sqm and can be considered small.[40]

Domestic New Build

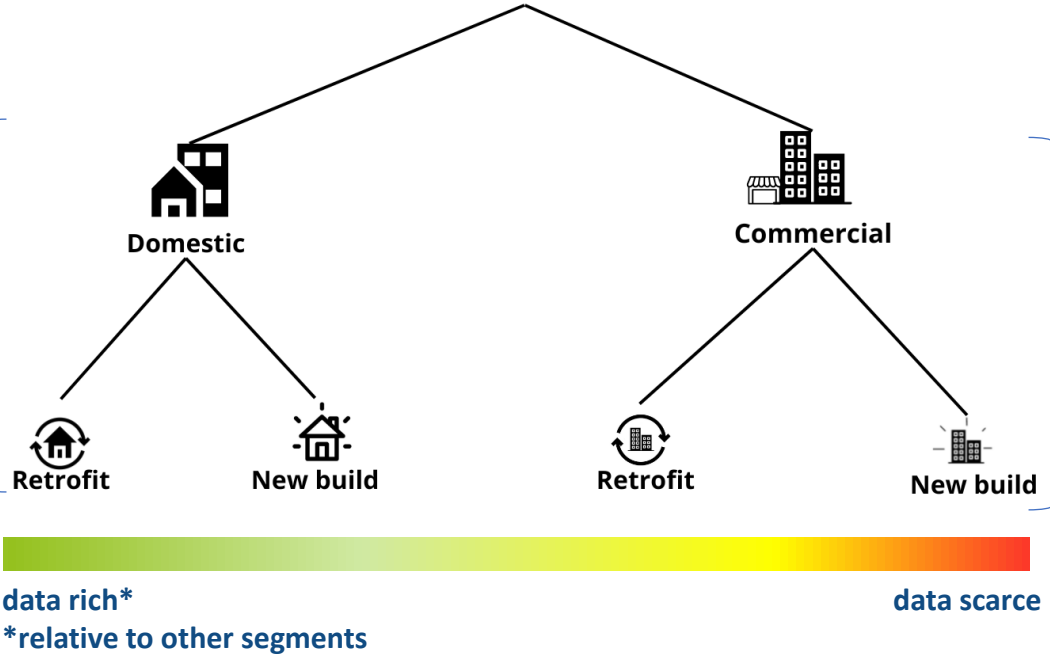
- Heat pumps are expected to drive domestic new build market due to the overall efficiency of the system and the lower installation costs from upfront designs to accommodate them.
- Houses with **small thermal load requirements** (such as Passivhaus or equivalent) might opt for only electric underfloor heating / small radiators and hot water boilers.
- Heat pumps may not be the best option for some apartments due to e.g. space constraints. Either communal / district heating systems or DEH is likely to be the preferred option.

Direct electric heat market segmentation

There are different levels of data available for each segment of the DEH market observed.

Data available for domestic DEH market:

- Some public reports/databases with UK data.
- Some relevant Scottish housing data.
- Data inconsistent across stakeholders, publicly available data and industry value chain, e.g. the Heat in Buildings Strategy estimates 262,000 homes in Scotland use electric heating while interviewees estimate 280,000-320,000 homes.



Data available for non-domestic DEH market:

- No hard commercial data available.
- Some housing stock information.
- Some public and stakeholder commentary signifying opportunity/market segments within commercial buildings.
- Minimal stakeholder insights focusing on the use of DEH in the commercial sector.
- Quantification near impossible due to broad range of applications.

Domestic direct electric heat market size estimation

Using existing data, sizing the domestic DEH market is possible although with a degree of uncertainty.

Domestic Retrofit Market Sizing

- **From multiple stakeholders and industry experts, the number of homes using DEH is between 280,000-320,000 in Scotland (roughly 12% of the housing stock) [44] This differs from the 262,000 homes estimate from the Heat in Buildings Strategy.**
- 1 in 4 homes in Scotland classified as fuel poor (relative to 1 in 10 in the UK). [43] This has implications both for the impact of higher operating costs of DEH and any upfront replacement costs for alternate technologies.
- Scaling the proportion of UK homes with storage heaters and other direct electric heating (panels, radiators) versus those with just some storage heaters to Scotland, we can estimate:
  - ~150,162 Scottish homes with electric storage heaters and radiators/panels
  - ~85,807 homes with just panel/radiators heaters
- There are also arguments that existing stock may supplement ageing heat systems with DEH technologies. [10, 45]
- At an average of 10 panel heaters per system [10], this puts a top end estimate of 2.36 million electric panel heaters/radiators and 150,000 storage heaters in Scotland. However, estimates from the stakeholder interviews suggest there may be 250,000 homes in Scotland with storage heaters currently.

Domestic New Build Market Sizing

- Using a similar approach for new-build estimates, 18,974 new homes were constructed in Scotland in 2021, equivalent to 0.7% of Scottish housing stock. If assuming same DEH installation rates as existing stock, roughly 1,900 new builds / year, about 10%, (at 2021 numbers) will use DEH.
  - Some uncertainty in this estimate as new builds may be more likely to install DEH technologies either as main heat source or supplementary to heat pumps to support consumer choice and ability to provide flexibility services to grid.
- The percentage of new builds with DEH will increase quickly with the upcoming gas boiler ban, particularly for the smaller, well insulated flats where individual heat pumps are difficult to fit.
- European market for new build is well supported in some countries, e.g. Germany, but also features strong domestic competition and some market entry barriers for companies based in Scotland.

Non-domestic DEH market size estimation

The non-domestic market is likely to be dominated by heat pumps and communal / district heating systems, but there is evidence to support a growing market for DEH.

Commercial Retrofit Market Sizing

- Approx. 200,000 commercial properties in Scotland, with an estimated half currently heated using low or zero emissions heating solutions. [46]
- Based on total UK heat demand, 10% heating demand met by electricity – implication that it is predominantly smaller commercial properties using electric heating.
- In the SME Loan Fund, DEH solutions not listed under "Renewables" next to heat pumps, but some solutions available under HVAC, e.g. underfloor heating.
- Smaller commercial properties with more variable customer footfall are more likely to benefit from DEH technologies – e.g. outdoor heating zones at pubs, restaurants, stadiums, hotel rooms which can be heated independently of each other, open-space flexible office spaces with variable heating requirements etc.

Commercial New Build Market Sizing

- Uncertain how many commercial developments are being built in Scotland per year, but likely to be 250-350 per year. [48]
- Heat pumps and heat networks expected to be preferred solution except where there are specific requirements for zone heating or the properties are small. 95% of UK non-domestic properties are less than 100 sqm and can be considered small.
- New-build commercial properties are more likely to use DEH technologies as a supplementary measure for particular zones or times of day, with heat pumps and heat networks providing the bulk of space and water heating.

Public data available on current and predicted DEH market size

There is limited public focus on the range and applicability of DEH technologies to provide low and zero emissions heating in Scottish and/or UK homes

Publicly available data on non-domestic DEH installations

- DEH estimated to be 1% of public and commercial heating demand in 2030.[10] Current market size estimates difficult to come by from data-driven approach; sales data varies wildly due to size of systems purchased with order-of-magnitude estimates from stakeholders more consistent.
- Non-domestic building stock estimated as 220,000 , but no publicly available data characterizing heating systems directly according to Scottish Government. However, the Heat in Buildings Strategy estimates 50% of commercial properties have some form of DEH technology onsite.

Commentary on public data

- Data is scarce and generally predicts an insignificant if any role from DEH in the future of heating by 2030.
- Commercial (and industrial) data is severely lacking, although most commercial and industrial spaces are likely to have some form of DEH installed as supplementary heating sources.
- Heat pumps predicted to overwhelmingly dominate the market alongside heat networks as the main source of heat according to both publicly available data and findings from stakeholder interviews. However, the role of DEH as a supplementary source of heating is unclear.

Broad differences in Scottish housing stock versus the rest of the UK

- Scotland has an older housing stock than the rest of the UK with a higher proportion of homes built before 1919. [47, 49] Older homes may require more extensive retrofitting to low carbon heating systems in compliance with decarbonisation policies, with DEH technologies having simpler installations than heat pumps. [39]
- Scotland has a lower level of gas grid coverage, leaving oil and electric heating as the alternatives. Current predictions state only 10% of off gas-grid homes unfeasible for DEH in UK (50% are capable now, 25% may require fuse upgrades from 80A to a max 100A, 15% may require other upgrades). [10,49]
- There is a higher proportion of rural housing stock, which could pose challenges in connecting to low-carbon heating networks. [49]
- Scotland has a higher level of fuel poverty than the rest of the UK, with the current price of electricity making DEH potential unattainable for more residents in Scotland. [43,47]

Stakeholder data and insights on the current and predicted DEH market size

Stakeholder data from various angles within the heating supply/value chain all seem to converge on the same data and insights, which are at odds with public data.

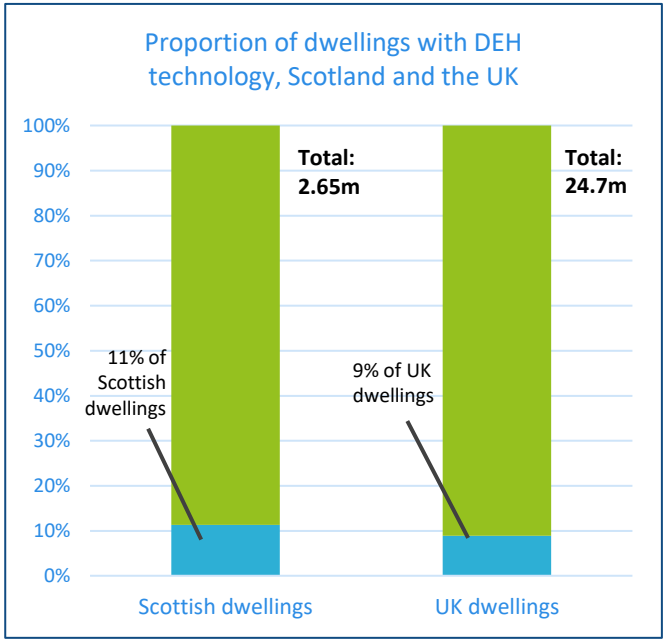
Stakeholder Interview Market Sizing: Domestic Market (summary)

Stakeholder data conclusions

- **Significant disparity between public 2030 estimates and the current 1) Scottish manufacturing/DEH company ecosystem and 2) stakeholder/expert market sizes**
- Multiple interviewees said 280k-300k homes currently use DEH systems; BEAMA estimates as high as 320k (12% of dwellings), with some industry players internally estimating up to 15% dwellings.
- Predicted 80/20 split in domestic homes for heat pumps/direct electric systems which implies potential 530,000 homes **primarily** using DEH by 2045.
- Current UK market for DEH is approx. 2.2 million installations in domestic properties not including heat pumps (BEAMA)
- Significant market potential in Europe, where DEH technologies are well-established, but also highly competitive markets with existing manufacturers.

Key Stakeholder Commentary

- Current heat pump market smaller than people imagine.
- English DEH more prevalent in flats, but Scottish DEH more prevalent in rural homes.
- Greater interest in DEH in Scotland as Scottish Government has more developed heat policy, including the launch of the Passivhaus equivalent standard for new builds.
- Stakeholders have not identified any significant recent sales growth in the industry noting that the biggest barrier is cost of electricity.
- General optimism that electricity costs will decrease, and flexibility / off-peak tariffs become more broadly available, reducing operational costs of DEH.
- BEAMA anticipates demand for DEH technologies to increase and supply chain complexity/size to evolve.



Key findings from the academic literature review

Most DEH academic literature focusses on a single technology, particularly infrared and thermal storage. Relevant extracts from the literature are included below by year of publication.

CLT CARBON LIMITING TECHNOLOGIES

Summary findings from the academic literature review

- There is a lack of academic literature comparing technology performance across electric heating technologies or comparing electric heating technologies with alternate heating, including gas boilers. However, the increased interest in smart homes and embedded flexibility means there is more emerging literature on the role of electric heating within a whole house/community energy system. Sample papers highlighted below.

A Comparison of Widespread Flexible Residential Electric Heating and Energy Efficiency in a Future Nordic Power System, Rasku & Kiviluoma (2019) :

- "With sufficient amounts of VRE [variable renewable energy], residential P2H [power-to-heat] with thermal storage was found to yield more system cost savings than simple energy efficiency improvements. However, energy efficiency improvements remained more beneficial for house owners, as excessive use of residential P2H for assisting the power system could result in increased heating costs." Note this was based on Finnish housing stock, which is relatively new and energy efficient.

Smart electric storage heating and potential for residential demand response, Darby (2017):

- Focuses on potential for residential demand response via storage heaters, looking at both current state of things and conditions to be met. UK specific focus. Provides an overview of both legacy and emerging storage heaters ("smart storage heating"), including overview of customer satisfaction and applicability to demand response.

Legacy article: Electric storage heating: the experience in England and Wales and in the Federal Republic of Germany, Ashbury & Kouvalis (1976):

- Following the development of the original storage heater for dwellings in the 1960s, this article discusses the differences in commercialization of electric storage heating in England/Wales versus Germany/Europe. Although several decades old, it contains pertinent information on the market conditions for the two countries, particularly the effectiveness of the use of off-peak tariffs to smooth electricity demand consumption.

Key findings from the review of the European market

Most interviewed Scottish-based manufacturers indicated a limited interest in exporting to the European market, either due to existing partner facilities located in Europe or because the domestic market was sufficiently large.

Summary: While there were no market reports estimating the value of electric heating technologies (other than estimates of the heat pump market), the below reports summarise key findings which can be used to infer the potential for other electric heat solutions deployed alongside heat pumps and other low to zero emissions solutions.

Heating Market Report 2021, European Heating Industry (2021)

- The EHI estimates that there are over 100 million heaters installed in European buildings, of which 60% are classed as old and inefficient. Buildings heated by district heating are counted separately. Installers are identified as the key enablers of adoption of more efficient and low carbon heating systems, with 80% of consumers with recent heating systems having received advice from their installer. The report provides an overview of the most common heat technologies, including heat pumps and gas boilers, but little information is provided on the market share of electric heating excluding heat pumps. Of the 100 million heaters currently installed, some may be converted to district heating.

A review of heat decarbonisation policies in Europe, ClimateXChange (2019)

- Within Europe, Norway has the largest share of heating from electricity (85%) across domestic and non-domestic buildings, most of which has been some form of resistive electric heating although this is increasingly being supplemented by or replaced with heat pumps. Sweden and Finland have shares of approximately 30% of domestic buildings using electric heat, with the UK, Ireland, and France ranging from 9-15% and remaining countries with shares of less than 3%. This compares with approximately 10% of domestic buildings using electric heating in Scotland. Norway represents the upper end of the spectrum regarding electrification of heat at the individual building level but all countries will likely increase their share of electrified heating alongside district heating connections.

Quantifying the Heating and Cooling Demand in Europe, Stratego, Work Package 2, Background Report 4 (2015)

- This report estimates both the share of domestic heat demand met by electricity for each EU country and the split between the use of heat pumps and other electric heating, with data captured from reports published 2011-2014. Estimates range from 0% of electricity used in domestic heat demand in Lithuania to 77% in Malta. Given the age of the data, it is unsurprising that most of this domestic electric heating is met through other electric heating technologies, with heat pumps contributing more than 25% of total electric heating in only 6 EU countries – Austria, Czech Republic, Netherlands, Slovak Republic, Spain and Sweden. Over time, it is likely that most electric heating will be met through heat pumps.

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How direct electric heat can compete against alternative heat solutions

Through storage, demand side response and maximising use of flexible electricity tariffs, DEH can become cost effective and provide wider grid balancing benefits, supporting a just transition to net zero.

DEH can be competitive against other solutions – including heat pumps and district heating – where heat demand is very low or specific to defined zones where it does not justify installing a property-wide wet heating system and/or where heat demand is flexible enough to benefit from lower time of use tariffs. There are **two main types of flexibility DEH can offer the grid**; load shifting through home thermal storage and demand side response. However, to deliver this flexibility, the DEH technologies will need to be powered by digital technologies that can track tariffs and respond to other price signals (including both in-built control capabilities and a smart meter to communicate with).

Digital information sharing, monitoring and coordination between assets and organisations needs to happen across multiple storage vectors to ensure grid optimisation and access cheap electricity tariffs. For example, where a property has electric heating and an electric car or electric battery, how should electricity demand be managed to maximise use of off-peak tariffs? The potential for DEH in this flexibility market is sizeable - a UK government commissioned report indicates that a flexible grid can provide net savings between £9.6-16.7 bn annually for the UK.[50]

Home Thermal Storage is comprised of technologies that can charge, store and discharge heat in a controlled manner based on external signals. The applicable DEH technologies include storage heaters and water cylinders. However, there is a small thermal heat loss during every cycle of charge and discharge and the exact amount of loss varies across different storage technologies.

Demand Side Response is changing the amount or timing of grid electricity consumed by customers in response to an external signal. Domestic DSR technologies include smart appliances such as washing machines, dishwashers, and refrigerators. All DEH technologies can respond to signals to reduce current electricity consumption or shift it to another time. The smart meter rollout is a key piece of enabling infrastructure that supports smart tariffs and coordination between technologies.

Opportunities for direct electric heating manufacturers

DEH has a role to play in both domestic and non-domestic low-carbon heating, for instance where space heating demand is limited due to high levels of insulation and for smaller targeted spaces/zones within larger areas.

DEH can fill gaps where heat pumps are not appropriate

- Heat pumps are considered the preferred option due to their Coefficient of Performance (COP), an indicator of efficiency. Heat pumps are around three to four times more efficient in converting electricity to heat than DEH solutions.
- Heat pumps are not suitable to install in all cases. The reasons can relate to upfront equipment cost, disruption / cost of installation, property heat requirements and space availability, and level of insulation.
- DEH technologies may be an economically viable alternative or supplementary solution which expands the low-carbon heating options available to customers.

”The message shouldn’t be “heat pumps for everyone, and DEH if not”, but “low/zero carbon heat for everyone, now let's see which system is most suitable for you”.”

Small non-domestic and social housing stakeholders are showing substantial interest in DEH technologies

- There is a general alignment across interviewed Scottish companies that there is substantial interest for DEH solutions from the non-domestic and social housing sector.
- Feedback indicates that most demand comes from smaller commercial and industrial properties. A key reason is that DEH allows for targeted heating that can quickly be turned on or off which is useful for rooms with varying occupancy. Additionally, one issue with larger sites are grid constraints / capacity to meet fully electrified onsite demand.
- For social housing, some DEH systems are suitable due to the low heat demand of houses, existing solar panels, relatively lower installation costs (compared to heat pumps), or limited disruption to the tenant.

Half the manufacturers interviewed indicated that their largest market was non-domestic. For the other half, the majority indicated social housing was the primary market.

Opportunities for direct electric heating manufacturers

There is potential to increase DEH economic activity in Scotland through supporting engagement within the local supply chain and increasing awareness of the flexibility services DEH technologies can provide.

Potential opportunity to increase procurement within Scottish supply chain

- Interviewees identified barriers to engaging with the wider Scottish manufacturing supply chain, indicating that there may be missed opportunities for increased domestic sourcing. With an increasing focus on embedding **circular economy** principles, there are potential opportunities to shift use of raw materials to reclaimed materials, e.g. steel and copper.
- Current sourcing is often done in Europe or Asia and a limited amount procured from the rest of the UK. Barriers to local procurement have been identified as price, quality, and lead times.

Over 75% of the interviewed organisations that manufacture in Scotland have indicated that they would be interested in sourcing more locally.

Heat technologies providing flexibility and storage are likely to have increased market growth potential

- Grid flexibility is key for decarbonisation of the grid and will provide total system cost savings.
- DEH technologies which can provide flexibility will provide benefits to customers, e.g. through access to cheaper off-peak / time of use tariffs.
- Thermal storage technologies provide additional flexibility through load shifting compared to other DEH technologies which focus on demand response.
- Solutions with in-built flexibility features such as Sunamp and Connected Response is likely to grow faster as they provide both demand response and load shifting capabilities.

Increasing energy system flexibility is key to decarbonising the grid and can result in savings from £9.6bn to £16.7bn annually for the UK. [50]

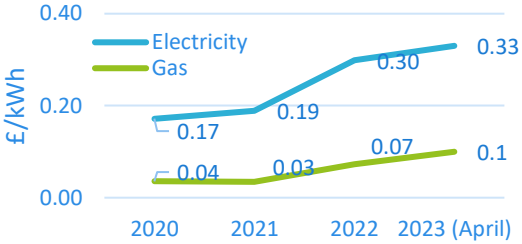
Challenges for direct electric heating manufacturers

Potential customers are being drawn away from DEH due to high electricity prices or lack of understanding of costs, efficiency, and use cases.

High electricity prices are deterring potential DEH customers

- Recent electricity price increases are deterring customers who believe that DEH operating costs will be significantly higher than gas boilers and heat pumps.
- Medium term electricity prices are forecasted to go down, but not all the way down to pre-2022 levels.[53]
- Due to high electricity prices, consumers are hesitant to replace heating systems with DEH. There is a different rationale for heat pumps due to their higher efficiencies in converting electricity to heat.
- At least one interviewed company is hesitant to launch new products due to the current electricity system volatility.

Average variable energy price for domestic consumers



These figures incorporate the Energy Price Guarantee from October 2022. Values include tax

Lack of understanding of DEH solutions is limiting consumer choice and deterring uptake

- Interviewees highlighted a general lack of understanding of DEH across stakeholders (consumers, installers, and policy makers). This relates to efficiency, ease of use, different use cases, and operational cost (which is directly linked to price of electricity). Interviewees singled out infrared and storage heating as especially misunderstood.
- The interviewees thought one factor was due to the lack of independently verified DEH performance data which can be used to make informed decisions. The gap seems to exist both at a consumer and installer level.
- This leads to consumers not knowing whether they are better served by a heat pump, DEH solution (stand-alone or supplementary) or a gas boiler.

"One key argument for raising awareness is that consumers should still have a choice in what heating solution they install – due to a general lack of awareness of direct electric heat, they may not be aware that this is an option. "

Challenges for direct electric heating manufacturers

All DEH manufacturers are facing increased supply chain costs and there are limited commercial reasons to increase DEH manufacturing footprint in Scotland.

DEH companies are facing increased supply chain costs

- Interviewed companies cost base has increased due to increased cost of components and logistics prices.
- Increase in electricity prices is also affecting manufacturing costs.
- This increases pressure to reduce costs and leads to more international low-cost sourcing strategies.

Prices of input goods bought by UK manufacturers has increased by 14.1% in 2022.[51]

There is a limited business case to build new manufacturing capacity in Scotland

- For organisations to move their manufacturing base to Scotland would require incentives and support frameworks such as investment support or energy price relief. This was echoed by both private companies and trade organisations.
- Existing Scottish-based manufacturers already have access to spare manufacturing capacity. Less than half of the interviewed manufacturers were planning to expand their Scottish capacity above existing spare capacity over the next couple of years if they hit their growth targets.
- One manufacturer mentioned that cost of goods is preventing further local manufacturing relative to opportunities outside the UK.

Less than half the interviewed manufacturers in Scotland are planning to expand locally despite all expecting future growth, due to existing onsite excess capacity.

Challenges for direct electric heating manufacturers

Deployment is limited by lack of heat engineering skills to design and install a range of DEH systems. DEH technologies also have difficulties getting a high SAP score which limits customer choice.

Lack of installer and heating engineer skills is leading to poor performing systems and might limit uptake

- Heating installers lack knowledge of DEH technologies which leads to poorly performing installations – examples cited by multiple interviewees include installing DEH requiring three-phase electric capacity in homes with only single-phase capacity.
- Heating engineers (some are also installers) consider the **entire house heating system** incl. loss, technology, radiators, insulations etc. There is a lack of this skill leading to sub-optimal heating technology recommendations and systems not being sized correctly.
- The supply of good manufacturing staff and welders is limited, but that is currently not creating any issues for the Scottish-based DEH manufacturers.

"The heating sector as a whole has a thousand times fewer people than we need over the next 20 years. There is a net loss of heating engineers in the market."

SAP and EPC scores reduce customer opportunities to choose DEH

- SAP is calculated using Primary Energy Factor, which makes gas boilers appear efficient compared to DEH. This gives them a higher SAP score.
- There are other challenges preventing new DEH technologies from achieving a good SAP score. For example, SAP does not value flexibility for thermal storage or factor in that infrared system may operate at a lower temperature, reducing energy demand.
- The SAP score drives the EPC rating, which governs the type of heating technology buildings can have (including social housing). The new SAP 11 is expected in 2025.

"SAP was designed to promote gas heating… SAP 11 will change things because EPC needs to be reviewed to make DEH more appealing."

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Policies affecting the Scottish direct electric heat market

Summary of selected policies affecting the state of the Scottish DEH markets suggests limited support for future deployment and uncertainty regarding the ecosystem for current installations.

Heat in Buildings Strategy, Scottish Government, 2021

- Expectation that electric heating systems will likely be predominantly either individual heat pumps within buildings or larger heat pumps providing heat to heat networks by 2030.
- Recognises the role of thermal storage, including at a domestic level, could reduce electricity network constraints and help keep consumer bills down.
- Recognises that the current Energy Performance Certificate regime would rate the replacement of an existing electric heat system with cheaper fossil-fuel based heat higher than replacement with a zero emissions system.
- Includes an action to investigate how building-level storage technologies (including heat batteries, electric batteries and thermal storage cylinders) can support the transition to net zero emissions energy technologies within buildings.
- Includes a reference for a support tool for domestic consumers – **Home Energy Scotland**, delivered by Energy Saving Trust. Use of their online tool provides no DEH upgrades/supplementary technologies for urban flats using existing storage heaters (tested for a brick-wall flat in Edinburgh in March 2023).
- Includes a reference to the SME energy efficiency scheme which provides cashback for installation of some DEH technologies.

New Build Heat Strategy, 2023 (Consultation Part 2)

- Recognises direct electric heating to be compliant with the New Build Heat Strategy requirements for any new build from April 2024, including electric panel heaters, electric fan heaters, thermal fluid-filled radiators, and electric radiant heaters.
- Does not mention the use of thermal storage/batteries, time of use tariffs or flexible demand in reducing the strain on the local/regional electricity grid or reducing end-customer costs.

Policies affecting the Scottish direct electric heat market

Summary of selected policies affecting the state of the Scottish DEH markets suggests limited support for future deployment and uncertainty regarding the ecosystem for current installations.

Fuel Poverty Bill, Scottish Government, 2019

- No direct mention of electric heating, including legacy electric heat storage systems, or how changes to legacy time of use tariff systems may affect fuel poverty.
- No discussion of how flexible tariffs might be targeted towards vulnerable households, allowing properties to take advantage of when there is excess renewable electricity on the grid to charge existing thermal storage systems for free/for payment to avoid curtailment of renewable generation on the grid.

Draft Energy Strategy and Just Transition Plan, Scottish Government, 2023

- Whilst there is a request to UK government to amend the current electricity pricing regime to support deployment of zero emissions energy, there is no direct mention of direct electric heating technologies for domestic or non-domestic deployment.
- Expectation that 1 million homes currently using gas for heating as well as most of the 170,000 homes using alternate fossil fuels will switch to zero emissions heating by 2030.
- Identified upfront grant support for heat pump installation (£7,500) with a rural uplift (£1,500) for heat pump installation with energy efficiency measures. Some DEH solutions included as part of energy efficiency measures.
- Identified the need for more support for vulnerable customers and customers with a reliance on alternate measures to heat their homes (heating oil, LPG, coal and biomass).
- Deployment of the Green Heat Finance Task Force and bolstering the delivery of Local Heat and Energy Efficiency Strategies.
- Expansion of the Supply Chain Development Programme with current priorities of heat pumps, hydrogen electrolysers and component parts.

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Voices from the industry and recommendations

Through interviews with 16 stakeholders involved in the manufacture, installation and delivery support of DEH, we have drawn out impactful messages relating to the market view and recommendations for Scottish Enterprise and for public sector in Scotland.

The following pages include quotes from interviewed stakeholders to help inform decision-making, followed by four key recommendations resulting from the interviews.

Voices from the industry – what is the role of DEH?

> The current status of heat electrification feels a bit unjust. While historically electricity has been a high carbon fuel, we've known a pathway for the electricity grid to decarbonise for a long time, and we're now at a point where the average GB grid emissions are lower than gas. Homes with storage heaters, electric boilers and other DEH installed have been using these systems but paying much more relative to gas boilers.
>
> While not 'early adopters' in the usual sense of the word (often times the households have DEH because there wasn't much option e.g. their home is off-gas), they are a group that are already helping us get closer to net zero and have paid the cost for it.
>
> Going forward, we need to make sure that this group benefit from the advances in electric heating that they've helped develop so that they don't get left behind.

Joanna O'Loan, Knowledge Manager, Energy Saving Trust

Voices from the industry – what is the role of DEH?

> A real hindrance to the market is around current electricity prices – even where an agile tariff exists, it's difficult to get it and even if you do, it only applies to electric vehicle charging, not thermal storage!

Wayne Hyde, Product and Marketing Manager, McDonald Water Storage

> Customers need to understand that there are more options than a heat pump – it's tricky because you can get a grant for heat pumps but not for DEH, which potentially will drive clients towards a solution which may be unsuitable for their needs.

Garry Cowan, Area Sales Manager, Electric Heating Company

> The supply chain will evolve as the market demand expands to ensure that there are adequate supplies within easy reach of the contractors.

Chris Stammers, Portfolio Manager, BEAMA

Voices from the industry – what is the role of DEH?

If you had a magic wand, what is the one thing you would change to drive interest in/uptake of DEH solutions in Scotland/the UK?

> Reform the EPC process to be more inclusive of innovative electric heating products – the market is not the same as it was 15 years ago – we need to think of the end user, meet their needs and get away from the tick-box syndrome we currently have.

Electric Heating Company

> Close the gap between electricity and gas prices. It doesn't make sense if we are trying to wean people off gas to have that huge disparity.

Turnbull & Scott

> In the future you will see the whole house as a flexibility asset to the energy system.

BEAMA

> Could we have a "no heat pump possible" certificate, acting as a certificate of entitlement on fuel costs reduction, available if you act as a good consumer by providing storage flexibility capacity back to the grid? With more incentives where there is more storage as this can provide more capacity to the grid.

SunAmp

> Changes to SAP and EPCs combined with awareness-raising to level the playing field relative to heat pumps. However, there are legitimate concerns about mass uptake of direct electric without consideration of storage – rather than switching off wind, use of preferential rates to store excess renewables as heat.

BE-ST

How the market for direct electric heat can be supported

Recommendations

Provide robust, transparent information on DEH solutions

There was a consensus amongst the interviewed manufacturers that there was a severe lack of understanding of the types of direct electric heating technologies available, how these would integrate with heat pumps and other technologies and which mix of technologies would be most suited from a whole building perspective. There were particular concerns raised for the transition of legacy direct electric heat systems, protecting customers and not taking a tickbox/one-size-fits all stance to identify zero emissions solutions.

Recommendation: An education initiative targeting installers, electricians and training and skills programme providers to provide neutral, robust and transparent information of the benefits and drawbacks of direct electric heat across property types, improving consumer choice and whole building energy transformation programmes. This could be driven by installer and electrician trade associations in conjunction with colleges.

Support for those on legacy zero emissions heating systems

There are already a minimum of 260,000 homes and up to potentially 320,000 homes in Scotland on direct electric heating systems, primarily storage heaters. From the stakeholder interviews, there was broad consensus on the concern for these legacy homes using DEH systems which have already transitioned to a zero emissions heat supply but who face increasing electricity costs. Additionally, there is uncertainty regarding the expected shutdown of the radio-tele switch mechanism to run the meters on some of these legacy systems.

Recommendation: Before the imminent shutdown of the existing radio/tele metering facility (expected March 2024) for legacy zero emissions heat systems, there needs to be a support programme for the roughly 160,000 Scottish homes on these systems to transition to more modern applications of the existing system or a full replacement with an alternate solution. This could be delivered by Scottish Government.

How the market for direct electric heat can be supported

Recommendations

The existing supply chain for Scottish-based DEH manufacturers is fragmented

There was significant variation across the manufacturing supply chain depending on the interviewed party. Most had a combination of UK, European and Far East suppliers in their supply chain. Recent disruptions due to COVID, Brexit and the Russian invasion of Ukraine had presented logistics issues. Additionally, all interviewees were highly aware of their carbon impact and were looking to reduce embodied carbon footprints from sourcing components more locally. However, they were experiencing challenges in identifying suitable suppliers, and had all had challenges higher costs, poorer quality, longer lead times and a reticence in producing smaller batches (e.g. for research and development items) in the local supply chain.

Recommendation: There is a need to facilitate introductions, connections and networking across the local supply-chain and supporting ecosystem for direct electric heat technologies to develop a cohesive customer proposition. This could be delivered by HeatSource and by Scottish Enterprise.

Further research on the potential for DEH in the commercial and industrial segments

Most of the interviewed stakeholders identified the need for a better understanding of the commercial and industrial pathways to decarbonisation. Heat zones, e.g. for outdoor seating at restaurants and pubs, flexible office spaces, hotel occupation and industrial applications for particular zones within warehouses and manufacturing facilities with high-temperature processing were all highlighted as being uniquely suited for DEH solutions.

Recommendation: Further research and understanding of the market size and potential deployment of DEH technologies in the commercial and industrial sectors is required, including restaurants and pubs, hotels, wellness facilities and industrial facilities requiring decarbonised high-temperature heating solutions. This could be delivered by Scottish Government and ClimateXChange.

Section:
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