

The potential of Heat as a Service as a route to decarbonisation for Scotland

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1 Executive summary

1.1 Aims and findings

To reach the target set out in the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 of net-zero carbon emissions by 2045, Scotland needs to decarbonise heat and improve the energy efficiency of its buildings. This evidence review examines the potential of Heat as a Service (HaaS) to support this aim by providing a route to the decarbonisation of heat of domestic properties in Scotland.

Heat as a Service is a term which covers a range of services that enable people to achieve a warm home in a variety of ways. These include services which provide or enable finance to purchase and install heating equipment; maintenance of heating equipment; energy efficiency upgrades of building fabric; paying for the amount of heat delivered to the home; paying for the temperature the home is heated to; paying flat-rate tariffs for the home to be heated; or combinations of these. To date, there is not much evidence as to what has been tried in terms of HaaS or how effective it has been in delivering substantial emissions reductions. However, the limited evidence there is suggests that some HaaS offers have potential to:

- help get Scotland to net zero by accelerating the uptake of low-carbon heating systems and improving energy efficiency across the domestic energy market;
- improve outcomes for consumers, especially the more vulnerable, by helping target financial support and providing better cost certainty; and
- support businesses in developing new, sustainable, business models and creating new jobs.

This report outlines HaaS business models that have been tried across Europe, and categorises them in terms of the outcomes they offer consumers. We look into the potential benefits of HaaS for Scotland, and some of the current barriers which might prevent this potential being realised. Through a series of case studies, we explore in more detail how different business models might work and be adapted to Scotland.

Our findings explain how HaaS could potentially help Scotland achieve its net-zero aims, tackle fuel poverty and grow businesses in the energy sector. It introduces how HaaS could work for companies interested in exploring its potential and makes recommendations on how Scotland can discover the potential of HaaS to meet its policy goals.

Main findings

- **A number of different HaaS business models have been tried, but there is limited information available.** We grouped existing models in terms of what they offered consumers. From the simpler to the more complex services, we categorised them broadly as: providing heating breakdown protection, support to buy a new heating system, paying for heat and paying for comfort. It is important to note that there is limited information available about what companies have tried or are currently planning in this space, and they are unlikely to share commercially sensitive data about their learnings to date.
- **Case studies provide insights into how HaaS could help Scotland meet its policy aims, but none describe a comprehensive solution at this stage.** The Danish Energy Agency, a government body, for example, successfully introduced a boiler scrappage scheme to encourage uptake of heat pumps via a Heat as a Service subscription business model. While Scotland can learn from Denmark's approach to working with businesses and consumers to roll out this model, there are important differences between the two countries to consider. HaaS offers are beginning to emerge around storage heaters which are prevalent in Scotland: Connected Response is working with social housing providers to offer improved heat services which involves retrofitting storage heaters to make them smarter and cheaper to run. OVO's Smart Heat Offer includes a discounted 12-month finance offer to purchase smart storage heaters coupled with a simple (Economy 7) time-of-use tariff and intelligent heat optimisation/control. Finally, originating in the Netherlands, the Energiesprong model is an approach to enable deep retrofit in domestic properties, making them highly energy efficient, and which focuses on delivering a comfort outcome to residents. This model has been trialled in England, but only with social landlords so far.

Companies choose different ways to set their tariffs and finance their offers. HaaS offerings range considerably with different tariffs: rental fees for heating systems; rates for the heat energy delivered (e.g. in £ per MWh); rates for keeping a home warm for a time (e.g. in warm hours). Some district heat providers offer a fixed rate for unlimited consumption, while some landlords include "Heat with Rent". Tariffs are set using simple assumptions (e.g. about a building or household), complex energy models, or historic data analytics. Offers are financed using consumer credit, equity release, government funding, private finance or private capital. There is potential for the finance industry to play a role in delivering HaaS going forward.

- **Different HaaS offerings must comply with different regulations sometimes from a range of different regulators.** It would appear there are no distinct regulatory barriers that prevent companies offering HaaS. Providers would still, however, need to comply with existing regulations around supplying energy, protecting consumers and selling financial products. There are challenges to

overcome, for instance, to spread equipment costs over long time periods without locking consumers in unfairly and to help consumers compare HaaS deals with tariffs in the existing energy market.

- HaaS could help overcome the two main barriers that put people off installing low-carbon heating systems: concerns about cost and comfort.** People in Scotland are not switching to low-carbon heating systems fast enough to reach the net-zero target. Aside from a lack of awareness, two of the main reasons people do not switch are cost and concerns about comfort. Many homes will need preparing, for instance, with insulation and other energy efficiency measures, before low-carbon systems can deliver the comfort consumers want. Some households will need support to make sure they can afford their energy, particularly those in fuel poverty. A range of different HaaS approaches, some more complex than others, will be needed to overcome these different barriers and attract consumers to a low-carbon heating experience.
- There is not yet much evidence about what consumers like or dislike about HaaS, but there are some likely drivers to HaaS uptake in the future.** HaaS trials, like those from the Energy Systems Catapult, show that with experience, HaaS becomes easier to understand and can deliver the cost and comfort control consumers want. It can also help people be more open to new options, including low-carbon heating solutions. These options can be available to all consumers, as long as they are designed inclusively and for more vulnerable consumers. However, work is still required to develop business models with fair and transparent payment mechanisms, and a market where consumers are able to compare and contrast HaaS models and other options to give them confidence they are paying the right price for the service they want. Features of HaaS that could appeal to consumers include: offering certainty over costs, spreading costs over time, improved control over heating and costs, tailored offers, improved comfort, being greener, and – with the right support – becoming easy to understand.
- The main challenges facing businesses with an interest in innovating in this space are understanding regulations, and learning to deliver HaaS in a commercially viable way.** Ofgem’s Innovation Link service offers support on energy regulation to innovators looking to trial or launch new products and services. To date, very few innovators have approached the service with business models relating to HaaS, and no substantive regulatory barriers have been flagged to the team. However, businesses have so far been reluctant to launch the more complex HaaS offers with most potential to meet Scotland’s broader policy aims of improving energy efficiency and reducing fuel poverty as well as decarbonising heat. They are put off by the increased challenge of pricing these types of offer. Billing regulations, the assignment of rights and the consumers’ right to switch supplier could also pose problems for business wishing to sell HaaS. Businesses may need support and encouragement if they are to: learn how to mitigate the commercial risks of installing equipment, maintaining equipment and recovering the costs of equipment over long periods of time; attract consumers with fair tariffs; and build new partnerships to deliver services that meet consumers’ expectations cost-effectively. There is currently

very little evidence business can draw on to design and deliver successful HaaS offers in Scotland. Building this evidence base is expensive for any single business, even though it has the potential to pay a large dividend to the energy sector, including consumers, in future.

1.2 Recommendations

Recommendations for the Scottish Government to move forward on Heat as a Service:

- 1) Continue to engage with the Danish authorities to understand lessons from its HaaS Support Scheme for oil boilers, and implications for Scotland.
- 2) Use local area energy plans (such as the Local Heat and Energy Efficiency Strategies in Scotland) to pick the places where HaaS has most potential in Scotland.
- 3) Work directly with businesses and consumers to understand how to overcome the challenges they have with selling and buying HaaS in Scotland.
- 4) Invite businesses to test HaaS with consumers in Scotland to explore how it can be designed, delivered and achieve Scotland's decarbonisation aims.
- 5) Set out a roadmap on the potential for HaaS to contribute to heat decarbonisation and tackling fuel poverty, to encourage industry to invest in understanding the potential.
- 6) Develop and deliver any legislation needed to unlock the HaaS opportunity.

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2 Introduction

2.1 Background

To reach the targets set out in the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019¹ of net-zero carbon emissions by 2045, Scotland needs to decarbonise heat and improve the energy efficiency of its buildings: in 2017, 79% of Scottish households (around 1.9 million) used mains gas for heating, 12% used electricity, 6% used oil with the final 3% connected to heat networks or using alternative fuels². Therefore, there is some way to go to transition homes in Scotland to low-carbon heating, given that the Scottish Government estimate that around 50% of homes, or over 1 million households, will need to convert to a low-carbon heating system by 2030 to ensure interim statutory targets are met.³ Home working has increased during the Covid-19 pandemic and could continue at higher rates long into the future. This would further increase the importance of improving the energy efficiency of people's homes, another key Scottish policy objective (targets are to reduce the energy requirements of domestic homes by 15% by 2032)³. In making the transition to low-carbon heating, it is also imperative to ensure no household is left behind and that any measures and policies put in place support Scotland's statutory target of having no more than 5% of households in fuel poverty by 2040⁴.

Heat as a Service (HaaS) is a term which covers a range of services, with no widely agreed definition. Currently, most people in Scotland pay for heating by purchasing, installing and maintaining the equipment required to heat their home (e.g. a gas boiler and radiators or electric storage heaters), then pay in kWh for the energy they use in order to achieve the outcome of a warm home (i.e. the gas they burn or the electricity used by their heaters). HaaS helps people achieve the same end goal - a warm home – but in a variety of different ways. These include services which provide or enable finance to purchase and install the heating equipment, maintenance of heating equipment, energy efficiency upgrades of building fabric, paying for the amount of heat delivered to the home, paying for the temperature the home is heated to, paying flat-rate tariffs for the home to be heated, or a combination of these. The general approach has huge potential as a route to meeting Scotland's targets for net zero and fuel poverty. The energy sector has explored various options in the past, but to date there is not much evidence on what has been tried, or how effective it has been in delivering substantial emissions reductions. The limited evidence there is suggests that some HaaS offers have potential to:

- help get Scotland to net zero by accelerating the uptake of low-carbon heating systems and improving energy efficiency across the domestic energy market;
- improve outcomes for consumers, especially the more vulnerable, by helping target financial support and providing better cost certainty; and
- support businesses in developing new, sustainable, business models and creating new jobs.

¹ <https://www.legislation.gov.uk/asp/2019/15/enacted>

² 'Scottish House Condition Survey: 2017 Key Findings - Gov.Scot', accessed 1 December 2020, <https://www.gov.scot/publications/scottish-house-condition-survey-2017-key-findings/pages/4/>.

³ Securing a green recovery on a path to net zero: climate change plan 2018–2032 - update, <https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/>.

⁴ <https://www.gov.scot/policies/home-energy-and-fuel-poverty/fuel-poverty/>

How do you define Heat as a Service?

There is no single or agreed definition of HaaS. It often has different meanings for different stakeholders and purposes.

Often the consumer is not considered when defining HaaS. This report defines HaaS as **“helping people achieve the same end goal - a warm home - in a variety of different ways.** These ways can include services which **provide or enable finance to purchase and install the heating equipment, maintenance of heating equipment, energy efficiency upgrades** of building fabric, **paying for the amount of heat** delivered to the home, **paying for the temperature the home is heated to, paying flat-rate tariffs** for the home to be heated, **or a combination of these.”**

This report reviews the evidence of how the market has explored domestic HaaS, in terms of the kinds of services and offers that have been tried, and what remains to be done to progress it further in Scotland. We will begin by outlining our objectives and describing the methodology we employed. We will then give an overview of existing business models and how these currently address the government’s challenges. Then, we outline the potential benefits of the different models, and discuss how HaaS could play a role in enabling consumers to move forward in the transition to low-carbon heating. After this, we present the current challenges and barriers to delivering HaaS and finally conclude with some recommendations for the Scottish Government.

2.2 Objectives

This report has been prepared by Energy Systems Catapult (ESC) on behalf of ClimateXChange to address research questions posed by the Scottish Government.

These questions were:

- What HaaS business models exist, which could work in Scotland, and how are tariffs set?
- How large are HaaS companies, how are they financed, and how are they regulated?
- What do consumers think of HaaS and how does experience with it change their view?
- What drives or prevents consumers from taking up HaaS?
- What are the practical benefits and limitations of HaaS for consumers, suppliers, and installers?
- How ready is the market to deliver HaaS in Scotland?

2.3 Gathering evidence

Four approaches were used to gather evidence.

1. A call for evidence (see Appendix 1) was issued to relevant contacts of and subscribers to ESC. This call was also published in the ESC newsletter, on the ESC website, and was shared on LinkedIn and Twitter by the ESC and individuals within its network.
2. A structured search was run via a database to identify relevant company reports, blog articles (to gain insight into business models and thinking – opinion pieces

were not included), journal articles, conference proceedings and other papers. Details of search terms can be found in Appendix 2.

3. Nine experts were interviewed by members of the project team. They were selected to represent a range of organisations (including energy suppliers, businesses, consumer organisations and academics – see Table 1) that either have been exploring the HaaS concept, or would be instrumental in delivering HaaS in the future. They included a combination of existing contacts of Energy Systems Catapult or the Scottish Government, and organisations that responded to our Call for Evidence. These experts were asked to share their views and current plans in relation to HaaS and the research questions.
4. A workshop was run in conjunction with OVO and the Scottish Government attended by circa 50 experts from across the energy sector on the topic of routes to decarbonisation in Scotland, during which HaaS was explored as an option. The views expressed during the workshop very much mirrored the findings we have reported in the document and the testimony of the expert interviewees. Important points raised during the workshop that were relevant and not already covered were added to the report.

Table 1: List of companies which participated in expert interviews

Organisation	Sector
Ofgem	GB Energy Regulator
Citizens Advice	Consumer charity
Locogen Consulting Ltd	Energy development consultancy
OVO	Supplier
SSE-Enterprise	District Heat owner / operator
Connected Response	Digital heating system platform
University of Leeds	Academic
Danish Energy Agency	International
BEAMA	Industry body

Assessing evidence

The call for evidence and structured search resulted in the identification of 52 pieces of evidence which were assessed for quality and relevance to the research questions. To establish confidence that assessments were consistent, a calibration activity was included: another ESC researcher also assessed six randomly-selected items and results were compared. Assessment criteria can be found in Appendix 2, and the outcomes of the calibration activity can be found in Appendix 3.

Available evidence

Forty-nine pieces of evidence were reviewed in compiling this report, with three rejected as part of the calibration activity (not relevant to research question or full text unavailable). Very little of it was specific to Scotland: we included evidence from the UK as a whole and, where relevant, abroad. Where possible, learnings specific to Scotland have been highlighted. Additional sources were referred to as necessary in the report and are referenced in the document.

Findings from the workshop are reported where relevant throughout. A spreadsheet identifying reviewed evidence can be found in Appendix 3.

3 Existing Heat as a Service business models

3.1 Overview of existing HaaS business models

“As-a-service” business models have become increasingly popular, particularly in the manufacturing and construction industry⁵. Key examples include Rolls-Royce’s TotalCare services and Caterpillar’s service-based business model. With TotalCare, Rolls-Royce provide advanced aero-engine service packages based on how the aircraft flies. Caterpillar has intelligent servicing products for its machinery and tyres on heavy plant that enables asset costs to be spread over time whilst guaranteeing performance.

By reviewing existing literature, carrying out interviews, and drawing on the team’s existing knowledge, we were able to draw out some of the best available information on HaaS business models. It is important to realise, however, that organisations will rarely share the details behind their existing, or future, business models due to commercial sensitivity. Most organisations have also not decided on their energy as a service strategy and may not want to reveal their learnings to date. Nevertheless, it is apparent that existing energy as a service business models are often associated with subscription-based services that are seen in other industries such as consumer mobile phone contracts, or car leasing.

Delta-EE has developed a framework outlining a definition of HaaS⁶. It emphasises the role that a service provider plays in delivering HaaS, and the risks that they may need to manage in doing so. Reflecting on the consumer role is often important to focus the business model on customer needs.

⁵ Howard Lightfoot, Tim Baines, and Palie Smart, ‘The Servitization of Manufacturing: A Systematic Literature Review of Interdependent Trends’, *International Journal of Operations & Production Management* 33, no. 11–12 (11 October 2013): 1408–34, <https://doi.org/10.1108/IJOPM-07-2010-0196>.

⁶ Roxanne Pieterse, ‘Defining Heat as a Service’, 10 July 2019, <https://www.delta-ee.com/delta-ee-blog/defining-heat-as-a-service.html>.

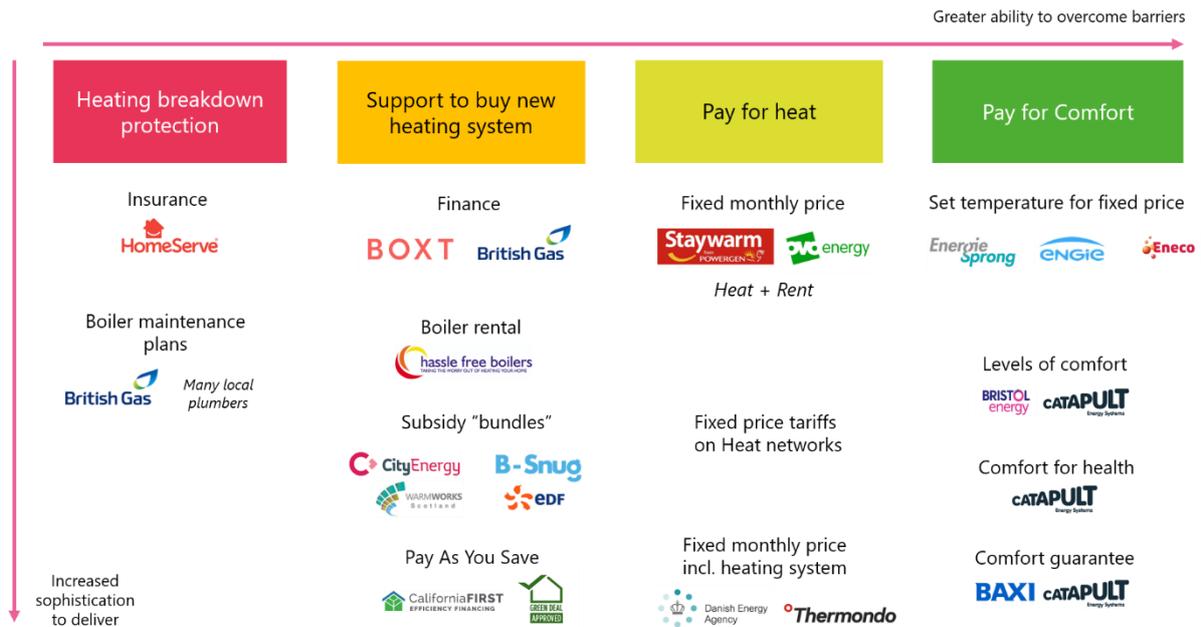


Figure 1: A range of example international HaaS models currently or previously available on the market, categorised into different consumer offers

Figure 1 summarises a selection of existing energy as a service business models positioned against a range of customer propositions. The range varies from providing reassurance on a heating system working, to guaranteeing a level of comfort.

Protection from heating system breakdown

This is a typically “mass-market” range of consumer propositions that provide customers with reassurance that their heating system will be fixed if it breaks down, so they have heating when they need it. It is an insurance product that helps the customer avoid any unexpected costs of parts and labour. Organisations that offer these services include HomeServe, Domestic and General, British Gas and others. Local central heating engineers often also provide heating service plans to spread the cost of annual servicing.

There are some more novel heating services available using connected boilers, such as British Gas’s IQ or Tado’s Care and Protect products that inform customers if there is a boiler problem and tells engineers what the likely issue is. This provides the customer with more reassurance, and the service provider with more efficient servicing operations.

Spreading the cost of a new heating system

Some consumers struggle to pay for the costs of a new boiler or heating system. Financing and loans can help overcome this. It is becomingly increasingly quick and easy to secure financing for a new gas boiler. BOXT, for example, can give consumers a fixed price quote for a boiler plus finance within a few minutes.

Low-carbon heating is currently more expensive than the typical gas or fossil alternatives. To bridge the gap, it is further supported by subsidies. The UK has distributed over £600m since 2014 on domestic Renewable Heat Incentive (RHI)

payments⁷ to help bridge the gap between the cost of fossil fuel and low-carbon heating systems.

Some recent and more innovative providers are covering most of the cost of the heating system and controls, and receiving RHI payments themselves (e.g. EDF's FutureHeat⁸ and Shell Energy's B-Snug⁹). The customer agrees to pay an upfront fee of up to £500, signs a seven-year contract to use the system, and pays an ongoing "subscription" of up to £200 per year. Such schemes are designed for off-gas homes where the RHI payments are highest and the supplier has the greatest likelihood of recovering heating system costs. Early feedback has indicated that consumers have struggled with the complexity of the contract and obligations set on them by the Renewable Energy Consumer Code (RECC).

Other models related to home retrofit include "Pay As You Save", where the customer's new energy efficiency improvements are paid for by the savings they achieve over time, or the deep-retrofit of EnergieSprong models in Social Housing (further detail below).

Paying for heat

Some HaaS business models "charge" the customer fixed prices, whether they are "flat rate" (i.e. same price regardless of consumption) or based on units of heat used. These models are arguably some of the closest to providing customers with comfort. E.ON (formally Powergen) offered homeowners over the age of 60 a fixed monthly price for their gas and electricity depending on the size of their house. This tariff, "Staywarm" was a truly "unlimited" energy tariff, designed to help more vulnerable consumers stay warm without worrying about the cost. It attracted over a quarter of a million customers but was gradually phased out¹⁰.

These fixed-price-for energy models have further developed in the market to include new heating systems. Thermondo – a primarily digitally based heating system installer, now includes a new heating system "on subscription" with a single fixed monthly price over a long term contract (e.g. 10 years). The monthly price includes "renting" the heating system and all servicing. The monthly price also includes heat, although the customer actually pays for the amount of heat they use (measured in kWh) as the payments vs consumption is reconciled at the end of each year (much like a standard direct debit for energy).

Pay for comfort

There are a select number of more advanced business models that provide the customer with a level of comfort for a price.

One way this is currently being achieved is through a version of an Energy Performance Contract, primarily with the social housing market. The business model that pioneered this approach, called Energiesprong, originated in the Netherlands. The Energiesprong market development team work with contractors and social housing providers across Europe to implement the model. ENGIE have worked with Energiesprong to apply this to the UK in their ENGIE Zero service¹¹. The model is based on a provider, like ENGIE, taking on a long-term contract in a social housing community. They will pay for and carry

⁷ 'Public Reports and Data: Domestic RHI', Ofgem, 7 June 2016, <https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/contacts-guidance-and-resources/public-reports-and-data-domestic-rhi>.

⁸ 'Hybrid Heat Pump | Upgrade Your Oil or LPG System', EDF, accessed 21 January 2021, <https://www.edfenergy.com/heating/electric/hybrid-heat-pump>.

⁹ 'Smart Efficient Hybrid Heating Solution | B-Snug', B-Snug Smart Heating, accessed 21 January 2021, <https://www.b-snug.com>.

¹⁰ We have not received permission to share the reasons for its withdrawal

¹¹ 'ENGIE Zero', accessed 16 November 2020, <https://www.engie.co.uk/places/engie-zero/>.

out “deep-retrofit” of these households. It can include a full house refurbishment often with insulation, new low-carbon heating with full system replacements and improved controls. The householder will typically continue to pay for the energy they use, with the supplier of their choice. The improved building fabric will be guaranteeing them a temperature range that they find comfortable, and the smart controls help them achieve this. Sometimes the social housing provider may pay for the energy used by tenants, and a flat rate energy cost is included in the tenants’ rent. We are not aware of these flat rates being linked to the level of comfort (or energy consumption) of each household, however.

The ESC, through the primarily UK Government (BEIS) funded Smart Systems and Heat Programme, developed and demonstrated Heat as a Service where customers bought comfort rather than commodity. They developed Heat Plans, using Warm Hours rather than kWh ([see video here](#)¹²). These Heat Plans were designed and delivered using smart heating controls in the ESC’s “Living Lab” of 100 homes across England. There are probably many ways that a “Comfort as a Service” contract could be designed, but the ESC’s approach seems to be one of the few that have been publicly demonstrated.

Bristol Energy collaborated with the ESC to successfully switch Living Lab participants to the Bristol Energy Heat Plan energy tariff. In a Heat Plan, a customer can buy an allowance of Warm Hours per week, and each Warm Hour is a fixed price. If a customer is warmer than they have typically wanted to be in the past, or want to heat more of their home than usual, then they may be charged more. If they exceed their allowance each week they also pay for each Warm Hour over their allowance. Customers were very positive about the price certainty that Warm Hours provided.

3.2 Case studies

As described above, many different services have been tried that could be considered HaaS by the current broad definition, each with different benefits to the consumer, underlying business cases and subsequent implications for net zero. They also differ in their applicability to Scotland. We present three case studies, informed by our expert interviews and evidence review, of existing HaaS offers from Europe and the UK that provide insight into possible approaches to HaaS and net zero for Scotland.

3.2.1 Case Study 1: Danish heat pump support scheme

Description

The Danish Energy Agency introduced a subsidy scheme to encourage uptake of heat pumps primarily in oil heated homes^{13 14}. Energy service providers finance, install, operate and maintain the Heat Pump. The consumer also pays fixed prices for the heat pump, installation and maintenance and for the amount of energy they use. This scheme aims to drive the uptake of heat pumps in areas where district heating is not available and to help home owners without the financial means to invest in a heat pump.

The Danish Energy Agency has built on the experiences of businesses who first introduced this approach in 2016. First, it analysed the market and evaluated different business models operating. Then it ran an open tender to commission five companies to

¹² <https://youtu.be/Em9dkeHF3EI>

¹³ ‘Executive order on subsidies for new business concepts for heat pumps’, June 2016, <https://www.retsinformation.dk/eli/ta/2016/807>.

¹⁴ ‘Support for New Business Concept for Heat Pumps’, Energistyrelsen, 2 September 2016, <https://ens.dk/ansvarsomraader/energibesparelser/varme-og-ventilation/stoette-til-nyt-forretningskoncept>.

deliver the scheme. One company did not want to continue after the tender so the four winning companies were: Best Green¹⁵, Fyrfyret¹⁶, OK amba¹⁷, and Sustain Solutions¹⁸.

Each company will receive up to 5m Danish Krone (i.e. 20m Danish Krone in total, or £600,000 each and £2.4m in total) towards the cost of delivering the scheme to c.350 consumers over four years (i.e. 1400 consumers in total). This support will be 'front loaded', companies will receive more support for the first customers to help with set up costs (e.g. creating a tariff, marketing, defining contracts, setting up offices, recruitment).

Business model

Customers pay an up-front fee for the installation of the heat pump, then a fixed price per MWh of heat delivered and a fixed annual payment to the service provider. The minimum subscription is 10 years. The Danish Energy Agency defined the pricing structure. Energy service providers are free to adjust each of these three prices, depending on their business model. The intention is to encourage market competition. Businesses who can install, operate, and maintain the heat pump most efficiently will be able to offer consumers the lowest prices.

Relevance to HaaS

Customers pay a fixed price for kWh of heat output by the heat pump, not for the kWh of electricity the heat pump consumes. They also pay fixed annual prices to repay for the heat pump, installation and any maintenance costs. Some energy service providers (e.g. OK) offer consumers a fixed monthly rate including all these costs.

The scheme is not designed to improve the energy efficiency of buildings or to help consumers afford their heating bills. However, energy service providers are responsible for assessing whether homes are suitable for heat pumps before installing them.

Lessons learned

The Danish Energy Agency is closely monitoring progress. It meets the companies delivering the scheme every six months to review progress. There have already been three benefits of the scheme:

1. More heat pumps have been installed than would have been without the scheme;
2. The scheme offers households a new way of installing a heat pump, complementing the other two options of buying or leasing a heat pump;
3. The companies say they would not have offered a subscription scheme without the public subsidy (which provided some financial assistance and risk assurance for the service companies to set up and launch the concept).

There are also early signs that the market is forming. Businesses have taken different approaches to pricing their offers. Some providers have standard prices on their website for all homes, others create bespoke quotes for individual consumers.

Consumers like the convenience of the scheme, needing to work with only one third party provider (for example not having one company remove their existing system and another to install the heat pump). So far, heat pumps have predominantly replaced oil boilers. This could be because electric heat pumps in Denmark are typically cheaper to run than oil boilers, even though the unit rates for heat through this HaaS scheme is set higher than other heat pump installations. It is worth noting that in Denmark the tax on electricity for heating is set to fall but the tax on oil planned to rise. Denmark also has an

¹⁵ <https://www.bestgreen.dk/>

¹⁶ <https://www.fyrfyret.dk/>

¹⁷ <https://www.ok.dk/privat/produkter/varmepumper/naervarme>

¹⁸ <http://www.sustainsolutions.dk/naervarme/>

interesting policy to set a lower unit price for the electricity used for heat than other electricity used at home.

However, the scheme is still in its early stages. More lessons will emerge over time.

Relevance to Scotland

This scheme is the first example of a government supporting the roll out of Heat as a Service to decarbonise heat. It is one of a large range of other measures in place to decarbonise heating in Denmark. These include:

- subsidies to invest or connect to low-carbon heat sources;
- regulations to support switching to low-carbon heat sources and prevent switches the other way (the building code is performance based with benefits to low-carbon heating);
- lower tariffs on electricity than fossil fuels;
- energy efficiency schemes to upgrade the thermal fabric of Danish homes;
- a platform supported by the Danish Energy Agency with a list of heat pumps and their properties (COP, noise levels etc.), tested by third parties, alongside their energy efficiency performance;
- a knowledge centre for installers including a website and phone support line; and
- financial support and loans for low-income households.

The Danish Energy Agency runs the scheme. This agency is part of the Ministry for Climate, Energy & Utilities, but is independent and focused on assuring the technical integrity of the scheme.

However, there are also some important differences between Scotland and Denmark:

1. The challenge is larger in Scotland.
Although, Denmark and Scotland have similar numbers of homes (c.2.5m), 85% of Scottish households have gas boilers, compared with <15% in Denmark.
2. Danes may be more familiar with buying heat in MWs as in this version of HaaS.
Around two thirds of Danes already buy their heating in MWs from district heating schemes. Fewer than 5% of Scots have district heating.
3. Public engagement may be raising awareness of heat pumps in Denmark.
Denmark has run many events (180 at the time of writing and rising) around the country to raise public awareness of heat pumps since Autumn 2016.
4. Scottish homes may be less thermally efficient than Danish homes.
Even in Denmark HaaS providers survey the building to confirm if its eligible for the scheme. The Danish Technical Institute estimated that heat pumps were suited to most of the Danish housing stock. Conversely, many Scottish homes will need thermal upgrades (e.g. with insulation) for occupants to become comfortable with heat pumps. This version of HaaS does not aim to solve this challenge. It does not encourage home owners to improve the thermal efficiency of their home so it is ready for a heat pump when their gas or oil boiler breaks. Other versions of HaaS can reveal homes that need thermal upgrades for heat pumps to make occupants comfortable and make these upgrades more appealing.
5. Fuel poverty is a bigger policy objective in Scotland.

Related to the previous point, this version of HaaS is not designed to make sure vulnerable households can afford their heating. Danish households are less likely to have problems paying for the energy they need than Scottish households: in 2012, only 2.6% of Danish homes reported being unable to keep their home warm enough, compared to averages of around 10% in the rest of Europe¹⁹. Scotland reported 25% of homes to be in fuel poverty by its own definition in 2017²⁰.

In Denmark fuel poverty is treated as an issue of poverty, not treated as a separate issue as it is in Scotland. The Danish social security system and energy regulations are designed to try and make sure everyone can afford the energy they need. Low-income pensioners are eligible to receive around £2,150 a year in assistance for energy expenses²¹. Scotland does, of course, have schemes in place to support those in fuel poverty (Energy Efficient Scotland / Warmer Homes Scotland) but these are mainly targeted under the definition of fuel poverty, unlike in Denmark.

3.2.2 Case Study 2: Smart storage heating and HaaS

Description

Connected Response is a Scottish company developing a range of new products and services in the energy sector around real time control and cloud connectivity. It is retrofitting existing storage heaters to provide a more commercially viable “Heat with Rent” offer. Previously, storage heaters have failed to deliver good control over comfort levels to customers and are often expensive²² but the addition of smart controls and the option to charge multiple times a day (rather than the original once overnight) has been shown to greatly increase the comfort output possible with existing storage heaters.

Not all social housing providers want to adopt a “Heat with Rent” model because of the risks around the high costs of energy as tenants often struggle to be comfortable for a reasonable energy cost. However, the Connected Response platform improves customer control and comfort, with the option of taking advantage of the cheapest energy price throughout the day. In turn, this can mean a more commercially viable heat with rent offer, and / or help improve tenant heating experiences for the same or lower energy costs (if the tenant pays their own energy bills). Connected Response is currently working with Westminster City Council, Kensington & Chelsea and rolling out in Glasgow. The Connected Response controls and sensors can be retrofitted to existing storage heaters, which the social housing provider will typically pay for as part of its asset maintenance and improvement programmes. Homeowners could also pay for the upgrades, although Connected Response is focusing on the social housing market to begin with.

OVO Smart Heat offer²³. OVO is a UK-based energy supplier with a stated aim of striving to reach zero carbon with its members. Its smart heat offer is centred around smart storage heaters, fully controllable via an app to allow zoning, scheduling and temperature control. Hardware and installation is offered to customers via a discounted 12-month finance offer coupled with a simple (Economy 7) time-of-use tariff and

¹⁹ Eurostat 2014 In: Sam Neiro, ‘Energy Poverty in Denmark?’, EU Energy Poverty Observatory, 17 January 2018, <https://www.energypovetry.eu/news/energy-poverty-denmark>.

²⁰ ‘No Real Change in Fuel Poverty in 2017 - Gov.Scot’, accessed 30 November 2020, <https://www.gov.scot/news/no-real-change-in-fuel-poverty-in-2017/>.

²¹ Neiro, ‘Energy Poverty in Denmark?’

²² Lightfoot, Baines, and Smart, ‘The Servitization of Manufacturing’.

²³ OVO, ‘Smart Home Heat’, accessed 1 December 2020, <https://www.ovoenergy.com/smart-home-heat>.

intelligent heat optimisation/control. Compared to a standard storage heater system, these heaters can cost customers up to 23% less to run per year. OVO offers this service in conjunction with partners and heating system manufacturers Glen Dimplex.

Relevance to Haas

Connected Response is currently installing these systems in social housing where the heat is included with rent. In the future, the intention is to provide more customised heat/guaranteed outcome offers to customers and charge them individually. Whilst its immediate plan is to charge based on the energy consumed to reach these outcomes, it is aware of some of the issues around fairness in this model, especially in social housing. One suggestion is to charge a standard tariff with reductions for energy efficiency or reduced energy use.

Relevance to Scotland

Approximately 12% or 300,000 homes in Scotland are heated by electricity, mostly by electric storage heater²⁴. Upgrading these heaters could improve comfort levels, and reduce costs for residents. Upgrading existing storage heaters to those that have better controls could lower energy costs and provide more access to renewable power, and is seen favourably by social housing providers.

Potential

Storage heaters offer an alternative form of electrification of heat, to be considered alongside heat pump options. In addition, smart electric heater users could take advantage of flexibility services to achieve greater cost and carbon savings. However, a rethinking of current energy sector regulation would be required to enable this: current regulations limit flexibility and do not allow the customer to be rewarded for making intelligent use of off-peak and low-carbon electricity.

3.2.3 Case Study 3: Comfort as a Service based on Energiesprong model

Description

Energiesprong – or ‘energy leap’ in Dutch – is a model which involves a deep retrofit of domestic properties to make them highly energy efficient. Originating in the Netherlands, it has helped enable over 1,800 deep retrofit properties²⁵. Energiesprong as an organisation acts as an intermediary, working with other housing associations and contractors to deliver the model.

It is based on a “Managed Energy Services Agreements” (MESA) model where the provider typically takes on the energy supply contract of the end customer. This will happen after completing a range of energy efficiency improvements including external solid wall insulation, low-carbon heating, electricity generation and storage, and other measures. Key commercial enablers for the model include:

- the long-term duration of the MESA contract – up to 30 years. This provides revenue certainty for the provider.
- reduced energy supply cost, and the variation of supply cost, because of the high energy performance of the new building.

²⁴ ‘Scottish House Condition Survey: 2019 Key Findings - Gov.Scot’, accessed 21 January 2021, <https://www.gov.scot/publications/scottish-house-condition-survey-2019-key-findings/>.

²⁵ Donal Brown, ‘Business Models for Residential Retrofit in the UK: A Critical Assessment of Five Key Archetypes’, *Energy Efficiency* 11, no. 6 (1 August 2018): 1497–1517, <https://doi.org/10.1007/s12053-018-9629-5>.

Relevance to HaaS

The Energiesprong approach promotes its focus on delivering guaranteed comfort outcomes for residents (e.g. 21°C). Residents can pay a fixed price for this comfort to the MESA provider, which is sometimes included in their social housing rental fees if relevant.

The provider can decide whether to include fair usage limits on the agreed comfort level, or what that comfort level can be.

Lessons learned

The “deep retrofit first” approach from Energiesprong and other MESA retrofit models provides better commercial confidence of the comfort guarantee. One of the challenges of this model may be how well it can be applied to the private homeowner market. The social housing market has much greater control over housing stock and asset maintenance. It can deliver the upgrades in a cluster at one time, and is able to commit to a long-term contract with the service provider.

Relevance to Scotland

The Energiesprong model would be well suited to Scotland, although there is a slightly higher proportion of flats than houses in the social housing sector compared to England²⁶. As the Energiesprong model is typically suited to terraced and semi-detached households, due to the current availability of deep retrofit fabric and technology solutions, it may be less suited to Scotland. However, Energiesprong in Europe has recently been developing a delivery model for apartments²⁷.

3.3 How are existing Heat as a Service Models being delivered?

3.3.1 How HaaS tariffs are set

An energy supply licence currently requires suppliers to bill for units of energy used by customers. This requirement could discourage energy suppliers from offering more novel HaaS tariffs, although suppliers can apply for a derogation where the supplier can demonstrate that certain regulation results in inefficient or negative outcomes. As outlined in Section 2, however, some suppliers are offering “flat rate” energy tariffs for heat – for example, some district heating providers, “unlimited” energy tariffs (E.ON Staywarm) and some social landlords providing “Heat with Rent”.

These alternative billing approaches are typically priced based on simple assumptions (e.g. building size, building fabric or occupant number). The provider may take the risk on the cost to serve each consumer, and it is often hard to control that risk. Our evidence review does not indicate that consumers in the Energiesprong model, for example, have a clear penalty on exceeding a 21°C temperature “limit”. In other markets, for example, the mobile market, consumers are typically aware of a limit to their flat rate, beyond which further charges would apply. This helps to manage the risk of the cost to serve these customers. Existing billing regulations may prevent this approach from happening because it is not yet clear within the regulations how different tariff rates can be applied to different usage amounts.

²⁶ ‘Social Tenants in Scotland 2017’, accessed 16 November 2020, <https://www.gov.scot/publications/social-tenants-scotland-2017/pages/4/>.

²⁷ ‘Energiesprong Starts Innovation Project for Apartment Buildings – Energiesprong’, accessed 21 January 2021, <https://energiesprong.org/energiesprong-starts-innovation-project-for-apartment-buildings/>.

The Energy Systems Catapult's HaaS model (Heat Plans) did start to introduce different charges outside of a comfort allowance – “Extra Warm Hours” – for when customers exceeded the number of Warm Hours used in a week.

The ESC, through its demonstration of HaaS, suggests there are at least two ways to set a price for a comfort-based HaaS contract:

1) Using data from smart controls and energy metering. Data algorithms and analysis can help to calculate the cost of heating for each home. Smart controls can also help the customer understand how they like to be warm. It can also help them make choices on how much to spend for the level of comfort they like²⁸.

2) Using models to estimate the cost to serve for certain types of building and how people in them like to be warm. At scale, this can be considered similar to the way in which insurance companies set the price for their premiums. Models such as the Energy Systems Catapult Home Energy Dynamics tool²⁹ can do this, or the National Energy Foundation³⁰ and other dynamic building physics tools.

These can then be used to price a HaaS after further assumptions have been made about any commercial and risk margins the provider wants to apply.

3.3.2 Financing

HaaS offers are financed in a variety of ways. From our review, the following broad categories exist:

Private finance agreements

This can include consumer financing of new boiler and heating systems, and re-mortgaging to release capital, including specific green mortgages³¹.

UK Government funding

There is a variety of subsidies available focused on technologies, including the existing Renewable Heat Incentive (RHI), Green Homes Grant (England only) and others including ECO and Smart Export Guarantee. The RHI can be assigned to the provider to make the proposition more attractive to the consumer by reducing upfront cost. EDF's Future Heat, Shell Energy's B-Snug and the Energiesprong models, amongst others, do this.

Provider capital

Some HaaS providers use their own capital to reduce the upfront cost for the consumer, but tie the consumer into long-term contracts to recover this capital. Thermondo in Germany applies this model in its own right, but many others combine provider capital with government funding, for example EDF's Future Heat, Energiesprong and the Danish Scrappage Scheme.

When exploring stakeholders' expected financing requirements for HaaS in this evidence review, it was clear the finance industry could play a helpful role in delivering HaaS. It is likely that a combination of financing models will continue to be needed. One key consumer blocker that stakeholders were aware of was the current need to lock

²⁸ ESC, 'SSH2: Industry Insight - The Delight of Better Control', 2019, <https://es.catapult.org.uk/reports/the-delight-of-better-control/>.

²⁹ ESC, 'Home Energy Dynamics Could Revolutionise Low Carbon Heating Design', *Energy Systems Catapult* (blog), 2019, <https://es.catapult.org.uk/news/data-could-revolutionise-low-carbon-heating-solution-design/>.

³⁰ NEF, 'Building Physics and Modelling Services - National Energy Foundation', 2020, <http://www.nef.org.uk/service/new-builds/analysis-compliance/building-physics-modelling>.

³¹ World Green Building Council, 'Green Mortgages', World Green Building Council, accessed 16 November 2020, <https://www.worldgbc.org/green-mortgages>.

consumers in to long-term contracts. For consumers to adopt HaaS in the future, choice of service will be important. Some regulation changes might be needed, for example, consumers may need to change the provider of their service level agreement, but not the financing agreement.

3.3.3 Regulations

Current HaaS models are being delivered in accordance with existing regulations, though none specifically cover HaaS.

UK relevant regulations

In the UK, relevant regulations cover electricity and gas supply and their billing, supplier regulations, parts of the Consumer Protection Act, and financial regulations (where finance is offered as part of the service). Where homes are rented, additional landlord/tenant regulations exist. However, when we interviewed Ofgem's Innovation Link, about Ofgem regulating mainly through issuing licences for activities such as supply, generation, distribution, etc. (which all have a definition in law), we were told that Ofgem believes most HaaS business models they are aware of would not fall under any of these licensable activities.

Heat networks

Heat Networks deliver heat rather than energy and thus do not need to comply with the same electricity and gas supply regulations as other heat supplies. Currently, there are no specific regulations for heat networks, although they can voluntarily conform to Heat Trust scheme rules that are designed to protect the consumer and the suppliers^{32 33}. This will change with the forthcoming Heat Networks regulation, at Stage 3 in the Scottish Parliament³⁴ at the time of writing. In November 2020 new billing regulations³⁵ came into force which require final consumption meters to be installed and for billing to be based on consumption where this is technically feasible and cost-effective to do so. Bills are required to be in kWhs.

Comfort standards

In some countries, indoor comfort standards exist e.g. Spain's IEQ, which measures how well a building meets the comfort requirements of the occupants in terms of health, well-being and productivity. This takes into account parameters such as thermal comfort quality, air quality, odour quality, quality of light, sound, and vibration and have been proposed as measures that could be used as targets for HaaS offers in that country³⁶. These are to some extent covered by UK Building Standards, which apply to new builds or when changes are made to a building, and are measured mostly in terms of technical standards (e.g. levels of air tightness and insulation) rather than occupant experience. Exceptions are voluntary standards that some buildings adhere to (e.g. the passivhaus

³² CMA, 'Heat Networks Market Study', 2018, <https://www.gov.uk/cma-cases/heat-networks-market-study>.

³³ 'Heat Trust', accessed 16 November 2020, <https://heattrust.org/>.

³⁴ 'Stage 1 Report on the Heat Networks (Scotland) Bill', Scottish Parliament Reports, accessed 21 January 2021, <https://digitalpublications.parliament.scot/Committees/Report/EEFW/2020/11/17/Stage-1-Report-on-the-Heat-Networks--Scotland--Bill>.

³⁵ 'The Heat Network (Metering and Billing) (Amendment) Regulations 2020' (Queen's Printer of Acts of Parliament), accessed 21 January 2021, <https://www.legislation.gov.uk/ukxi/2020/1221/contents/made>.

³⁶ Juan Gómez-Romero et al., 'Comfort as a Service: A New Paradigm for Residential Environmental Quality Control', *Sustainability* 10, no. 9 (September 2018): 3053, <https://doi.org/10.3390/su10093053>.

standards)³⁷, which specifies thermal comfort. Sound regulations also apply: where heat-pumps are installed in outdoor spaces within a certain distance of neighbouring properties, planning permission is required if noise exceeds a particular level.

4 The potential of HaaS

4.1 People are not installing low-carbon heating

Growing concern about climate change amongst Scottish consumers is not translating into a quick enough uptake of low-carbon heating to enable Scotland to reach its net-zero targets³⁸. Citizens Advice Scotland reported that, when asked in 2018 in a YouGov poll, 73% of Scottish consumers said they felt climate change needed to be addressed now, yet very few Scottish citizens linked reducing their household energy consumption to reducing climate change³⁹. A gas boiler is still the default choice for most consumers⁴⁰, and in the same year 93% of Scottish consumers (similar numbers to the rest of GB) said they expected to replace their current boiler with a gas boiler when it required replacing⁴⁰. Given the average life of a gas boiler is 10-15 years⁴¹, people installing gas boilers today will not be expecting to change these until after 2030-35. Clearly, rapid action is required to address this situation and support consumers in switching to low-carbon heating sooner rather than later.

Those who do not have low-carbon heating tend to perceive drawbacks and few, if any, benefits to switching. A main concern is up-front cost, with 60% of Scottish owner-occupiers who are aware of renewable heating thinking these systems would be expensive to install, and a further 35% being unsure of how much it would cost⁴² (see Table 2 for an example of the costs of installing and running a heat pump in comparison to a gas boiler). Financial support schemes do increase switching to low-carbon heating but they are not enough to encourage everyone to switch⁴³. Loans which could help address upfront costs are not appealing to those not willing to get into debt⁴⁴. For example, householders in Orkney and Fife were found to prefer to use grant support or their own savings rather than get into debt⁴⁵. Grant support may be appealing as long as

³⁷ <https://www.passivhaustrust.org.uk>

³⁸ Danica Caiger-Smith and Amal Anaam, 'Public Awareness of and Attitudes to Low-Carbon Heating Technologies: An Evidence Review', Technical Report (Catapult Energy Systems, October 2020), <https://doi.org/10.7488/era/724>.

³⁹ 'Changing Behaviour in a Changing Climate', Citizens Advice Scotland, accessed 21 January 2021, <https://www.cas.org.uk/publications/changing-behaviour-changing-climate>.

⁴⁰ Caiger-Smith and Anaam, 'Public Awareness of and Attitudes to Low-Carbon Heating Technologies'.

⁴¹ Tyeish Liburd, 'How Long Do Boilers Last? - Living by HomeServe', *Living - Your Home, DIY and Life by HomeServe* (blog), 13 May 2020, <https://www.homeserve.com/uk/living/heating-and-cooling/how-long-do-boilers-last/>.

⁴² Caiger-Smith and Anaam, 'Public Awareness of and Attitudes to Low-Carbon Heating Technologies'.

⁴³ Caiger-Smith and Anaam.

⁴⁴ 'Home Energy Programmes Delivered by Energy Saving Trust in Scotland', *Energy Saving Trust* (blog), accessed 21 January 2021, <https://energysavingtrust.org.uk/report/home-energy-programmes-delivered-by-energy-saving-trust-in-scotland/>.

⁴⁵ Kathryn Gilchrist and Tony Craig, *Home Energy Efficiency-Review of Evidence on Attitudes and Behaviours* (The James Hutton Institute on behalf of ClimateXChange, 2014).

it sufficiently reduces up-front costs⁴⁶. Finally, schemes (e.g. the RHI) can be seen as complex and very difficult to navigate, requiring people to gather lots of information at a time where they may be in a hurry to replace a broken heating system⁴⁷. Support from experts (e.g. schemes such as Universal Home Insulation Scheme (UHIS) where forms

Table 2: Comparison of the annual energy and total lifetime costs of heating a typical UK semi-detached home when using an air source heat pump (ASHP) versus a gas boiler*

Air Source Heat Pump		Gas Boiler
£752	Annual Energy Cost (2020)	£712
£19,800 (£14,047 with RHI)	Lifetime Cost (2016-2030)	£12,414

Comparing the costs of running an ASHP and a gas boiler is difficult as it depends on a number of factors, some of which may change in the future. For example, a levelised effective carbon price would close the gap between the cost of running and ASHP and a gas boiler more than the prices illustrated above (by increasing the cost of running a gas boiler). Time-of-use tariffs and home energy management systems could also reduce the annual cost of running a heat pump. However, without the RHI (due to end March 2021) or other capital cost reductions in technology and insulation, the lifetime costs to the consumer of an ASHP are likely to be higher than current costs of running a gas boiler.

*The costs above assume the homes have a 'normal' level of insulation, the gas boiler (23kWh) has a mean efficiency of 0.92 and the ASHP (6kWh) has a mean seasonal performance factor of 3 (Barnes and Bhagavathy, 2020).

** Figures are from (Sturge and Day, 2020)

Barnes, J. and Bhagavathy, S. (2020). The Economics of Heat Pumps and the (Un)intended Consequences of Government Policy. <https://www.sciencedirect.com/science/article/abs/pii/S0301421519307839>

Sturge, D and Day, G (2020) Accelerating to Net Zero: A sector led approach to an economy-wide carbon policy framework. ESC. <https://es.catapult.org.uk/reports/accelerating-to-net-zero-a-sector-led-approach-to-an-economy-wide-carbon-policy-framework/>

are completed by the surveyors) lead to better customer experience⁴⁸. Package deals that recommend a suitable system to meet funding requirements have been suggested as a way to encourage people to have confidence in opting for renewable heating systems⁴⁹.

Comfort is another key concern for consumers. Many are not confident that low-carbon heating systems will give them the comfort they want or are used to. Without correct installation and sufficient insulation this concern is justified, as low-carbon heat sources

⁴⁶ UK DECC, 'Home Owners' Willingness to Take up More Efficient Heating Systems', 2013, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191541/More_efficient_heating_report_2204.pdf.

⁴⁷ Caiger-Smith and Anaam, 'Public Awareness of and Attitudes to Low-Carbon Heating Technologies'.

⁴⁸ Consumer Focus Scotland In: Caiger-Smith and Anaam.

⁴⁹ J. Richard Snape, Peter John Boait, and R. M. Rylatt, 'Will Domestic Consumers Take up the Renewable Heat Incentive? An Analysis of the Barriers to Heat Pump Adoption Using Agent-Based Modelling', *Energy Policy* 85 (2015): 32–38.

such as heat pumps will not be able to deliver the same level of warmth as a traditional gas boiler⁵⁰.

“We did have a project where we were looking at doing a shared loop ground source heat-pump network... there was a lot of work to overcome any perception problems people have with heat pumps”

Locogen

In response to an advert for a free heat pump, for example, only 9 out of 15,000 people who saw the advert signed up for the offer. The reasons they gave for turning it down were concern about high running costs, not being able to get comfortable, appearance and noise⁵¹. Other issues include a lack of space for technologies such as heat pumps.

Therefore, there is still some way to go to get consumers on board with low-carbon heating, with cost and comfort two of the main barriers to increasing uptake. Below, we explain how HaaS could potentially help Scotland overcome these barriers.

4.2 The path to decarbonisation

The path to decarbonising heat (see Figure 2) involves moving from where we are now, with the majority of domestic heating being provided by gas boilers, to a world where domestic heating is being provided by low-carbon energy. Making this transition requires our homes to be low-carbon ready (e.g. insulated, double glazed etc.) and to be connected to, or have installed, low-carbon heating devices in order that they can be heated by low-carbon energy. For this path to be followed, both consumers and the supply chain have to be both willing and able to take each of these steps along the path, and they have to have a reason for doing so. If they are not willing or able, this will create barriers in the path to decarbonising heat.

⁵⁰ Caiger-Smith and Anaam, ‘Public Awareness of and Attitudes to Low-Carbon Heating Technologies’.

⁵¹ ESC, ‘Decarbonising Heat: Increasing Heat Pump Performance’, 2020, <https://es.catapult.org.uk/reports/decarbonising-heat-understanding-how-to-increase-the-appeal-and-performance-of-heat-pumps/>.

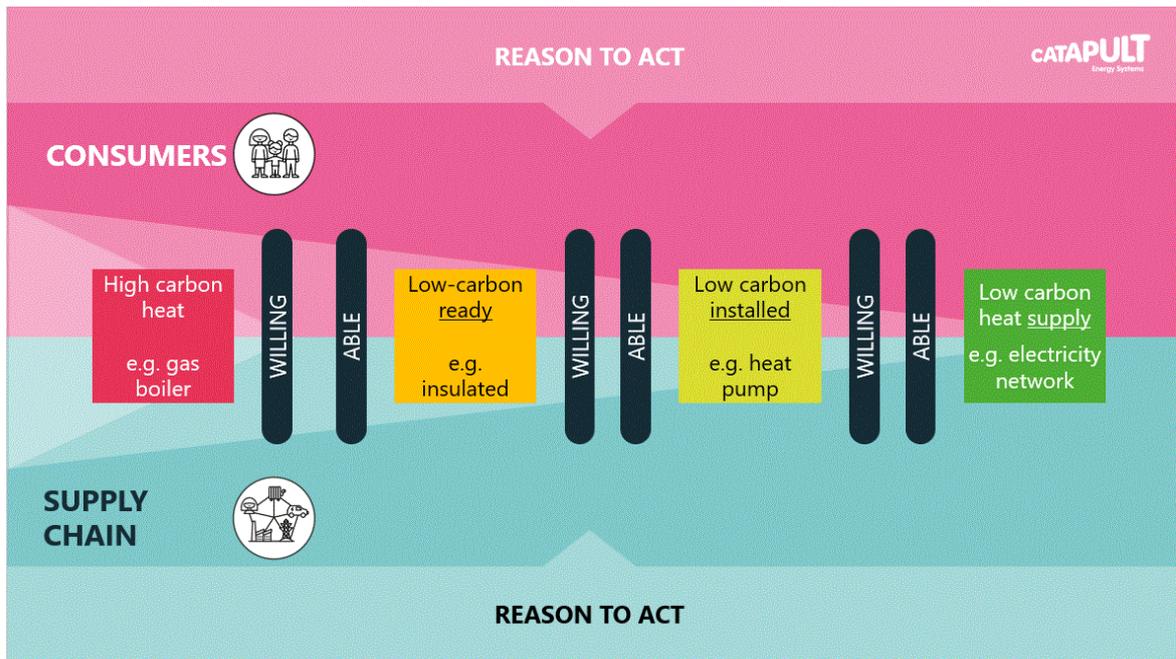


Figure 2: Path to decarbonising heat

Following this path will require a suite of measures, including affordable and accessible energy efficiency measures, information and support to raise consumers' awareness of options and costs, and affordable low-carbon energy and heating technology. HaaS is one way in which some of these steps can be achieved, and barriers can be removed. For example, HaaS models (see Figure 1) which provide support to purchase or rent a new heating system can help overcome the barrier of consumers being *able* to install a low-carbon heating device by helping them spread the costs. However, these models do not address the *willingness* of either parties to install them, or consumers' willingness or ability to prepare their homes.

There is an opportunity here for HaaS, in particular comfort as a service offers, to support more of the steps, and overcome more of the barriers, in this process.

We will explore in more detail these and other potential benefits to businesses and consumers of HaaS in the following sections. In particular, comfort-based models have the potential to:

- support getting to net zero by accelerating the uptake of low-carbon heating systems and improving energy efficiency across the domestic energy market;
- tackle fuel poverty by improving outcomes for consumers, especially the more vulnerable, by targeting supporting, providing better comfort and cost certainty; and
- offer new business opportunities to suppliers, manufacturers and other businesses involved in the energy supply chain.

4.3 Support getting to net-zero carbon emissions

There are two main ways in which HaaS, in particular comfort as a service, could be a route to net-zero carbon emissions: by driving the uptake of low-carbon heating, and by driving the uptake of energy efficiency measures.

Driving the uptake of low-carbon heating

Providing finance offers to make low-carbon heat appliances affordable is one way in which HaaS can enable consumers to transition. However, whilst cost is a major barrier for many, finance offers alone are not enough to persuade people to switch. They do not address the willingness barrier and consumers still remain unsure about whether the low-carbon heating will be able to deliver them the comfort they want at a cost they can afford.

Evidence in support of heat networks as a route to decarbonisation makes the case that whilst the energy source for all networks may not currently be low-carbon, the heat experience for the consumer is independent of the type of energy used to deliver it beyond the impact this has on their cost or comfort. This effectively removes barriers created by consumers being either unable or unwilling to transition to low carbon in the future, putting the onus on the heat network service provider to make this transition⁵². In a similar way, providing a heat or comfort outcome to consumers as part of a service could make them indifferent to the type of energy providing this service, as long as it is giving them the heat or comfort outcome they are looking for at a price they can afford. Consumers have been found to be more open to the idea of switching to a low-carbon heat source if it is packaged as part of a service rather than on its own, and after having experienced a HaaS⁵³.

“It’s exactly the right thing to do because it means that the decision of what type of boiler or heat system you have is driven by something bigger than a home owner rushing around on a Friday night because their boiler has broken down. And that is the reason we have so many boilers in the UK, because at that time, they’re distressed purchases”
BEAMA

“This is the way into low-carbon heat, particularly heat pumps”
(Donal Brown, University of Sussex)

Driving the uptake of home efficiency measures

Another step in the process of reducing carbon emissions associated with heating is to improve the energy efficiency of homes. Thanks to a number of initiatives to promote this, the energy efficiency ratings of Scottish homes have been increasing steadily since 2010, with 33% of homes having an Environmental Impact Rating in band C or better in 2018 and most homes having at least some loft insulation (94% have 100mm) and 59% having wall insulation⁵⁴. However, there is still some way to go to ensure all homes reach required standards, i.e. for all residential properties in Scotland to achieve an Energy Performance Certificate (EPC) rating of at least EPC C by 2040⁵⁵, with a

⁵² ETI, ‘District Heat Networks in the UK: Potential Barriers and Opportunities’ (The ETI, 2018), <https://www.eti.co.uk/>, <https://www.eti.co.uk/insights/district-heat-networks-in-the-uk-potential-barriers-and-opportunities>; Heat network partnership for Scotland, ‘Investment in Heat Networks in Scotland’ (Heat network partnership for Scotland, 2015), <https://www.districtheatingscotland.com/wp-content/uploads/2015/04/Heat-District-Heating-Scottish-heat-network-investment-opportunity-FINAL.pdf>.

⁵³ Caiger-Smith and Anaam, ‘Public Awareness of and Attitudes to Low-Carbon Heating Technologies’.

⁵⁴ ‘Scottish House Condition Survey: 2018 Key Findings - Gov.Scot’, accessed 1 December 2020, <https://www.gov.scot/publications/scottish-house-condition-survey-2018-key-findings/pages/2/>.

⁵⁵ ‘Energy Efficiency: Energy Efficiency in Homes - Gov.Scot’, accessed 21 January 2021, <https://www.gov.scot/policies/energy-efficiency/energy-efficiency-in-homes/>.

target of reducing the energy requirements of domestic homes by 15% by 2032⁵⁶. Also, it may be important to improve the energy efficiency of some homes to make sure low-carbon heating systems deliver the warmth consumers want. Having explored the effectiveness of different ways of incentivising and enabling people to make these changes to their homes, a complete energy or comfort approach (such as HaaS) has been suggested as a more effective way of driving home efficiency improvements than siloed support measures⁵⁷.

4.4 The potential to reduce fuel poverty and support the vulnerable

About 2.5m households in England⁵⁸ and 845,000 in Scotland⁵⁹ live in fuel poverty – broadly meaning they may not be able to afford the energy they need. The UK Government has spent approximately £3bn a year over the past decade trying to alleviate fuel poverty, but it is still a major problem. There is also the additional burden placed on the NHS from those living in cold homes⁶⁰ – reported to be over £1bn/yr⁶¹. Current measures in place in Scotland to tackle fuel poverty include initiatives to improve the energy efficiency of homes in order to reduce the cost to heat them⁶². Some of these initiatives, such as Warmer Homes Scotland, have also started to look at ways to support access to low-carbon heat sources for those in, or at risk of, fuel poverty. They include increased subsidies for people most in need, and targets to commit to building fabric improvements to reduce energy costs. There are also some examples of services designed to offer affordable heating to the most vulnerable, including Staywarm by E.ON, which offered a fixed-price subscription tariff for over-60s, and Budget Warmth by Scottish and Southern which guaranteed one room to be heated in October to March, paid via rent to the Local Authority (though this latter scheme is not considered enough to raise someone out of Fuel Poverty by the standards set by the Scottish Government). There is little evidence, however, to show that these services have brought consumers out of fuel poverty. Even with this additional support and some innovative schemes and services to help alleviate it, fuel poverty is still an ongoing issue. It has proven to be very difficult to find homes which are affected by fuel poverty, and then deliver the solutions to help overcome it.

It has been found that people at risk of fuel poverty do not just want to minimise what they spend, rather they want to be able to manage how much they spend whilst getting the heat they want⁶³. Furthermore, what they want or need from their heating varies as much as it varies for everyone else. Understanding how much it will cost them to get the heat that they need can help them understand what they can afford. Though potentially

⁵⁶ 'Energy Efficient Scotland: Route Map - Gov.Scot'.

⁵⁷ Brown, 'Business Models for Residential Retrofit in the UK'.

⁵⁸ 'Annual Fuel Poverty Statistics Report 2020 (2018 Data)', 2020, 73.

⁵⁹ 'A Scotland without Fuel Poverty Is a Fairer Scotland: Report - Gov.Scot', accessed 21 January 2021, <https://www.gov.scot/publications/scotland-without-fuel-poverty-fairer-scotland-four-steps-achieving-sustainable/pages/2/>.

⁶⁰ 'Local Action on Health Inequalities: Fuel Poverty and Cold Home-Related Health Problems' (Institute of Health Equity, 2014),

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/357409/Review7_Fuel_poverty_health_inequalities.pdf.

⁶¹ 'The Cost of Cold: Why We Need to Protect the Health of Older People in Winter' (Age UK, 2012).

⁶² Scottish Government, 'Home Energy and Fuel Poverty: Fuel Poverty - Gov.Scot', accessed 11 November 2020, <https://www.gov.scot/policies/home-energy-and-fuel-poverty/fuel-poverty/>.

⁶³ ESC, 'Fuel Poverty in a Smart Energy World', 2020, <https://es.catapult.org.uk/reports/fuel-poverty-in-a-smart-energy-world/>.

more difficult to access for some (e.g. older people who may be less familiar with such technologies), smart controls can give people more control over their heating, enabling them to choose which parts of their home to heat, when, and at what temperature⁶⁴. Heat as a Service could simplify people's experience of heating, with fixed price or simpler outcome-based tariffs, giving them more control over their bills.

As outlined in Section 3.1, smart heating controls can be a key enabler to more sophisticated HaaS offers. The data available from these, and similar devices could be used as one way for consumers to get better control of their heat at home, whilst understanding better how much this costs. The Catapult's Heat Plans for example included options for participants to buy "Pay as you Go" Warm Hours. Instead of an allowance of Warm Hours each week, Pay as you Go participants were charged for each Warm Hour they used and could see in real time how much this was costing them.

As well as helping the customer make more informed decisions on their comfort preferences based on cost, data from smart controls is needed to help HaaS providers develop accurate estimates of the cost of warming homes up. This data can be used by businesses, with customer consent, to help target financial support to households at risk of fuel poverty.

4.5 Benefits of energy service business models

Servitisation is a growing trend⁶⁵. It has transformed various sectors, from aerospace to entertainment⁶⁶. Energy as a Service business models also have the potential to transform the energy sector⁶⁷. That is because they could unlock value right across the energy system to consumers, retailers, product manufacturers, installers and networks.

Services could increase consumer's trust in the energy sector, if providers can deliver more value. Consumers might be attracted to service providers, choose to stay with them longer and willing to pay more for a service, than for fuel. Consumers might be willing to sign up to longer service plans giving providers ongoing revenue for longer periods.

Service providers, which can deliver the service using less energy, will be able to offer lower prices, so energy services also reward businesses who use energy efficiently. Businesses who serve many thousands or millions of consumers can afford to invest more in discovering these efficiencies than any individual consumer. For instance, energy service providers may offer their customers more efficient heating systems, or insulation, if this can improve the quality of their service and reduce running costs.

In this way, the energy as a service business model also encourages businesses to form new relationships across the supply chain. Service providers may begin to work more closely with product manufacturers, installers, network operators and network investors.

⁶⁴ ESC, 'Smart Systems and Heat: Phase 1', Energy Systems Catapult, 2017, <https://es.catapult.org.uk/impact/projects/smart-systems-and-heat/smart-systems-and-heat-phase-1/>.

⁶⁵ Lightfoot, Baines, and Smart, 'The Servitization of Manufacturing'; Doroteya Vladimirova, *Made to Serve. How Manufacturers Can Compete through Servitization and Product-Service Systems* (Taylor & Francis, 2015).

⁶⁶ Rolls Royce shifted from selling engines to selling power-by-the-hour <https://www.rolls-royce.com/media/our-stories/discover/2017/totalcare.aspx>. Netflix shifted from renting DVDs to streaming content on demand <https://www.bbc.co.uk/news/newsbeat-42788099>.

⁶⁷ John Batterbee, 'Domestic Energy Services', text/html, The ETI (The ETI, 2018), <https://www.eti.co.uk/>, <https://www.eti.co.uk/insights/domestic-energy-services>.

The level of service consumers buy will reveal their preferences and how much they are willing and able to pay to meet them⁶⁸. For instance, some consumers might be willing to pay more for homes that warmed up more quickly, or for surfaces they could make warm to dry laundry. This information could be used to improve consumers' satisfaction with their heating. For instance, manufacturers could use this information to design more appealing products that consumers would pay more for. They could also use performance data to refine their products to increase consumer satisfaction.

Performance data can also guide continuous improvement for installers. For instance, heating system efficiency could be compared before and after a new heating system was installed, across different installers, or by the same installer across properties. Data about how satisfied consumers were with the qualities of services could help installer training focus on improving aspects of installation that consumers care most about.

Service providers can become a channel to market for new products. For instance, if services include products and maintenance, this reduces upfront costs for consumers and enables them to buy better products⁶⁹. As has been seen in other sectors, the emergence of car leasing and telecoms plans have accelerated uptake of newer models of vehicles and mobile phones.

There may also be operational benefits for network operators. It will become increasingly difficult to match electricity supply with demand as the amount of electricity generated by solar and wind varies with the weather. So called 'demand-side management' could help by using smart controls to use electricity to heat water, warm homes and charge cars when it is available, and store it to use or sell back to the network when it is not.

Consumers are more open to this idea if they are given guarantees they will still get the service outcomes they want (e.g. enough hot water for a shower, enough heating to feel comfortable and enough electric vehicle (EV) battery charge to get to their destination). Energy as a Service business models may be able to give consumers the confidence they will get the outcomes they want from the energy they buy, leaving providers free to provide flexibility to networks when needed.

Further up the supply chain, investors in new networks face the risk that if too few consumers pay to use their network, they will not recover the cost of their investment. For instance, district heat network investors need to supply most nearby homes to function profitably. The energy as a service business model could help in two ways. First, because consumers are paying for an outcome and do not need to care how it is provided, it could give consumers the confidence to switch to the heat network. Second, it could enable network investors to work with service providers representing thousands of consumers in an area. This is likely to be more efficient than the network operator attempting to talk to each consumer about a technical topic they are relatively disinterested in.

Another benefit (and challenge) of the energy as a service business model is that it will require a new, highly skilled work force. Designing and delivering energy services is a more complex task than billing for energy consumption. Similarly, new skills will be needed to take the opportunities the business model creates further up the supply chain. Energy services could create a wave of new jobs just as business model innovations have in other sectors like aviation, automotive, telecoms and supermarkets.

⁶⁸ Benjamin K. Sovacool et al., 'Testing Smarter Control and Feedback with Users: Time, Temperature and Space in Household Heating Preferences and Practices in a Living Laboratory', *Global Environmental Change* 65 (1 November 2020): 102185, <https://doi.org/10.1016/j.gloenvcha.2020.102185>.

⁶⁹ Kathyryne Cleary and Karen Palmer, 'Energy-as-a-Service: A Business Model for Expanding Deployment of Low-Carbon Technologies', 2019, <https://www.rff.org/publications/issue-briefs/energy-service-business-model-expanding-deployment-low-carbon-technologies/>.

Therefore there are a range of potential benefits to business of HaaS models across the whole energy sector, from installers, to suppliers and networks. These models could enable businesses to invest in offering better services and outcomes to consumers whilst increasing efficiency across the sector.

4.6 Mitigating the impact of Covid-19

Covid-19 has led to a situation where people are spending more time in their homes, either working from home or due to loss of employment, and left many people struggling financially. Whilst it is hoped that these issues will pass when the pandemic is over and as the economy recovers, predictions are that there will be some permanent changes to the way we work, in particular with more people working at home⁷⁰. Being at home means heating our homes more, making the need to reduce our carbon footprint even greater at a time when financial and other concerns puts investing in low-carbon heating even further from the top of people's minds.

Therefore, it is imperative to find ways to reduce up-front costs and spread the cost of investing in home improvements and low-carbon heating, and HaaS could play an important role in this. Cost certainty will also be relevant. The smart heating controls necessary for these offers have the potential to give people greater control over their heating, in particular zonal heating control could allow people to target the heat in their home to a particular room where they might be working from home, potentially reducing cost and waste⁷¹. This may also be a good time to up-skill the workforce, many of whom are currently struggling to find work, to deliver these new energy services.

5 Getting consumers on board

5.1 What do consumers think of Heat as a Service?

To date, there has not been much research looking specifically at consumers' experiences of existing HaaS models. In summary, people expect a heat service to enable them to get comfortable, and to be transparent and give them confidence they are paying a fair price for their heating.

One of the first challenges to consumer adoption of HaaS is knowing its benefits in the first place. ESC research showed that consumers can find the concept confusing, but this is often because people do not understand their existing energy bills. For example, they do not realise that with normal tariffs they have to buy more energy to heat their home on cold days. Many thought they were already paying a fixed price for their heating (through their direct debit for example), but they were not. This meant that they did not understand a key benefit of HaaS, namely that they pay a fixed price to have a warm home, whatever the weather. The ESC [made an explainer video](#)⁷² to help people understand this. It clarified HaaS to people, and they started to value paying a fixed price for comfort rather than paying for their consumption of kWh that varied with the weather. Smart controls played a large part in helping them realise this. In the end,

⁷⁰ Laura Gardiner and Hannah Slaughter, 'The Effects of the Coronavirus Crisis on Workers', *Resolution Foundation*, 2020.

⁷¹ Arash Beizaee et al., 'Measuring the Potential of Zonal Space Heating Controls to Reduce Energy Use in UK Homes: The Case of Un-Furbished 1930s Dwellings', *Energy and Buildings* 92 (1 April 2015): 29–44, <https://doi.org/10.1016/j.enbuild.2015.01.040>.

⁷² <https://www.youtube.com/watch?v=1JLqM2KCdFM&feature=youtu.be>

people who became familiar with a fixed price for heating through Warm Hours preferred them to kWh⁷³.

When it comes to appeal, the ESC has shown, as with many new products and services, that customer appeal of HaaS varies. A quantitative survey of 3,000 owner occupiers with a representative UK sample in 2018 found about a third preferred HaaS to kWh. Approximately a further third wanted to buy kWh rather than HaaS and the remaining third were unsure⁷⁴. It is likely that those who were not sure needed more information on how the service works before they said they would buy it. When trialling HaaS with people in homes with the ESC's Living Lab, half of those offered HaaS tried it out⁷⁵. This was far higher than expected - normally around 10% of people try novel products and services (the uptake of electric cars and heat pumps is below 5%). The trial was designed carefully to include mainstream consumers, by screening out early adopters of smart heating controls and anyone working in the energy industry. Through smart controls, participants in the trial were able to better understand their comfort and how much it costs. They could see how weather had an effect on those costs, and valued a fixed price for heat enough to choose HaaS⁷⁶. This was, however, a small study with uptake depending on the offer, as people have different preferences when it comes to the detail. For example, in the trial, the ESC discovered that some people may prefer to spread the costs of heating over the year to reduce monthly spending, whereas others may like to pay for heating during the winter only. Some want to pay more for an all-inclusive, unlimited offer; others wanted to pay less for a more limited package where they paid more for extras. Some of the participants who did not want to try out a Heat Plan thought it was too expensive as a significant 'profit margin' was added to see if customers were willing to pay more compared to kWh. Some customers almost negotiated, which we encouraged to understand what price they were willing to pay. Many still decided on a price that was higher than they have paid for their gas in the past.

In a real market selling HaaS, competition would ultimately reduce prices and generate differentiated offers so they were affordable and attractive to a range of consumers. What's more, experience of living with HaaS led to customers saying they would be more likely to switch to low-carbon heating in the future⁷⁷ and that they would trust recommendations made to them based on analysis of data to optimise their service choices⁷⁸.

⁷³ Batterbee, 'Domestic Energy Services'.

⁷⁴ 'How to Tailor Energy Services so They Will Appeal', *People Lab by ESC* (blog), 31 January 2019, <http://www.peoplelab.energy/2019/01/31/how-to-tailor-energy-services-so-they-will-appeal/>.

⁷⁵ 'SSH2 Field Trial Learnings - Insight Report' (ESC), accessed 21 January 2021, <https://es.catapult.org.uk/reports/ssh2-field-trial-learnings-insight-report/>.

⁷⁶ ESC, 'SSH2'.

⁷⁷ ESC, 'Introduction to Heat as a Service', Energy Systems Catapult, 2019, <https://es.catapult.org.uk/reports/ssh2-introduction-to-heat-as-a-service/>.

⁷⁸ Batterbee, 'Domestic Energy Services'.

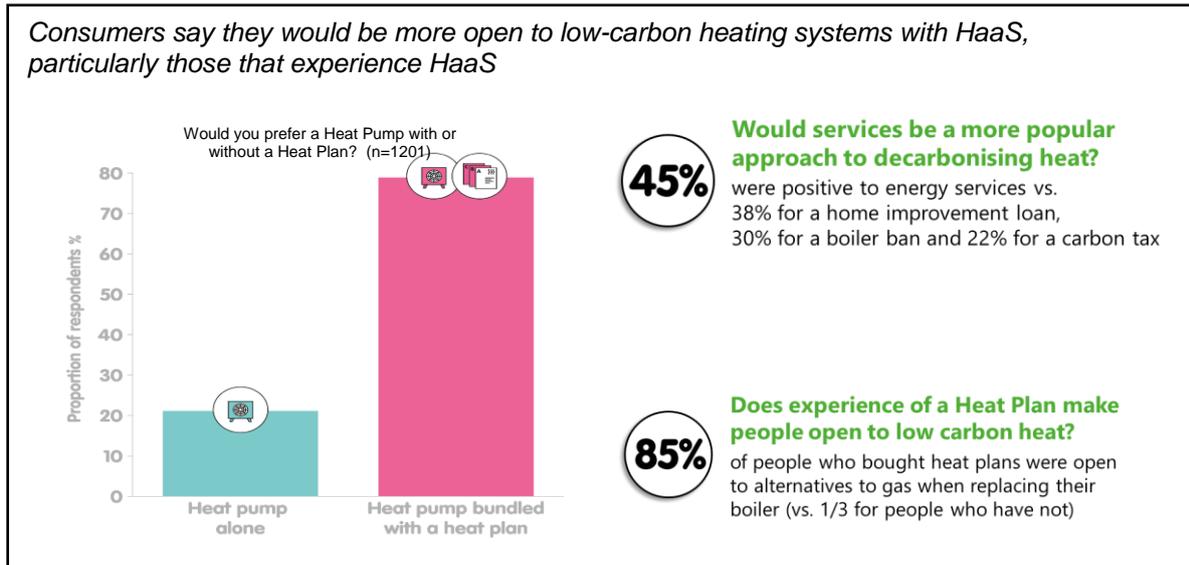


Figure 3: Consumer responses to service offers⁷⁷

Consumers will no doubt need support and protection in place to help them understand these different offers and reassure them about the new ways of paying for energy, as outlined by the ESC and Citizens Advice⁷⁹. Further work, ideally in live markets, is needed to progress this work and demonstrate how HaaS can be delivered.

Some lessons can be learned from people living with heat networks. Their main concerns are with bills being unclear, and not knowing what they are paying for⁸⁰. Heat network customers usually have very little choice about being connected to the heat network, or the kind of service they receive, or how they are expected to pay. In many cases their heating is not even directly related to how much they personally consume. They also report struggling to get comfortable. Networks can voluntarily sign up to Heat Trust rules, and legislation is on its way to protect the interests of consumers and businesses which will address some of these issues⁸¹.

Therefore, with experience, HaaS becomes easier to understand and can deliver the cost and comfort control consumers want. It also helps people be more open to new options. However work is still required to develop business models with fair and transparent payment mechanisms, and a market place where consumers are able to compare and contrast HaaS models and other options to give them confidence they are paying the right price for the right service.

5.2 What might drive or prevent consumers from taking up Heat as a Service?

Based on the evidence we reviewed, we summarise below some of the ways in which HaaS offers might encourage or restrict consumers from adopting it.

⁷⁹ 'Designing Smarter Consumer Protection in a Smarter Energy World: Using Field Trials to Explore How People Understand Energy as a Service' (ESC for Citizen's Advice, 2019), <https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/Closing%20report%20Using%20field%20trials%20to%20learn%20how%20to%20design%20energy%20as%20a%20service%20FINAL%20version%20for%20May%20release.pdf>.

⁸⁰ CMA, 'Heat Networks Market Study'.

⁸¹ CMA; 'Heat Trust'.

5.2.1 Consumer drivers

HaaS offers could drive uptake of low-carbon heating through the following drivers:

Offering certainty over cost

Different models provide different levels of cost-certainty to consumers. Fixed-price services offer customers guarantees over how much they will have to pay for their heating, and heat-outcome models guarantee the price of the heat generated (e.g. Danish scrappage scheme and HaaS). Comfort outcomes guarantee the cost of achieving certain temperatures in the home. In all three cases the provider is taking the risk of changing energy costs. In fixed-price or comfort models they are also taking the risk on fluctuations in outdoor temperature.

Spreading costs

Consumers can spread the cost of heating the home (fixed and comfort models do this) as well as the cost of purchasing, installing and maintaining the heating asset and infrastructure. Consumers may also spread the cost of making energy efficiency improvements to the home.

Improved control over heating and cost

Smart controls, which help to offer and monitor more comfort-oriented HaaS offers, can give consumers much better control over their heating, potentially leading to better comfort and less waste. Combined with a clearer relationship between cost and outcome (either a heat or comfort outcome), or just a fixed-price tariff, this can give consumers better control over cost. It also provides the consumer and provider with more certainty on the type of improvements or heating system required in a home, and the performance of this against expectations.

Tailored offers

HaaS offers huge potential for providers to learn what consumers want, and explore different ways of offering this to them, in much the same way we can currently choose between many different mobile phone contracts⁸². Given better control over their heating, consumers learn more about what it is they want⁸³. The data collected from individual consumers in their homes can be used to offer appealing services that mitigate some of the risks to the service provider (e.g. setting maximum temperatures or charging more for unlimited tariffs). Early research shows that consumers are receptive to such offers⁸⁴.

Improved comfort

Concern that low-carbon heating may not meet comfort needs is one of the barriers to adoption. However, people are often not as comfortable as they would like to be with their existing heating systems⁸⁵. Smart controls can make it easier for people to control the temperature in their homes⁸⁶ and tailored services, especially those including home energy efficiency improvements, have the potential to greatly improve people's comfort

⁸² Gómez-Romero et al., 'Comfort as a Service'.

⁸³ Batterbee, 'Domestic Energy Services'.

⁸⁴ Batterbee.

⁸⁵ Caiger-Smith and Anaam, 'Public Awareness of and Attitudes to Low-Carbon Heating Technologies'.

⁸⁶ ESC, 'Smart Systems and Heat: Phase 2 - Summary of Key Insights', Energy Systems Catapult, 21 March 2019, <https://es.catapult.org.uk/reports/smart-energy-services-for-low-carbon-heat/>; ESC, 'Fuel Poverty in a Smart Energy World'.

levels⁸⁷. With better comfort, people will be less concerned about the kind of heating appliance which delivered it.

Being more green

Although this is not the only consideration, many consumers are motivated by environmental reasons to improve the energy efficiency of their home and invest in low-carbon heating. Nearly three quarters (73%) of the Scottish public said they felt climate change needs to be addressed now⁸⁸.

“Customers have responded well to the carbon emissions reduction that the smart control and tariff optimisation features of our Smart Heat offer provide.” OVO

Being easier to understand and more convenient than the way they currently heat their home

At the moment consumers find the concept of HaaS confusing as it is very different to the way they currently pay for their heating. However, they are also confused about the way they currently pay for their heating and especially the relationship between their monthly direct debit payments and the amount they are paying for their heating throughout the year. Once they have experienced it, people find HaaS easier to understand than paying for kWhs⁸⁹.

5.2.3 Barriers to consumer uptake

There are, however, some issues that would have to be overcome before consumers will be both willing, and able, to take up HaaS offers.

It is hard to compare HaaS offers to existing energy tariffs

Currently it is very difficult for consumers to compare HaaS offers to conventional offers, especially as they are often not clear on exactly how much they are currently paying to heat their home. Some ways of paying for heat (e.g. in terms of hours of heating) would be difficult to compare to others (e.g. kWhs). Consumers will need to be able to compare different HaaS offers with each other and with conventional energy retail offers.

Lack of knowledge, awareness and understanding of offers

At the moment HaaS is a new concept and there is a lack of understanding as to what it is, and what it might mean for consumers. Pioneering companies have work to do to raise awareness and educate people about what these new services can offer them⁹⁰.

Costs

It is not yet clear what the cost of achieving net zero will be to consumers. What is clear is the very limited uptake of low-carbon heating at the moment. Assuming HaaS is a potential part of a solution, providers will face new costs learning how to sell HaaS instead of kWh. Consumers may need to buy new equipment to access HaaS offers (e.g. smart heating controls).

⁸⁷ Justine Bornstein, ‘Energy as a Service (EaaS) Report. Deloitte UK’ (Deloitte UK, 2019), <https://www2.deloitte.com/uk/en/pages/energy-and-resources/articles/energy-as-a-service.html>.

⁸⁸ Caiger-Smith and Anaam, ‘Public Awareness of and Attitudes to Low-Carbon Heating Technologies’.

⁸⁹ Batterbee, ‘Domestic Energy Services’; ESC, ‘Introduction to Heat as a Service’.

⁹⁰ Matthew Lipson, ‘How Can People Get The Heat They Want At Home, Without The...’, text/html, The ETI (The ETI, 2018), <https://www.eti.co.uk/>, <https://www.eti.co.uk/insights/how-can-people-get-the-heat-they-want-without-the-carbon>.

OVO told us that its customers are put off by large, upfront payments or long-term contracts, but are attracted to the idea of lowering their carbon footprint and saving money on their bills.

“While longer financing plans or contracts help lower initial and monthly costs, there is a balance between lower prices and committing to longer contracts” OVO

These extra costs could mean that HaaS costs more than kWh offers. Some consumers are, however, willing to pay a little more for a better service – as shown in many other markets (entertainment, telecoms, food). Indeed in the ESC’s HaaS trials (see Figure 4), some participants were willing to pay up to 40% more than their average gas bill for HaaS⁹¹.

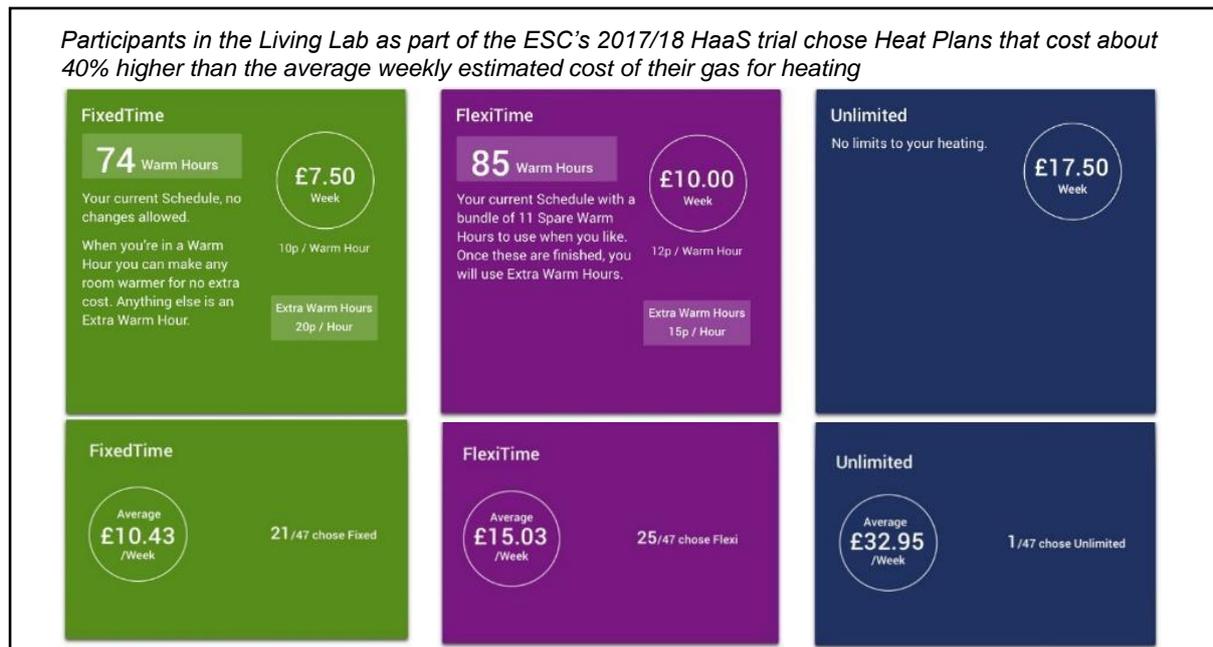


Figure 4: Examples of different Heat Plans offered to participants as part of the ESC’s 2017/18 HaaS trial⁹¹

Furthermore, HaaS providers have an incentive to learn how to deliver comfort as efficiently as possible. If they learn more efficient ways to operate heating systems, they could lower the cost of their HaaS offers and attract more customers. For instance, smart heating controls can save money⁹² by running heating systems more efficiently and turning heating down in empty rooms⁹³.

At this stage, there is no evidence one way or the other as to whether HaaS increases costs to consumers in the medium term. Public innovation funding could also subsidise the costs businesses face in learning how to sell HaaS for the first time, as is happening in Denmark.

⁹¹ ESC, ‘Smart Systems and Heat’, 21 March 2019.

⁹² ‘Evaluating the Nest Learning Thermostat’, accessed 21 January 2021, <https://www.bi.team/publications/evaluating-the-nest-learning-thermostat/>.

⁹³ Beizaee et al., ‘Measuring the Potential of Zonal Space Heating Controls to Reduce Energy Use in UK Homes’.

Uncertainty of new technology and performance

As with every new product or service, there will be early adopters while others will be put off HaaS because it is new and unfamiliar.

With the slow uptake of low-carbon heating systems today, consumers are clearly not confident enough as to how these new technologies can heat their homes. The ESC's HaaS trial showed that people become more open to the idea of switching to low-carbon heating with HaaS, because of the increased confidence it provides of low-carbon technology still keeping them warm⁹⁴.

Financial lock-in

The costs of energy efficiency improvements and low-carbon heating systems mean that consumers will need to somehow pay – whether upfront or over time. HaaS does not change this – although the costs of equipment could be added to the price of the HaaS offer. A HaaS provider will need to be able to recover the cost of any equipment they have included and the sector needs to learn how to do this in a fair way.

“How do you bundle something as an energy supplier with a long term plan and financing agreement if the customer can switch? ... If a lot of the value is in the control of the heat pump, basically, or the electrical storage ..., how do you protect the company from competition?”

Donal Brown, University of Sussex

“There is a real tension between how people live their lives and inflexible, long contract lengths”

Citizens Advice

If this is done over a number of years, consumers will likely want to be able to switch HaaS provider at some point over the payback period. This happens already in other sectors such as mortgage products (borrowing the same amount with different providers) and car leasing (returning the car if payments are not maintained). HaaS can help solve this challenge as the data required to price and deliver a HaaS contract can give the consumer confidence on the investment required (i.e. specify the improvement needed more accurately), and give the provider information on how well the equipment is performing against the contract – throughout the term of a long-term contract for example.

Digital exclusion

Lack of access to information about HaaS offers and low-carbon heating, or to smart-heating controls which usually also have a smart-phone or web interface, could be a barrier to the uptake of those consumers without a smart phone or internet access. Other channels of communication will need to be considered, and service providers will have to support the installation and control of heating for those who are digitally excluded. Citizens Advice further recommends that fair defaults are in place for people who may be disengaged or otherwise limited in the extent to which they are able to engage with their heating⁹⁵.

⁹⁴ ESC, 'Smart Systems and Heat', 21 March 2019.

⁹⁵ Jennifer Arran and Rici Marshall Cross, 'How Accessible Are Future Energy Supply Business Models? A Report for Citizen's Advice', 2019, https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/How%20accessible%20are%20future%20energy%20supply%20business%20models_Citizens%20Advice_FINAL.pdf.

Other issues

There are some other issues which may prevent consumers taking up or benefiting from HaaS. For example, there may be some problems for those with complex or restricted meter arrangements, including prepayment meters, although we have not explored these technicalities in detail. On the other hand, it may be that HaaS can offer a solution to some of these and other challenges faced by consumers in upgrading to a new, smarter energy network and low-carbon heating. Further investigation, trials, and demonstration would help answer this uncertainty. Regulators working with businesses to explore these challenges is often beneficial – as seen by the Danish Energy Agency working with service providers to deliver its version of HaaS.

6 Current challenges and barriers to delivering HaaS

In addition to addressing the issues above to encourage consumer uptake of HaaS, there are a number of other challenges for government and businesses to overcome to pave the way for HaaS offers. These include: regulations that make it difficult for businesses to innovate in this space; the current lack of evidence and knowledge around what a successful HaaS business model looks like and how to deliver HaaS in a way that is commercially viable.

6.1 Regulations can allow innovation in this space

The businesses we spoke to and our evidence review raised the following regulatory issues as being potential barriers to innovation:

Billing currently has to be in kWhs and it is not possible for suppliers to bill directly for heat

The energy supply licence currently requires suppliers to bill for units of energy used, presented as kWh to consumers. This does not stop service providers selling an outcome with units other than kWh. For example, a service provider could sell HaaS and buy the energy from a supplier in kWh who will meet the energy supply licence requirements. This may have implications for offering heat or comfort-outcome services, especially as managing the risk of fluctuations in supply costs and outdoor temperatures will need to be part of a provider's business model. The precise exemptions to current supply licences, if required, to ensure consumer protection may still need to be defined and agreed on a case-by-case basis, but Ofgem is open to exploring these changes to encourage innovation and new markets.

Assignment of rights of Renewable Heat Incentive (RHI) payments

Handing over the assignment of rights of RHI payments is one possible step for HaaS business offers which support the purchase of a new asset that the service provider will maintain and run for the consumer. However, this process is currently very complicated for a provider to comply with existing Renewable Energy Compliance Code conditions, and may put consumers off.

Consumer right to switch supplier

Customers need to have the right to switch supplier, even if service providers need to recoup the cost of any equipment installed. As described in Section 5, this should not stop providers from delivering HaaS as there are models in place in other markets to learn from. Similarly, central financing schemes (such as the Green Deal) went some way to enable a provider to access capital for the equipment and the consumer to switch

energy supply. Indeed the need to allow consumers to switch is also an incentive for the provider to retain their customers – an effective route to innovation and market development.

Risks to consider

Innovators face the risk that policy will change in the future, making their HaaS business model no longer viable. Put simply, lack of a clear long-term policy puts companies off investing in HaaS. Other sectors, however, have clearer long-term policies. For instance, the ban on sales of new petrol or diesel vehicles in 2030 gives carmakers a clear incentive to invest in designing high quality low-carbon vehicles. Targets on vehicle carbon emissions across a car manufacturer's product portfolio have also incentivised product innovation. In contrast, the heating sector has short-term policies subsidising components (e.g. heating systems or insulation), rather than integrated solutions.

A regulator's view

Ofgem has an Innovation Link⁹⁶ Service that offers support on energy regulation to innovators looking to trial or launch new products, services, methodologies or business models. The service helps businesses understand what Ofgem rules mean for them. We interviewed the Innovation Link team to ask about its experiences with innovators aiming to deliver HaaS in the market.

The Innovation Link team explained that, to date, very few businesses have approached it with questions about how to deliver HaaS. Given this low demand, the team has prioritised producing guides on topics that see more innovator enquiries. The team also explained that there was no obvious, substantive barrier, to their knowledge, that would prevent businesses selling HaaS in the market.

Innovation Link remains available to provide clarity on how the energy regulations apply to different business models. The team highlighted the importance of consumer protection to make sure consumers were able to enjoy their experiences with new products and services, including HaaS.

6.2 Companies need to learn how to deliver Heat as a Service

There is currently very little evidence available about how to design and deliver a successful HaaS offer in the UK. A great deal of further exploration, and trialling, is required to learn: how to set fair tariffs and mitigate the risk to the service provider of installing and maintaining equipment and delivering heat to the consumer; building new partnerships to effectively deliver new services; and finding the best ways to communicate with and engage consumers with these new services.

Setting fair tariffs and covering risks

HaaS offers are potentially appealing to consumers as much of the risk of achieving a comfortable and warm home for an affordable price will be passed onto the service provider. Depending on the service, these risks may include the upfront costs, installation and maintenance of heating equipment, and the cost to serve which may fluctuate due to changes in energy prices, the weather or consumer behaviour. There are also issues to consider around fairly supplying vulnerable consumers, and what to do if customers stop paying: unlike a secured loan, heat pump cannot be removed from a customer's home, taking away their only source of heating in order to recoup an investment.

⁹⁶ 'The Innovation Link', Ofgem, 10 October 2016, <https://www.ofgem.gov.uk/about-us/how-we-engage/innovation-link>.

“Heat with rent is all about equity... two ladies, both 75-85, both liked the same temperatures and both flats when you were in them were as hot, but one bill was twice as high as the other... One was on the 10th floor facing south and getting all the sun in the winter, the other was on the 2nd floor facing north and never getting any sun”,

Connected Response

Setting a fair tariff which mitigates risks to the service company of offering heat outcomes, fixed price or comfort outcomes requires data and understanding of consumer needs and behaviours. It also needs ways to tailor offerings to consumers to enable them to achieve the comfort they are willing and able to pay for, and for them to understand why their prices might be different to other peoples'. The ESC's research has shown that consumers understand that it costs more to make some homes warmer than others. For instance, they expect heating bills to be higher in a big, poorly insulated old home, than a small, well-insulated new home, although they might struggle to understand the impact of solar gain quite so easily⁹⁷. Work is needed, however, to make sure tariffs are understood in situations like this, and set fairly accordingly.

Building new relationships and communicating services

HaaS will also require more extensive business partnerships across the energy sector, e.g. between manufactures, energy suppliers, finance companies and installers, to deliver complete, seamless services to consumers that will really change the playing field and offer something they are willing to engage with. Communicating and explaining these new services to consumers in a way to appeals to them is also a challenge.

6.3 Companies need a commercially viable route to delivering HaaS

HaaS is a potential way to increase the uptake of low-carbon heating. However, investing in low-carbon heating and making the necessary energy efficiency changes and upgrades to existing pipes and radiators to ensure their effectiveness is expensive; a new heat pump costs considerably more than a new gas boiler. Even offering financing comes with a cost. This makes finding a business model that is competitive and attractive to customers a challenge, with repayment times that may be longer than the time people are in their homes. Managing the asset to deliver the service efficiently has potential to reduce consumer repayment costs, as has been done by RENESCO⁹⁸. However, this can also only happen over a number of years (in the case of RENESCO – 15 years) and requires the asset and the supply to be provided by the same company.

A further challenge is the current lack of trained engineers capable of installing heat pumps and with the knowledge and expertise to make the required changes to the home and heating system to ensure their efficient running. However, there may be an opportunity now to offer training to those wishing to up-skill during a time where many are struggling to find work due to the impact of Covid-19.

⁹⁷ ESC, 'Smart Systems and Heat', 21 March 2019.

⁹⁸ Brown, 'Business Models for Residential Retrofit in the UK'.

7 Conclusions and recommendations

7.1 How ready is Scotland to deliver Heat as a Service?

The home services market is worth billions and growing, catalysed by the increasing availability of data from Home Energy Management platforms⁹⁹. It is also clear that the range of different heating services available to consumers is increasing; the drive for lower carbon domestic heat is enabling some of this.

There is no reason for Scotland to be any less ready to deliver HaaS than any other country. Stakeholders we interviewed said the same:

“We don’t think there is anything particularly different about delivering HaaS in Scotland compared to the rest of the UK. As an organisation we would ensure consumers are protected.” SSE

With the higher proportion of off-gas homes, and readily available renewable energy sources, there are strong reasons why Scotland is arguably in a better position to provide consumers with comfortable homes which are as good as, or even better than, they currently have.

7.2 Conclusions

There are three important reasons for Scotland’s interest in HaaS:

- 1) To increase the uptake of low-carbon heat
- 2) To improve the energy efficiency of people’s homes
- 3) To reduce fuel poverty and improve outcomes for vulnerable consumers

HaaS has the potential to help meet all three of these objectives. Simpler heating system rental models can increase uptake of low-carbon heat by reducing the upfront costs and spreading repayment over time. More complex HaaS models (for example, those based on comfort outcomes) offer more potential by increasing consumers’ confidence they will be able to get the comfort they want from low-carbon heating systems; giving providers an incentive to improve the energy efficiency of customers’ homes; and revealing who faces higher costs to achieve comfort, which could help target support for those facing fuel poverty.

However, there are some constraints in the existing regulations that could be inhibiting the innovation of heat services. These, together with the risk that providers believe they will be taking with HaaS, is restricting market development. Most businesses are focusing on the simpler HaaS models which have less potential to meet all of the Scottish Government’s policy aims.

Little has been done, so far, to support the development of more complex HaaS models with greatest potential to support these policy aims. Publicly funded innovation programmes, such as the ESC’s Smart Systems and Heat Programme, have clearly demonstrated that they hold significant potential if the market can change. Scotland has an opportunity to invest in establishing how to attract innovators to unlock the full potential of this new business model.

⁹⁹ ‘The Home Energy Management Market Is Ready for Take Off’, accessed 21 January 2021, <https://www.delta-ee.com/delta-ee-blog/the-home-energy-management-market-is-ready-for-take-off.html>.

7.3 Recommendations

Recommendations for the Scottish Government to move forward on Heat as a Service.

- 1) Continue to engage with the Danish authorities to understand lessons from its HaaS Support Scheme for oil boilers, and implications for Scotland.
- 2) Use local area energy plans (such as the Local Heat and Energy Efficiency Strategies in Scotland) to pick the places where HaaS has most potential in Scotland.
- 3) Work directly with businesses and consumers to understand how to overcome the challenges they have with selling and buying HaaS in Scotland.
- 4) Invite businesses to test HaaS with consumers in Scotland to explore how it can be designed, delivered and achieve Scotland's decarbonisation aims.
- 5) Set out a roadmap on the potential for HaaS to contribute to heat decarbonisation and tackling fuel poverty, to encourage industry to invest in understanding the potential.
- 6) Develop and deliver any legislation needed to unlock the HaaS opportunity.

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