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#### **Disclaimer**

The views and opinions expressed in this report are those of the authors and do not necessarily reflect the official policy or position of the government. The information in this report is provided for informational purposes only and should not be construed as an independent review of the project.





#### **Executive Summary**

#### 1 Introduction, aims and objectives

#### Introduction

City Science partnered with Stephens Scown to research and develop the legal and commercial structuring for heat-as-a-service (HaaS).

'Heat as a service is whereby consumers purchase a "solution" where they pay for an experience of feeling warm and comfortable.'

The partnership between City Science and Stephens Scown was chosen to deliver this research due to their respective expertise. City Science are a decarbonisation consultancy who provide advanced data, analytics and modelling software and services alongside traditional consultancy services. Stephens Scown are legal experts with a depth of knowledge in the energy industry. This partnership was formed to combine City Science's technical and financial expertise with the legal expertise that Stephens Scown hold.

The research carried out was around the HaaS financial model, a promising Green Finance solution to rising energy costs, and the need for retrofit and low-carbon heat solutions within buildings. HaaS involves providing heat to customers on a subscription basis, similar to a utility service, with the provider responsible for the funding, installation and maintenance of the heating system and any associated retrofit measures. HaaS is an innovative model with no current deployment in the UK. The model would operate in a highly regulated environment as it is handling both financial credit through the provision of retrofit and the provision of energy to a consumer's home. Due to this, it was extremely important to ensure that the necessary legal research had been undertaken and to ensure that the models were commercially viable to bring to market.

### **Aims and Objectives**

Our project aimed to address these legal and commercial challenges by undertaking a comprehensive analysis of the current legal landscape in the UK; through developing a recommended legal, commercial, and financial structure that will enable HaaS onto the UK heating market. Throughout this project we also wanted to understand potential consumers wants and needs so that we could create a model that was most suited to them.

To ensure we created customer centric models we identified barriers to retrofit, including high upfront costs, lack of information, lack of trust in forecast savings and suppliers and complexity coordinating surveys/installations/finance. Through identifying these barriers, we were able to create HaaS models that offered solutions and kept the customer in mind. All four of the HaaS models overcome at least one, if not all, these barriers.

The four commercial models are:

- Comfort as an Outcome (including retrofit of heating appliance)
- Comfort as an Outcome (excluding retrofit of heating appliance)
- Heating System as a Service





Energy Performance Guarantee

In the discovery phase we were able to accomplish the project aims and objectives through the creation of four commercial models and understanding their potential legal and commercial structure. This amounted to £199,330 of grant funding with an average of £400 day rate for highly skilled legal and financial professionals.

#### 2 Key Barriers and/or Challenges

There are several key barriers and challenges surrounding the HaaS concept. In the discovery phase we were able to overcome them and create solutions to progress with commercialising HaaS. Key challenges and barriers that surround HaaS are:

**The lack of legal clarity**: Currently there is no legal structure in place for HaaS. We found this to be challenging when researching the regulatory environment as there was no clear consensus when determining whether billing in warmth would be deemed appropriate.

**Consumer confidence:** When collating surveys, we found that consumers were unsure whether they would like to be billed in warmth<sup>1</sup> or warm hours. They found the concept confusing and lacked confidence in it. However, to contradict this, previous research carried out by Catapult and the Living Lab in 2020 showed that customers that have been billed in warmth preferred it and found it easier to understand. This shows that customers are hesitant to change, however, once introduced to the idea with clarity and reassurance HaaS can still be the preferred choice to the consumer.

**Financial Viability:** HaaS is based on a number of moving variables with long payback periods on retrofit assets such as heating appliances. Therefore, financial forecasting for HaaS is complex and built on several estimates, such as, predicting long-term energy prices, determining climate variability and fluctuations in interest rate. To overcome this challenge, we built in sensitivity analysis to our financial forecasting. This allowed us to determine the allowance for fluctuations in variables and whether the models would still be financially viable if the variables were to increase/decrease.

The Contractual Agreement between the Customer and the Provider: HaaS requires the customer to be considerate of the heating provided; for example, the customer should not leave their windows open for long periods of time whilst the heating is on. Such customer behaviours would result in significant losses for the HaaS provider, thus, the contract with the customer would require a restriction on behaviour breaches which would result in either financial consequences or contract termination. This could be deemed difficult as customers are very resistant to behavioural monitoring. Behavioural monitoring would be carried out through devices

<sup>&</sup>lt;sup>1</sup> Billing in warmth or warm hours is being billed based on the temperature of your house, such as the temperature in degrees Celsius.





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE such as heat temperature sensors placed near windows and doors in the customer's home. These would allow the HaaS provider to track alterations in temperature. If large deviations were to occur, then the HaaS provider could investigate further or require compensation from the customer.

#### **Key Process Learnings**

There were several learnings throughout the discovery phase:

**Information research and gathering:** This was a large part of the discovery phase through gathering the necessary regulatory and legal information, alongside collating the technical requirements with the financial costings to understand the commercial proposition. The unknown innovative nature of HaaS meant that the research could no longer be laptop based. In response to this, we learnt to engage with specialist consuls and work closely with the technical team to understand technical components in greater depth.

**Engagement:** Throughout this process we engaged potential consumers of HaaS products, legal experts and other HaaS researchers. The consumer engagement was highly effective as it helped us to understand the consumer thoughts and behaviours around HaaS. City Science found the focus group learnings to be particularly insightful as HaaS models could be explained to the audience directly, providing greater understanding.

**Communication:** We found communication across partners to be a key part of the process. Through understanding the legal implications alongside commercial modelling, we were able to create four commercial models within the timeframe, that could be brought to market without legal intervention, and be a commercially viable product.

On reflection, if we were to carry out the discovery phase again, we would have greater engagement. Engagement with consumers provided useful insight, however, we lacked further engagement with energy producers and transmitters needed to understand their industry in greater depth and what options City Science could deploy in the commercialisation of the HaaS models.

### Reflection on key outcomes achieved

There were three main areas to our findings; legal, commercial and consumer preferences:

**Understanding the legal structuring:** Through collaborating with Stephens Scown, we were able to understand the regulatory environment in greater depth. HaaS is a unique innovative product operating in highly regulated industries, therefore, it was important to understand the regulations in detail. Our key outcomes were understanding the financial regulations, energy regulations and commercial law in order to determine the legal viability of HaaS.

Commercial viability: Commercial viability testing investigated the finances for each model. We found it was highly dependent on interest rates and the wholesale prices of electricity. In each model we aimed to keep the cost to the customer equivalent to their current usage in order not to deter customer demand. HaaS is affected by interest rates due to the cost of borrowing, if interest rates are





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE significantly high it can be detrimental to the HaaS provider as

significantly high it can be detrimental to the HaaS provider as the cost of capital increases for the HaaS provider, thus, reducing the profitability. Fuel prices also affect the Comfort as an Outcome model as the billed cost to the customer remains fixed whilst the energy supplied fluctuates, therefore, when the cost of energy increases the HaaS provider could be subject to losses.

Another commercial disadvantage of HaaS is that the customer must enter a longterm contract in order to pay off the upfront cost of the retrofit, this means long payback periods for the supplier or expensive break out clauses.

Consumer research: City Science conducted a consumer survey prior to preforming the financial and legal analysis and carried out a consumer focus group once the shortlisted models were finalised. Key outcomes of this work were that customers are highly price sensitive; they are interested in HaaS and the idea of an all-encompassing model but slightly unsure about being billed in heat. This means that individual financial modelling for HaaS needs to be thought about carefully and the cost to the customer no higher than what they are currently paying. If HaaS prices are higher than a standard energy contract, it is likely there will not be sufficient consumer demand. Customers will also need to understand how the billing of heat will work to feel reassured, therefore, the HaaS provider will have to create clear consumer contacts on explaining how HaaS would be carried out.





#### **Evidence Report**

#### 1 Product introduction

#### 1.1 The consumer value proposition.

There are numerous consumer barriers to retrofit/micro-generation/heat decarbonisation including high upfront costs, lack of information, lack of trust in forecast savings, lack of trust in suppliers and the complexity involved in coordinating surveys/installations/finance.

HaaS aims to overcome these challenges, through a simplified customer proposition of a single monthly subscription. To overcome these challenges, we embed key innovations in terms of contract terms, streamlined analysis and financing to deliver the leading HaaS offer in the UK.

To overcome these barriers, we considered different variations of HaaS including; Comfort as an Outcome, Energy Performance Contracts and Heating System as a Service. These models involve retrofit of some sort, with Comfort as an Outcome providing the most all-encompassing whole-house approach.

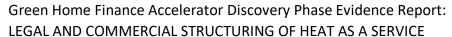
Comfort as an Outcome is the primary HaaS model, it is all-encompassing and provides the greatest decarbonisation through considering both the heating system and the fabric retrofit. Comfort as an Outcome is the provision of an agreed level of warmth/comfort to the customer. Through the supplier providing the warmth to the home it encourages the supplier to maximise energy efficiency of the customer's property to increase their profitability, i.e. the least amount of energy produces the greatest amount of warmth.

Energy Performance Guarantee provides assurance on energy savings post retrofit, through prior assessment and advice to the customer of what retrofit products to install. The capital cost of retrofit would be covered by the customer however, they would have confidence on the savings returned through reduced energy consumption due to the energy contract guarantee.

Heating System as a Service is the lease agreement between the customer and supplier for the heating appliance and maintenance within a home.

Energy efficiency and low carbon measures: To create warmth for the customer Comfort as an Outcome provides the consumer with; a property survey assessment for retrofit, the installation, provision of heat through low carbon methods (heat pump), micro-generating services all wrapped up into one subscription. It reduces the volatility of energy bills, whilst lowering carbon emissions and improves maintenance of retrofit assets through its subscription like service.

Energy Performance Guarantee provides the survey to assess retrofit and then a guarantee on the energy saving of that retrofit. This encourages retrofit through removing data barriers and increasing transparency and guarantee of return on investment for customers.







The Heating System as a Service solely looks at the maintenance and application of a new heating system. This would reduce carbon emission output through the efficiency of heat output from the heating appliance and the possibility to change over to a heat pump rather than gas or oil boiler.

**Target Demographic**: The current primary demographic for all models of HaaS are homeowners who are looking to install retrofit or upgrade their boiler. Through targeting those who are already considering an upfront retrofit investment, it will make the introduction of HaaS more desired and easier to market. Additionally, HaaS can provide these customers with a method of obtaining retrofit or a new heating system without having to provide the upfront cost, which in the cost-of-living crisis might save consumers from deferring the upgrade of inefficient boilers due to lack of finances.

**Costs:** The HaaS models will vary in price, dependent on the property and retrofit required. However, we have considered the price competitive nature of the domestic heat market, thus, have modelled all the HaaS models based on their current energy bills. HaaS will aim to not only provide warmth to the customer's home at the same price as their current provider, but also provide additional retrofit measures too. The only caveat to this is the payback periods will be longer thus, longer contract terms for the customers at approximately 10 to 15 years.

**Customer Journey:** HaaS by the nature of the product looks after the customer over the entire lifecycle of the heating/retrofit ensuring end to end support. HaaS radically streamlines the customer journey providing an "all in one place"/full-service offer. The HaaS solution will target consumers at key "trigger points" e.g. switching energy suppliers/moving house or exploring retrofit, providing a streamlined remote assessment, integrated survey, clear/transparent offer, seamless installation, the provision of heat and aftercare, all wrapped within a single monthly payment. We believe the simplified consumer journey, trusted partners and guaranteed cost savings enabled through our unique HaaS approach will provide a new, gamechanging proposition to UK consumers.

#### 1.2 Addressing consumer barriers to the uptake of domestic energy efficiency.

Primarily, HaaS reduces consumer barriers to uptake and financing by providing an 'all-in-one' customer proposition. The HaaS model makes it much easier for consumers, by providing guaranteed heat comfort for a single monthly charge.

Alongside this, the HaaS-provider is incentivised to deliver heat as cost-effectively as possible, in exchange for a long-term service contract. As a result, HaaS providers are incentivised to maximise deployment of cost-effective measures that enhance the overall contract value. Through this approach customers benefit and consumer barriers are overcome.

The consumer barriers that HaaS looks to overcome are:

• **Reduced Upfront Costs:** Reducing the upfront cost of measures, financing all capital, maintenance and operation through a single monthly charge.





- **Predictable Costs:** HaaS can provide more predictable/less volatile costs to consumers, due to a greater mix of on-site generation/demand reduction measures. This addresses a genuine consumer need of more reliable energy bills.
- Expert/Guaranteed Service: Providing all the necessary expertise and financing in a bundled way, with objectives aligned between customer and provider.
- Maintenance/Repair: Ensuring continuous good operation of solutions.

HaaS can provide a compelling mechanism to accelerate finance into energy efficiency, retrofit, decarbonised heat, and micro-generation through incentives and the removal of consumer barriers.

**Enable Domestic Energy Efficiency:** A range of energy efficiency measures are commonly feasible and incentivised for investment within the HaaS model. These include:

- Loft Insulation;
- Cavity Wall Insulation;
- Draught proofing; and
- Lagging of pipes.

Wider measures may also be feasible and financially viable within the model, depending on the house type and proposed customer service level. These could include:

- Under-floor heating;
- External or Internal Wall Insulation; and
- New glazing.

HaaS suppliers are also incentivised to work with supply chains to reduce costs of components and installations (similar to Octopus working to reduce the cost of heat pumps) to increase the range of demand-reducing measures that are viable/beneficial within the model.

Enable Low Carbon Heating and Micro-Generation: Through the HaaS model, providers are incentivised to provide heat at the lowest possible cost while ensuring that the customer benefits from their agreed level of comfort. The precise heat solution will depend on the building type and current heat system efficiency/age, but the HaaS model means that the customer-specifics will be investigated and modelled, with viable upgrade investments being accelerated.

#### 2 General scoping research and other activities

#### 2.1 Initial research methodology and scoping activities

Decarbonisation is at the heart of what City Science do and domestic heating amounts for around to 14% of UK emissions (Colm Britchfield, 2021), thus, we felt it was an important to address. This led to research into HaaS as City Science saw the opportunity of transferring the incentives for reduced energy use from the homeowners to a heat provider. City Science has carried out projects prior to this





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE discovery phase on different aspects of HaaS, studies have been conducted on the technology most viable to carry out HaaS in our Heat Pump Ready program<sup>2</sup>. This looks at the issues surrounding heat pump sizing and temperature monitoring to detect the size of heat pump needed. This project discovered the technology needed and narrowed the list of viable products.

From this study we realised that there was a need for further development in commercial and legal research and structuring of HaaS, hence the reason for carrying out this discovery phase. The research carried out in this project related to the legal and commercial structuring of HaaS, leading on from the work previously carried out on the technological deployment behind HaaS.

To narrow down the target audience City Science and Stephens Scown discussed various market segments and the challenges the HaaS provider might face in providing the service to them. The discussions enabled us to decide that in the initial stages of HaaS it would be best to only consider freehold homeowners in this discovery phase, this is due to the complexity of contract when deploying HaaS. In particular HaaS requires restrictions on customer behaviour within a customer contract, specifically requiring the customer to be conscious of their behaviours affecting the heating loss of the building; for instance, the windows and doors should not be left open for long periods of time when the heating is on as this would result in excess energy use and losses for the HaaS provider. This would be highly difficult to implement and require further contracts if HaaS was provided to a landlord or tenant, thus, we decided in the initial stages HaaS's target audience should be solely targeting homeowners.

#### Research methodology

This was a mixture of desktop-based research, utilising previous knowledge, consumers survey and stakeholder engagement. During the initial phases of the project we carried out extensive desk-based research on the regulatory environment to get a basic understanding of the challenges we might encounter. This initial research was discussed between City Science and Stephens Scown summarising what was already known and what needed to be researched further.

A consumer survey was also conducted, this had circa 100 responses. This enabled us to understand consumer demand and what consumers prioritised when considering energy providers and improving their homes in terms of retrofit.

We also held consumer engagement through a small focus group, the focus group consisted of 7 people, who were primarily of homeowners. We discussed the various models of HaaS and the attendees' thoughts on each of the models:

Comfort as an Outcome (with heating appliance): The focus group found this to be an interesting model, however they had concerns about being billed in warmth. They liked the idea of all-encompassing HaaS and not having to worry

<sup>&</sup>lt;sup>2</sup> Tables showing hardware research provided in annex.





- about the retrofit or heating appliance and that being managed entirely by the heating provider.
- Comfort as an Outcome (without heating appliance): This model was liked, however, the focus group preferred for the heating appliance to be included in the bundle.
- Energy Performance Guarantee: The attendees of the focus group liked the reassurance it gave to their retrofit as there is very little certainty in the installation of retrofit in terms of savings on energy bills. However, the attendees were unsure how much they would be willing to pay for the upfront assessment.
- Heating System as a Service: The focus group liked this model due to its simplicity and similarities to other financing mechanisms such as a car purchase hire. However, there were concerns about what would happen if they sold the property.

The focus group influenced us to prioritise the development of Comfort as an Outcome (inc. heating appliance) and the Energy Performance Guarantee as they sparked the most interest from the focus group. Comfort as an Outcome was suggested for further development due to its simplicity for the customer, with the HaaS provider managing the finance, retrofit, and energy contract. There was also great interest in the product as it was considered innovative. The Energy Performance Guarantee is what the attendees felt the most comfortable with and were excited by guaranteed benefits of retrofit through energy savings. Having the HaaS provider assess and guarantee the benefits would provide great comfort when investing in retrofit. Also, the quality of retrofit would be monitored which is often a concern of the asset holder.

#### 2.2 Existing market solutions that would compete against HaaS

HaaS will compete against typical heating systems as the consumers would have to move from their existing heating model to a HaaS model. HaaS will also appeal to those who are carbon conscious, therefore, HaaS will also compete against renewable energy initiatives.

Existing Market Solutions that could compete against HaaS:

**Traditional heating systems:** Upfront purchases of traditional heating systems such as boilers, furnaces, and heat pumps. They are controlled and owned by the asset owner, but the asset owner is also responsible for the upkeep and maintenance of them.

**District Heating:** In certain areas it might be possible for potential customers to access district heating. This is a low carbon alternative to heating but not available in all areas and can take several years to implement. District Heating was identified as a competitive model as it is a low carbon alternative to a typical gas boiler, however, it is only available is a small number of areas, therefore, does not pose a great competitor to HaaS.

**Energy Service Companies (ESCOs):** ESCOs can design, install, and finance energy efficiency and renewable energy projects, and they can also provide ongoing maintenance and support, however, the customer would have to pay an additional fee for their services it wouldn't be included in the cost of energy or warmth. ESCOs were identified as they will compete with the Energy Performance Contract as the





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE models have significant similarity (in retrofit advice), however, it does not include the guarantee which creates a competitive advantage for this model of HaaS.

Renewable Energy Systems: Micro-generation products can be used to create the energy to heat buildings, reducing the cost of heat when using a traditional heating system approach. This was identified as a competitor to HaaS as renewable energy systems would likely decrease the cost of energy for the consumer. It is likely that the HaaS contract would be a higher price than what the customer is already paying for their energy contract, thus, could deter customer demand.

HaaS differentiates from all these services through its end-to-end approach. The Comfort as an Outcome model provides an all-encompassing model, includes the work that an ESCO would deliver, provides the upfront capital costs for your heating appliance, maintains said heating appliance, and bundles renewable energy systems to reduce energy costs without the customer having to manage and worry about all the different suppliers and variables.

#### 2.3 Scoping research findings

Currently consumers are struggling with the cost-of-living crisis and are under great financial pressure.

Through our customer survey and focus group we found that the main objectives that consumers valued when looking for retrofit financing solutions were:

**Pricing:** Through project scoping and consumer surveys we found the primary concern for the customer was cost. This appears to have been driven by the cost-ofliving crisis as previous Catapult studies<sup>3</sup> have shown that customers were willing to pay more when being billed in heat, however, we found consumers were primarily price centric. We reflected this in the HaaS models, when creating the commercial models, we ensured the price was the same or less than the previous energy model, therefore, HaaS models would still provide incentive to price centric consumers.

Consumer Confidence: Consumers lack confidence in retrofit instalments, and installer reliability. Therefore, when looking to finance retrofit they want to make sure they are investing in the right retrofit and the installer ensures results. As HaaS is an all-encompassing model it will deliver the retrofit from end-to-end ensuring that it is well installed. High-quality installation is in the HaaS provider's best interest, the greater the energy savings the greater the HaaS provider's profitability. This means that the HaaS provider and the consumer are aligned in the goal of obtaining the highest quality retrofit.

**Increasing the value of their property:** Retrofitting a property can improve the Energy Performance Certificate (EPC) rating, which in turn could lead to increased property value. EPC could be reflected in the property value through lower interest rates on green mortgages determined by EPC grade or greater investment in EPC C

<sup>&</sup>lt;sup>3</sup> SSH2 Heat as a Service | Energy Systems Catapult





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE or above due to government legislation (prior to September 2023). If the HaaS model were to bring added value to the consumer's property through the instalment of retrofit this would incentivise uptake.

### The drivers/timings/trigger points where customers would consider retrofitting using the type of finance product:

The HaaS solution will target consumers at key "trigger points" e.g. switching energy suppliers/moving house, upgrading their heating appliance or exploring retrofit. We found at these points of change consumers were most willing to explore potential HaaS offerings through the consumer focus group. HaaS will provide a streamlined remote assessment, integrated survey, clear/transparent offer, seamless installation and aftercare, all wrapped within a single monthly payment. Thus, providing customers the best possible options at that "trigger point". Additionally, it will help support those who could not otherwise consider the upfront cost of retrofit or upgrading their heating appliance with the possibility of both at a fixed monthly fee. We believe the simplified consumer journey, trusted partners and guaranteed cost savings, enabled through our unique HaaS approach will provide a new, gamechanging proposition to UK consumers.

#### Market size and scope 2.4

Market Size: The market for HaaS in the UK is significant with households and businesses spending £55bn on energy each year<sup>4</sup>. Ultimately HaaS-style financial contracts could serve every area of the UK energy market, including bundled electricity and heat.

Serviceable available market (SAM): Based on recent history, small/new entrant suppliers to the UK energy supply market captured 20% of the total market share (2022 data), indicating a realistic serviceable available market of £11bn.

Serviceable obtainable market (SOM): Assuming 10% of the SAM would indicate a SOM of £1.1bn. This is comparable with Bulb's growth to £1.5bn annual revenue<sup>5</sup> (2019). Bulb provides a great case study/comparable for how this level of growth can be achieved, and evidencing the recent strong demand for innovative, low carbon energy services/products within the UK market.

In today's prices, £1.5bn annual revenue would equate to ~820,000 customer/properties (Bulb comparable = 1.5m customers).

Market Opportunity: Many small suppliers that could not protect themselves against recent increases in wholesale prices, became insolvent and had to notify the regulator, Ofgem, that they could no longer trade (House of Commons Library,

<sup>&</sup>lt;sup>4</sup> State of the Energy Market 2019 | Ofgem

<sup>&</sup>lt;sup>5</sup> BULB ENERGY LTD filing history - Find and update company information - GOV.UK (companyinformation.service.gov.uk)- Full accounts 31 March 2020





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE 2023). This market dynamic presents a significant opportunity for new entrants to the energy supply market.

**Customer Trigger points:** City Science identified that the consumer's trigger points for considering the HaaS model are; when retrofit is being considered, when their heating appliance lifecycle has come to an end and when changing energy supplier.

These are the trigger points as consumers tend to seek out available financing options at each of these points, they are willing to embrace change and alter their housing asset. All of these points create an open market opportunity for HaaS.

#### **Green Investment and Route to Market:**

HaaS would enable green investment, through providing a service that is better than what is currently available on the market. Green Investment would be encouraged through added benefits to the consumer. HaaS would not only encourage the move to low carbon alternatives in heating but provide a holistic heating product that provides end-to-end care.

There are several routes to market when deploying HaaS:

Through existing networks supply chain channels: For example, retrofit installers have extensive networks of customers that could benefit from an energy savings guarantee. This is the best method of acquisition as Carbon Rewind's (see section 3.2) customers are likely to be considering retrofit already, thus, utilising a customer trigger point and improving the potential to purchase the HaaS model.

**Partnerships:** A partnership with an energy or finance provider could be established to utilise their customer base whilst also using their services. Partnering with an energy provider or financer would give access to providing Ofgem Licensed services or Financial Conduct Authority (FCA) authorised services, thus reducing the barriers to entry for the HaaS provider.

Partnering with a retrofit provider would allow the HaaS provider to access a trigger point in the customer's journey or where they might transition to HaaS, therefore, reducing the marketing budget and providing the customer's trusted retrofit provider.

**Direct Sales:** Engaging directly with customers through marketing and acquisition strategies.

#### 2.5 Barriers due to cost of living and energy price crisis

Customers have become highly cost conscious around their energy bills. When carrying out surveys and our consumer focus group we found that potential customers are highly cost conscious. In the survey 60% of the 92 correspondents thought that price was of high importance and the majority of people wanted their bills to be lower. When questioned if they would be willing to pay more for their energy contract if measures to improve warmth and comfort were improved, there was slight agreement at 35% but only 21% strongly agreed with 17% strongly





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE disagreed. This differs from Catapult Energy Systems<sup>6</sup> which took place prior to 2022 findings who found that customers receiving warmth instead of energy in kilowatt-hours (kWh) were happy to pay more, this suggests that the cost of living/energy price crisis is likely the causation of consumer behaviour change.

#### 2.6 How does HaaS overcome these challenges/barriers?

Due to the barriers surrounding the cost-of-living crisis we put more importance on price. We ensured that HaaS models would be no greater than the price of energy the customer currently paid. The all-encompassing HaaS model provides a fixed subscription price to customers, which provides customers with reassurance that their bills are not going to increase imminently. We also considered this from the HaaS provider's perspective ensuring that the contract clause dates enabled the HaaS provider to increase/decrease the cost of the subscription if fluctuations in energy prices were to affect margins or payback.

The commercial modelling took the cost-of-living crisis into account through ensuring that the HaaS price was no higher than the current cost of energy. The energy prices that were used were modelled from the Green Book future energy prices, however, we kept the model dynamic allowing for changes to be made in the energy prices.

We carried out sensitivity analysis on interest rates for a proposed property. We investigated the effect of rising interest rates and how that would affect the profitability and payback period of the model. Sensitivity testing was carried out on climate and how changes in climate temperatures would affect the profitability of the model.

The graph below shows the return on investment of Comfort as an Outcome vs the Cost for a property over a 20-year period if the cost of HaaS were the same as the current average energy bill (British Gas, 2023). This model includes the retrofit of services of solid wall insulation, floor insulation and roof insulation.

<sup>&</sup>lt;sup>6</sup> SSH2 Heat as a Service | Energy Systems Catapult





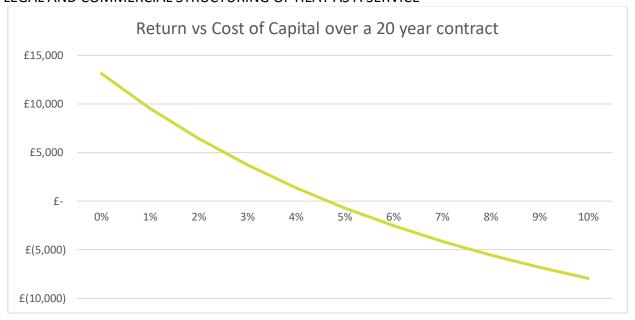


Figure 1. A Graph Showing the Return on Investment given Interest Rate increases.

However, the financial modelling is solely an example of a property. For HaaS each house would require its own individual financial modelling at the point of acquisition due to the variation in house type, fabric, rate of heat loss and surrounding climate of each property.

#### 2.7 Potential future price fluctuations and their impact on HaaS services.

All HaaS models would have to be dynamic and modelled on a case-by-case basis due to the individuality of installation and rates of heat loss per property. In addition to this when considering the contractual obligations of HaaS we also discussed the need for contractual clauses which state that an annual price change can occur in respect of energy prices or cost of maintenance increases (similar to how phone contracts often have yearly price rises). The Energy Performance Guarantee model would avoid these difficulties as the guarantee would be based on kWh and would therefore not be susceptible to energy price increases.

If choosing the all-encompassing HaaS model the energy prices could also be predetermined if the HaaS provider chose to purchase a longer-term energy contract such as a purchase power agreement. Through having a stable cost of the energy the HaaS provider would not have to manage fluctuating energy prices and variable profitability. The energy contract would also be able to match the customer contract length, therefore, the HaaS provider would have a guaranteed supply over the lifetime of their customer contract.

We chose homeowners with full control of their property (non-leasehold) as our target group due to simplicity of contract. HaaS requires a highly complex contract/contracts, therefore, having several different parties with various control on the property adds further complication to an already complex agreement. Once the HaaS models are delivered and the homeowner contract is defined and fully operating there could be more advancement into target market audiences.





#### 2.8 Expansion into other customer segments

No further product would be required, only the legal aspects of HaaS would have to be understood. For instance, when considering a landlord and tenant scenario the HaaS contract would formally sit between the landlord who owns the property and the HaaS Provider. However the tenants living in the property would be responsible for the customer behaviour agreements in the contract, thus they have the potential to breach the contract not the landlord. This would suggest that there should be a secondary contract either between the landlord and tenants or the HaaS provider and the tenants. This requirement is still in development and further research will be conducted once HaaS is in place for homeowners.

This does however leave significant scope to develop in later stages of HaaS, therefore, once the homeowner HaaS contracts are developed further and deployed, landlord and tenant contracts should be considered.

#### 3 Relationships and Partnership Building

#### 3.1 The development of knowledge base and relationships.

This project has allowed us to develop our knowledge base and relationships through knowledge sharing and engagement.

Our knowledge base has increased through our extensive work with Stephens Scown and their legal advice surrounding the deployment of low carbon heating and energy efficient measures. In particular, understanding the Ofgem regulatory requirements and the smart meter legislation has developed our knowledge when taking projects in energy efficiency/low-carbon heating/micro-generation forward.

We have not only established our relationship with Stephens Scown, but City Science has also established strong relationships with installers, retrofit suppliers and quality assurance schemes. This has allowed us to access retrofit costings in the financial analysis of this project and provide assurance that we could provide the finance if HaaS were to be pursued in future.

In addition to supply chain relationships, we have built relationships with the Energy Systems Catapult who previously carried out research surrounding HaaS. Sharing knowledge on findings helped us to understand the lack of interest by energy providers and the difficulties behind commercialising and scaling HaaS. Additionally, they provided useful contacts who are also interested in delivering and deploying HaaS.

#### 3.2 Project Relationships.

City Science has developed a strong relationship with Carbon Rewind. They are a growing national installer and retrofit advisor who deliver surveys, design, costing, retrofit measures and aftercare, providing full-service support to our HaaS operational model. Carbon Rewind supplied us with financial costs of retrofit that we were able to use in our financial modelling/analysis.

City Science has also developed a strong relationship with Koze Group Ltd (hiber) who are heating system and retrofit finance providers. City Science are now an





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE appointed representative of them, which provides City Science with direct access to finance for the HaaS delivery vehicle in future if necessary.

The Energy Systems Catapult shared their knowledge from previous HaaS research and provided useful insight into customer preferences and energy suppliers thoughts on being involved in HaaS. They shared with us that energy suppliers felt that HaaS posed liability towards them due to the lack of legal clarity of regulations and the long payback periods, therefore, they did not want to include it in their commercial portfolio.

#### 3.3 Future Partnerships

Relationship building took place in the discovery phase, however, we feel there is still possibility of further relationship building. In future City Science feel that it would be beneficial to build relationships with energy producers and transmitters.

#### Knowledge sharing between partner organisations?

Knowledge sharing has been managed between partner organisations through;

Creating a project plan: The project plan gave a detailed outline of the key research areas and deliverables. Once the deliverable was accomplished there was a meeting to discuss, ask questions and provide further insight.

Establishing an open culture: We regularly asked each other questions throughout the project, via email correspondence, during our in-person workshop and also in our knowledge sharing meetings.

Utilising a number of knowledge sharing methods: We held an in-person workshop, we had online/remote meetings and had correspondence via email.

A key point of knowledge sharing was our in-person workshop. This was to discuss the regulatory environment surrounding HaaS and debate the various legal challenges that would be faced, determine which models would be appropriate to develop further.

In this workshop City Science brought a long list of commercial models to the meeting with Stephens Scown's summary of regulations surrounding HaaS. From these initial starting points, we were able to discuss the technical implications of HaaS and how they might affect the contractual agreements. We also discussed in more detail the contractual agreement that would occur between the HaaS provider and the customer. This was a very constructive meeting that led to City Science's four finalised models.

Additionally, we aimed to keep our knowledge sharing as easy to understand as possible. Stephens Scown provided diagrams and key summaries in their legal summaries to ensure that they were easy to understand. City Science summarised the HaaS models clearly stating the key outputs of each on and gave a verbal summary of the financial findings.

#### Challenges when developing relationships.

The HaaS business model is counter intuitive to an energy supplier's current business model, thus there is significant push back from energy providers





Green Home Finance Accelerator Discovery Phase Evidence Report: CITY SCIENCE LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE surrounding HaaS. Energy Systems Catapult has previously worked closely with large energy suppliers to deliver HaaS, however, they found that energy suppliers are hesitant to consider HaaS in their commercial portfolio as the legal structuring is unclear, therefore it could pose a legal liability to them. Currently the legal risk that HaaS poses to them outweighs the commercial incentive, therefore there is great hesitation to take on a HaaS model.

The financial structuring of HaaS is also very different to the current commercial models in the energy industry. The current commercial models that are in place in industry have resulted in large profits, therefore this leaves no incentive for energy suppliers to diversify or move to other commercial models.

The uncertainty of legal and financial structuring around HaaS is a barrier to developing relationships with energy suppliers. The learnings obtained from this project have shown us that we are closer to approaching suppliers and gaining relationships. In order to approach energy suppliers, we feel we must progress with Ofgem to provide clarity around the HaaS regulations and through proof-of-concept in both the commercial and technological accuracy.

#### 3.6 Expertise gaps.

At a later stage of the project, we would like to develop a relationship with an energy provider, enabling a supply chain relationship to take place. An energy provider would be key to the provision of the all-encompassing HaaS model (Comfort as an Outcome).

The all-encompassing HaaS model requires the provision of energy to the customer via the billing in warmth, therefore, understanding and being able to purchase a supply is essential to HaaS. Through developing a relationship with an energy provider and transmitter this will allow us to understand the possibility of, purchasing their supply, entering into a power purchase agreement, and facilitating supply to the HaaS customers. This expertise would be essential in the deployment of allencompassing HaaS.

Alternatively, we could develop a partnership with an energy supplier, however, we understand that gaining a strong relationship with an energy supplier in the context of HaaS can be complicated as it is counter intuitive to their business model. Therefore, if we want to approach an energy provider, we feel that a proof-of concept approach would be applicable. This would show the energy supplier the commercial viability of HaaS and ensure its technological advice provides the models that create the most profit, otherwise it would be unlikely that the energy provider would be interested in the HaaS model.

#### Finance product research

#### Activities undertaken in the development of HaaS

HaaS by nature is a financial product alongside the heating element. Allencompassing HaaS allows for customers to pay a fixed monthly fee to receive 'comfort/ warmth' whilst also receiving retrofit to their home.





The key activities carried out to design the finance product consisted of:

- Understanding the energy savings impact of retrofit and the cost implication of that.
- Forecasting future energy prices using the Green Book medium forecasting.
- Determining the upfront cost of retrofit and the required payback period.
- Determining the length of contract.
- Researching the average household energy consumption and billing.

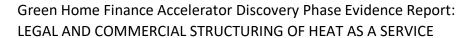
When determining what models to use we discussed the financial barriers to retrofit and low carbon heating, which included:

- Upfront capital
- Understanding of retrofit payback period (what difference it'll make to their energy bills)
- Incentive to switch to low carbon and efficient heating

Through understanding these barriers, we were able to create models that considered and overcame them. The models stated below all develop varying solutions to the identified financial barriers.

#### HaaS Model discovery:

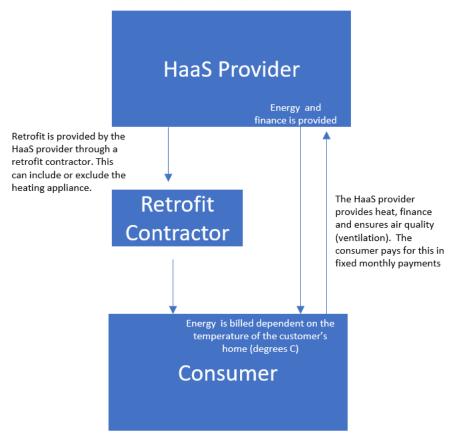
The all-encompassing HaaS model (Comfort as an Outcome) allows for a fixed monthly cost to pay for not only the energy used to heat the house, but pays back the retrofit costs, thus no upfront costs are incurred. There is an incentive to use HaaS in that the retrofit instalment is taken care of for the customer, there is no fear to the customer of fluctuating energy prices and there is generally greater control of the home temperature.







### All-encompassing HaaS Model Comfort as an Outcome

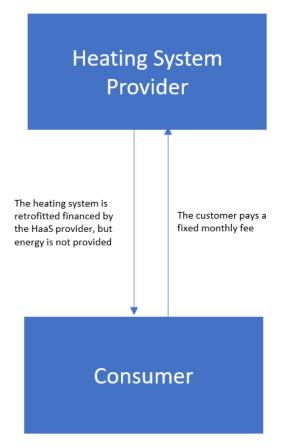


From this all-encompassing HaaS model we then considered a model that would provide the upfront finance without the provision of warmth, as consumer feedback suggested that consumers were unsure about being billed in warmth. Heating System as a Service provides and maintains the heating appliance at a fixed monthly fee. This removes the need for upfront capital for a new heating appliance and removes the worry of large maintenance payments.





### Heating System as a Service

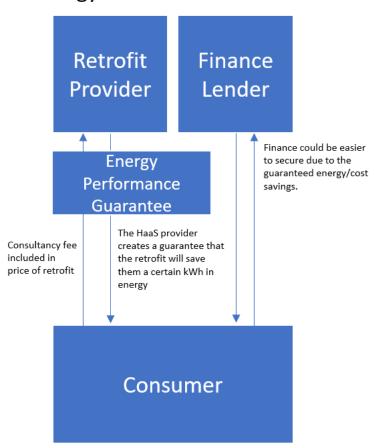


We also considered a model where the financial product sat outside the provision of heat and finance, the Energy Performance Guarantee. An Energy Performance Guarantee is where a consultant provides a detailed assessment of the property, analysing current energy usage and the property's fabric. Once the assessment is carried out, they provide advice on the retrofit required to reduce energy bills and the payback period of retrofit through energy savings. This provides the customer with understanding of the retrofit payback and costs; additionally it provides incentives through predicted energy savings calculations.





### **Energy Performance Guarantee**



We also carried out financial modelling and analysis. This analysis allowed us to determine the payback periods of the products and what would be essential to consider.

#### 4.2 Lessons learnt and research findings relating to the creating HaaS

When creating the finance product, we considered the learnings from both the customer survey and focus group alongside the desktop-based analysis. The lessons we learnt were primarily around the customer's needs and wants, and including these into the HaaS models whilst still being financially viable.

**Customer's needs to be central to the design process:** Through understanding the consumer needs and wants we can design a finance product that will drive demand and cater to consumer needs. This will make the product easier to market and sell to consumers.

The contract should be clear and simple to understand: When asked "If you were presented with a range of energy tariffs from which to choose how important would a clear and simple contract be?" the majority of responses (36%) were rated a 5 out of 5. Therefore, the survey results showed that customers were extremely concerned about the clarity and simplicity of their energy/heating/finance contract. This will be an important point to consider in the deployment of HaaS.





The finance product needs to be price competitive: The financing options for retrofit/energy need to be price competitive. We found that most consumers compare their energy contracts on price and are highly influenced by price in the current market. In the all-encompassing HaaS model retrofit finance will be bundled within the cost of energy therefore, it is essential that price is competitive.

Clear opting out policy relating to finance: In the focus group we found that consumers were concerned whether they could exit the contract and what the cost of exiting will be. It is essential to the finance contract this is set out before entering the contract with clear understanding of the implications of contract cancellation.

**Accurate data is essential:** When performing the financial modelling it became evident how important the accuracy of current energy usage versus post retrofit energy usage will be in our financial product, therefore, this highlights how important data will be in the financing process.

Primarily the key lessons that were learnt from the development of the finance product was that it needs to be consumer centric in order for the necessary demand to be met. Additionally, the accuracy of data and financial forecasting was essential to reduce financial liability and potential bankruptcy of the HaaS provider.

#### 4.3 Finance options considered alongside the final proposal

We considered including Heat as an Output as one of our HaaS models (financing models). This is whereby the consumer pays for the output of warmth from the heating appliance, therefore the kWh out of the heating appliance rather than kWh in. This model would have incentivised the HaaS provider to ensure the operational efficiency of the heating appliance was as great as it could be, therefore, reducing energy use inefficiencies and over consumption of energy.

However, we were unable to create this model due to the legalities around kWh and energy price caps, therefore, the HaaS provider would be unable to apply a price that would account for any energy lost in the heating process.

#### 4.4 Other findings of market research

The findings of market research have already been discussed throughout this report. There were no other findings as we tried to ensure that the primary research was targeting the legal environment and the commercial environment (including customer research). This research has already been discussed throughout this report.

#### 4.5 Did we participate in the FCA Regulatory Sandbox?.

There was no participation with FCA Regulatory Sandbox needed as City Science has an established partnership with the Koze group (who are FCA authorised) and are an appointed representative of them, which would allow for the provision of finance if necessary.





### 4.6 Legal research summary and key regulatory considerations

Through collaborating with Stephens Scown, we were able to understand the regulatory environment in greater depth. HaaS is a unique innovative product that would potentially operating in highly regulated sectors and industries; therefore, it was important to understand the regulations in detail.

Energy Regulation: Downstream gas and electricity are regulated by OFGEM, which administers and enforces the statutory licensing regimes under the Gas Act 1986 and the Electricity Act 1989 (Energy Regulations). Whether the Energy Regulations are applicable to HaaS will be dependent on which HaaS approach is chosen. Namely whether the model includes the provision of energy and the method of billing the customer (i.e. in kWh or otherwise). When researching the allencompassing HaaS model where the customer is provided warmth rather than billed in kWh, Stephens Scown and their specialist counsel found that it is "capable of falling outside" of licensing regulations, therefore, it is possible for a HaaS supplier to not hold an Ofgem licence. This is a very grey area and will need detailed monitoring and careful communication with Ofgem in order to move forwards with HaaS commercialisation.

**Financial Regulation:** A HaaS model that involves the provision of credit on a retrofit would require the finance provider to be FCA authorised. This can therefore be provided by a third-party provider (with FCA authorisation) or the HaaS provider can become FCA authorised themselves.

City Science has an established partnership with the Koze group (who are FCA authorised) and are an appointed representative of them, which would allow for the provision of finance if necessary.

**Commercial Law:** There are many practical considerations that would need to be carefully drafted as they would be bespoke to the scheme. This suggests it might be worth splitting the HaaS contractual relationship with the customer into separate functioning contracts, such as, Retrofit Services, Provision of Credit, and the Provision of Comfort.

Consumer Regulation: HaaS has been considered in the context of homeowners (as detailed above), who will be treated as consumers and subject to consumer protections under Consumer Regulation. Such protections would relate to the standard of services performed, the amount of pre-contract information given to the consumer, termination and cancellation rights of both the consumer and the HaaS provider. Any HaaS provider contracts with its customers should adhere to (and avoid contradicting) such Consumer Regulations, as they will apply regardless of what the signed contract provides.

**Data Protection:** As discussed elsewhere within this Discovery Report, the HaaS provider would be collecting and handling data obtained through several sources (for example directly from the customer and through monitoring systems within the property). Where such data is considered to be "Personal Data" (being any information relating to an identified or identifiable natural person), the HaaS provider is likely to be deemed a controller or a processor of personal data and therefore will be under strict obligations under the UK's data regime.







**Health & Safety:** The nature and extent of the health and safety duties that a HaaS provider will be required to discharge or comply with will depend on whether ownership and responsibilities regarding inspection, maintenance and repair are retained. Such duties are contained within the principal health and safety legislation applicable in England and Wales, including Gas Safety (Installation and Use) Regulation 1998, Electricity at Work Regulations 1989 and Health and Safety at Work etc Act 1974.

**Building Regulations**: Where any construction works are undertaken in connection with (for example a retrofit), the HaaS provider will need to comply with any applicable building regulations.

Commercial Considerations: There are many practical considerations that would need to be carefully drafted as they would be bespoke to the scheme. This suggests it might be worth splitting the HaaS contractual relationship with the customer into separate functioning contracts, such as, Retrofit Services, Provision of Credit, and the Provision of Comfort. Stephens Scown also considered the transferability of customer contracts, and specifically where a customer decides subsequently to sell their property. Stephens Scown considered that it may be possible for the customer to repay the cost to date of any retrofit or alternatively the incoming buyer could step into the shoes of the customer by way of a novation of the customer's contract(s).

In summary: From Stephens Scown's initial legal findings, they could see no reason that HaaS cannot be provided to customers. They identified specific legal hurdles that may be applicable when providing HaaS, caused by a combination of existing laws that can be overcome. Stephens Scown also identified that there is also a degree of uncertainty caused by the lack of regulatory landscape for HaaS.

#### 5 Advice/ Information Research

5.1 The approach to the provision of retrofit advice.

HaaS provides clear incentives for the operator to maximise deployment of costeffective measures under the contractual agreement.

**Initial Engagement**: Because of the incentive to appropriately size/cost measures, HaaS is inherently scientific in its approach. This will require that the property has an initial assessment to determine the current structure of the property, the u-value<sup>7</sup> of original fabric, and to undertake detailed stakeholder engagement to determine the client's desire service level and their monthly budget.

**Efficient Survey**: A HaaS provider is also incentivised to minimise the cost of the initial assessment, while capturing as accurate data as possible. At the point of contract proposal, consumers will be presented with a quote for their heat service and an outline of the types of measures that would be expected under the contract.

<sup>&</sup>lt;sup>7</sup> A measurement of thermal transmittance







**Retrofit Model:** After the initial assessment has taken place, thorough modelling and analysis will be carried out to determine what retrofit measures/heating-system are most appropriate, considering all the customer's specific preferences (including budget). A "whole house"/PAS2035-style approach underpins this to ensure suitability, maximum customer satisfaction and appropriateness.

The discovery phase has demonstrated that the model is routinely commercially advantageous if energy efficiency is maximised whilst adhering to the client's budget to shorten the payback period. The graph below shows that as the energy use in the property decreases the financial return for the HaaS provider increases.

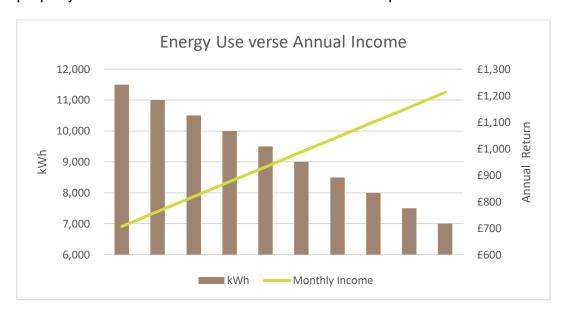


Figure 2. Graph Showing the Energy Use Decreasing and Increasing Annual Return to the HaaS Provider as the Property becomes more Energy Efficient and Customer Pays a Fixed Price (exc. Capital Costs)

**Consultation:** Modelling will result in a series of detailed recommendations that will then be presented to the consumer under the contract for installation. At this stage we will provide advice on alternatives, including options for different service levels, validating that the consumer is happy to proceed.

#### 5.2 Reason for the approach chosen.

This approach was selected due to its "whole house" nature. It considers the energy efficiency of the whole building, not just individual measures. This is because different energy efficiency measures can interact with each other, and it is important to consider the overall impact of any retrofit measures on the energy performance of the building. Also, the PAS2035 approach encompasses everything from fabric retrofit, low carbon heating and renewable energy which is strongly in line with HaaS and its all-encompassing approach.





City Science have also been working with the building performance network on the BS40101 standard<sup>8</sup>. We have taken our knowledge and learning from the Building Performance Evaluation and the verification of upgraded buildings and included these in the verification process.

Additionally, customer insight and satisfaction when delivering retrofit is highly important to us, therefore we have included both a pre-retrofit assessment and post-retrofit assessment consultation with the customer. This allows the customer to give their opinion on the retrofit, state their budget, provide feedback and their required service level.

#### 5.3 The consumer preferences relating to advice and information.

Our consumer survey and the consumer focus group research has shown that consumers prefer:

**Personalised Advice:** Consumers seek personalised advice. Consumers are often confused or overwhelmed when given generic advice, particular in retrofit as costs suggested in generic advice might not relate to the costs they have been quoted in their local area. Additionally, the energy savings given in a general report won't necessarily relate to their home's energy savings as it won't provide a holistic approach to the house retrofit.

Advice presented in a clear manner: Throughout the survey consumers were consistent in their preference around clarity. Consumers preferred clear contracts and clarity in advice. Consumers are often uncertain when investing in retrofit, therefore, a clear direction considering their wants and wishes is preferred.

Advice supported by a guarantee or backed by data: This increases consumer confidence in the retrofit advice as they felt that even if the retrofit was not successful, they would still receive a financial return or be compensated in some way. In the focus group the attendees preferred the advice to be reinforced by the provider via a tangible obligation as it was then not only in the consumers' interest to be the correct advice but in the provider's interest too.

#### 5.4 Integrating advice in the finance product (HaaS)

Providing data backed retrofit advice to the customer and outlining what would provide the most heat efficiency not only benefits the customer, but it also benefits the profitability for the HaaS provider. The greater the energy savings are from the retrofit the greater the reduction in energy usage of the house. Therefore, if providing the Energy Performance Guarantee model or the all-encompassing model it is likely to benefit the HaaS provider. When using the all-encompassing HaaS model, if there is a greater reduction in energy usage post retrofit then the payback

<sup>&</sup>lt;sup>8</sup> A standard that gives guidance on how to evaluate building performance (inc. operational energy)





Green Home Finance Accelerator Discovery Phase Evidence Report: LEGAL AND COMMERCIAL STRUCTURING OF HEAT AS A SERVICE period on that retrofit is shortened (if you keep the customer's energy bill equivalent to what it was previously) therefore reducing financial liability for the HaaS provider and shortening the fixed contract for the customer.

The research has shown that consumers appreciate the all-encompassing approach and simplicity of contract. Therefore, integrating advice to be followed with the installation and management of retrofit means the liability not only sits with the housing asset, it also sits with the HaaS provider too, thus, providing assurance to the customer.

#### 5.5 Choosing bespoke advice verses using an already existing service

Our research has suggested that our own bespoke advice is better suited to the HaaS modelling. This is due to the need for accurate u-value analysis and building assessments to determine the reduction in thermal transmittance once retrofit is carried out. The HaaS model requires bespoke data collection from each property. to determine the energy to temperature output, therefore, standardised advice is not suitable for this product.

The pros of this are:

- The advice is more accurate for that individual property; therefore, this should increase their energy efficiency.
- There will be accurate forecasts on energy savings for the customer prior to retrofit (in the Energy Performance Guarantee model).
- The advice can be tailored to the customer's budget and wants.

The cons to be poke advice are:

- Deploying technology in individuals' households or providing house assessments is more expensive than a standard advice tool.
- Specialist staff will need to carry out the assessments.
- The time to assess the property will be greater than a standard advice tool.

City Science feel that the pros of a personalised retrofit advice outweigh the cons, hence that is the method we would choose when moving forward with the creation and implementation of a HaaS model. The personalised approach has been chosen as although there are cost advantages in the generic approach, in the longer term, there are likely to be financial disadvantage the HaaS provider. To deliver the HaaS models the provider will need accurate readings and to provide the customer with detailed costings, therefore, it is not reasonable to deliver blanket advice when delivering HaaS.

#### Verification methodology research

#### 6.1 Verification and quality assurance of home retrofit installations

Data and verification are essential under the HaaS model to ensure that learnings from each building deployment/retrofit/installation are taken forward into subsequent modelling and service offers.

In the discovery phase we concluded the detailed verification and monitoring that was at a level suitable to inform the types of financially guaranteed contracts delivered through HaaS.





Our HaaS model will adopt a scientific approach to the end-to-end process. This will include:

**Home Energy Modelling:** Prior to installation City Science will conduct detailed analysis using a survey and dynamic energy model, identifying current heat efficiency of the property and rate of heat loss through different thermal components. The Home Energy Model will provide the baseline understanding of the system for verification/assessment of energy savings.

**Pre-/Post-Installation Monitoring:** Detailed, multi-room/space monitoring will be installed pre- and post- installation with thermal, electrical and other measures used to enhance/validate the Home Energy Modelling.

**Verification:** Post-installation verification will then be performed, utilising the model to identify detailed variances against the originally forecasted energy savings. This will determine whether the expected energy savings were met, while developing a databank to enhance the accuracy of the retrofit and energy saving model.

There is a significant incentive to use verification to understand and narrow the performance gap and improve the accuracy of the model to reduce any financial liability within the HaaS proposition.

**Process Analysis:** Detailed, disaggregate modelling and monitoring will help adopt a scientific approach to the end-to-end HaaS process, for example helping to understand the role of training and human factors in successful intervention/retrofit delivery.

### 6.2 Why was this approach selected?

The approach was selected due to the necessary accuracy required for HaaS models. Both the Energy Performance Guarantee and Comfort as an Outcome HaaS model requires energy forecasting post retrofit, therefore the models must be verified and accurate post deployment.

Home Energy Modelling will be the baseline for understanding the system of verification due to the incorporation of analytical software, and considerations for variables, such as, climate, orientation of home, occupants' energy habits and several more. The factors considered in Home Energy Modelling are all important variables when considering the temperature of a home and its heating efficiency. The software analytics will provide detailed data analytics provided through home sensors. These sensors will enable the HaaS provider to gain data readings on energy usage and temperature of the property without having to visit the property on several occasions, thus providing a non-intrusive verification process.

This analytical approach was also taken as the data readings can be saved to a databank and monitored pre- and post-retrofit determining the accuracy of pre-retrofit forecasted energy usage. This data bank will be used to increase accuracy of retrofit and energy savings modelling prior to retrofit. This will not only help the customer meet their required energy savings post HaaS implementation, but the verification will also additionally help the HaaS provider create a more accurate model.





# 6.3 Research that informed design choices for verification, quality assurance, and consumer preferences.

The commercial analyst and financial modelling demonstrated we needed to use the most accurate recording methodology primarily due to the financial liabilities. If the data is inaccurate in the HaaS models the HaaS provider would face significant financial liability. This was shown as significant when we carried out the financial modelling. For example, if the temperature to energy ratio was significantly different than forecasted, the all-encompassing HaaS model and Energy Performance Guarantee could face financial losses.

Additionally, we chose to use technology within someone's home as it presented a non-intrusive method of continual analysis, allowing for the accuracy of temperature versus energy to be analysed pre- and post-retrofit and throughout the lifetime of the project. In the focus group consumers highlighted that they would want a simple process that did not need excessive monitoring of intervention, therefore this would be easily applicable monitoring without constant human intervention.

#### 6.4 Verification activities integrated within the consumer journey.

Due to the nature of HaaS the verification process will need to be undertaken throughout the customer's journey in order to ensure that the energy to temperature ratio stays within a certain range and the temperature of the property is to the customer's requirements. HaaS is not only a finance product, but it also considers the energy and temperature provision of the property over the entirety of the contract; therefore, the data analysis and verification will be ongoing.

If the correct temperature is not maintained and the energy to temperature ratio is not precise then the HaaS provider would be subject to liability. Therefore, it is important to verify over the entirety of the customer's contract.

As the verification process is primarily using hardware/software in the form of temperature sensors and smart meters this will be a non-intrusive process, thus, easier to maintain over the lifetime of HaaS. We found in the focus group that users of a HaaS model would want the model to be as simple as possible without excessive amounts of in person monitoring, thus the non-invasive sensors allow continuous verification to take place without large amounts of customer disturbance.

#### 6.5 Identified steps to minimise the risk of fraud and mischief by customers

Our research found that HaaS customers could behave in certain ways that would reduce the heating efficiency of the property and possibly result in financial compensation of the HaaS provider or excessive energy usage. Therefore, we developed contractual and technological methods to overcome this.

Contractual methodology of overcoming detrimental customer behaviour when heating their property consisted of contractual restrictions, whereby, if these behaviours were noticed the HaaS provider could require compensation or termination of contract.

The technological method of overcoming customer behaviour challenges such as leaving windows and doors open for long periods of time would be the deployment of sensors on doors and windows. Therefore, the HaaS provider would be made





aware if doors and windows were open for long periods of time whilst the heating was on. This would allow the HaaS provider to utilise the contractual provisions with sufficient evidence of detrimental behaviour towards heating efficiency. Additionally, there could be an algorithm that can analyse the space heating versus water heating. Water heating tends to happen at the same point each day, thus, it is easy to identify when large changes in behaviour occur, ensuring that excessive amounts of water aren't being heated. If there was a circumstance whereby the customer needed an allowance for unusual behaviour, the customer would need to engage with the HaaS provider and agree conditions prior (or shortly post if unforeseen) the event occurring.

In terms of financial fraud there would be credit checks carried out prior to loans being given and transaction monitoring and other anti-fraud policies would be carried out throughout HaaS contracts.

#### 7 Marketing related research

### 7.1 Research findings related to consumer marketing preferences

Consumers tend to lean towards trusted suppliers: Customers tend to be more willing to purchase from well-known trusted suppliers. Uncertainty deterred customers from purchasing from new/unknown suppliers.

Consumers are more likely to choose the product based on price: Price comparison websites are often how consumers say they find their energy contract and the price is what incentivised them to choose that energy/finance provider.

Consumers prefer clarity and understanding of the product: Consumers preferred simple products that were easy to understand and not complicated. This was mentioned several times.

**Environmental benefits were important to customer:** Over 50% of the survey respondents stated that an energy contract being environmentally green was important to them, therefore, this could be utilised in the marketing of HaaS.

#### 7.2 How proposals for our marketing approach developed over the project?

Originally the idea was to carry out direct marketing to customers of the HaaS products, however, throughout the project we felt that customers are resistant to companies that they don't recognise or cannot access on comparison websites. Therefore, the marketing strategy was updated to:

Market through a retrofit provider (if marketing the Energy Performance Guarantee model): through partnering with a trusted retrofitter, we would be able to attach the additional consultancy work and guarantee easily and capture the customer's trigger point of already considering retrofit.

Create a comparable price and model of HaaS (all-encompassing): Create a product that could be possible to advertise through price comparison sites (subject to assessment). This would capture a larger audience and utilise a customer trigger point of switching energy providers.

**Partner with a trusted energy provider:** an alternative method of marketing HaaS could be through partnering with a trusted energy provider.





When marketing the HaaS product it needs to be through a trusted provider or platform in order to encourage a consumer to buy into the product, and target a trigger point.

#### 8 Future Plans for green home finance

Utilising lessons learnt to develop future products:

Increase awareness of the regulatory environment surrounding green finance products: Our project carried out extensive research into the regulatory environment of a green home finance product. These learnings can be taken and implemented to other green finance products. These learnings can be shared and disseminated.

**Engagement with consumers:** Through engaging with consumers, we have been able to identify key likes and dislikes. For instance, we now know that consumers are more price sensitive than they were previously, this can be carried forward to other green finance products.

**Creating ideas for innovative solutions:** This project has shown that innovate solutions enabling green finance are possible in the regulatory and commercial environment without the need for legal/regulatory chances or extremely expensive commercial models.

#### 8.1 How lessons learnt apply towards our future green home finance development

The lessons learnt in the project will be applied to further develop future green home finance products through understanding the legal environment that they operate in and being able to navigate its complexities.

In this project we carried out in-depth legal research on the legal and regulatory environment. This will provide useful knowledge in further development of green home finance products. Also, we have established a strong relationship with Stephens Scown. This partnership will allow us to create consumer contracts in future and effectively engage key regulatory bodies in the development of green home finance solutions.

Additionally, we have gained customer research and developed our knowledge of what customers want from a green finance product. This knowledge can be taken forward to develop and refine future products and marketing through understanding consumer likes and dislikes. For instance, we now understand that consumers are unsure when it comes to billing in warmth. Therefore, if we choose to develop HaaS further we will consider this when marketing to potential customers.

# 8.2 Utilising learnings from this programme to develop propositions or disseminate learnings.

Our project aims to support the market development for HaaS in the UK by disseminating learnings to wider industry to support effective design and development of future green finance propositions.

To support new propositions/market integration we will provide:





**Reports:** Prepare and publish detailed reports/white papers, documenting the project methodology, pilot findings, outcomes, and insights.

**Publications:** Publish blogs and case studies on our website, social media channels, and monthly newsletter.

**Active presentation:** Attend industry conferences/events to share learnings and identify opportunities for lender/supply chain integration. E.g. During the Discovery Phase we attended the Centre for Greening Finance and Investment annual conference, and the Installer Show. We have already committed to presenting at Construction Week 2023 where we will continue to build supply chain relationships.

**Collaboration:** Collaborate with industry associations and organisations to share findings through their networks (e.g. Building Performance Network). During the Discovery Phase, we presented our proposed solution to the Association of Mortgage Intermediaries, who showed a strong interest. We are particularly interested to disseminate our learnings regarding the green finance spread, to stimulate the market for more cost-effective green lending/investment.

**Policy insights:** Engage with national and local policy makers to share learnings and insights. For example, through the Discovery Phase we shared learnings with the policy team in the Department of Energy Security and Net Zero. We also have strong relationships with local authority policy teams throughout the UK (Oxford, Cambridge, Cornwall, Hounslow, UK100/LGA) with a keen interest in accelerating retrofit.

### 8.3 Key challenges or barriers for the future development of HaaS

Key challenges we see in future development are:

**Financial forecasting:** In green home finance the financial forecasting models have multiple variables, some of which, often fluctuate and are not very stable. Variables such as the cost of energy and the cost of finance are likely to fluctuate in future. Therefore, this makes the financial forecasting and modelling to determine commercial profitability challenging.

**Price of Gas versus Electricity:** Currently the price of gas is significantly cheaper than electricity. This means that customers are disincentivised to purchase a heat pump or other heating appliances that run on electricity even if the upfront cost of the appliance is catered for. This is likely to be a long-term barrier in moving over to electrical appliances that could be ran by renewable energy unless the price point of electricity verses its alternatives reduces.

**Regulatory Changes:** Green home finance products are often new and innovative products without established regulation. The regulations tend to evolve as the product develops. For example, Heat Networks were unrecorded and unregulated until 2014 when the Heat Network (Metering and Billing) Regulations were passed. The Regulations now require suitable meters to be installed and the customer to be billed accordingly. This example suggests that statutory framework and regulations relating to a green finance product could change over its lifespan, suggesting they could be open to regulatory barriers in future.





**Demand Side Barriers:** Consumers can be set in their ways and adopting new innovative methods of finance or heating might be overwhelming or create uncertainty. This will need to be overcome through various marketing methods and consumer engagement to provide the necessary reassurance to consumers.

#### 8.4 Solutions to address barriers identified

In order to address barriers above there would need to be:

**Methods of securing long-term price stability:** This challenge could be addressed through financial hedging or the purchase of a purchase power agreement (renewable energy) to ensure the green home's finance provider has long-term stable prices. However, this could also result in economic losses if the market price fell below the purchased price.

A reduction in the price of electricity versus gas: This could be resolved through a government subsidy on electricity, or renewable energy. Through reducing the price of electricity this would increase the demand for heat pumps and other heating appliances that are low carbon.

**Demand Side Barrier:** There are several methods of addressing demand side barriers; marketing and influencing behaviour, policy and government influence, public education of sustainability issues and methods to lower your carbon footprint, reducing the costs (decreasing barriers to uptake). All of these can either be applied separately or jointly to help encourage consumer uptake of low carbon technologies.





### **Annex**

### Tables showing hardware Research carried out:

Component Type	Manufacturer	Model	Accuracy	Resolution	Range	Temporal granularity	Data transfer mechanism	Power requirements (battery or wired)	Battery life	₩arranty	Specification
Temperature sensor	Purrmetrix	PMTX010001	±0.5oC	±0.12oC	-10 to 85oC	30 seconds	Sensors report data wirelessly to a gateway unit over a range of 40m (max 60m). A single gateway unit can collect data from up to 200 kittens.	battery	3 years	1 year	https://www.purrmetris.com/wp-content/uploads/2018/07/Temperature-sensor- datasheet-15-1.pdf
Humidity sensor	Purmetrix	PMTX010003	± 8% between 20-80% RH ± 15% between 30-100% RH	0.2% RH at room temp	20-100%	30 seconds	Sensors report data wirelessly to a gateway unit over a range of 40m (max 60m). A single gateway unit oan collect data from up to 200 kittens.	battery	3 years	1 year	Temperature-humidity-sensor-datasheet-15-1.pdf (purrmetrix.com)
CO2 sensor	Purrmetrix	PMTX010008	± (50ppm+3%) in a working environment of 0- 50oC and 0-90% RH	10ppm	up to 5000ppm CO2 operating range 0- 50oC	30 seconds	Sensors report data wirelessly to a gateway unit over a range of 40m (max 60m). A single gateway unit can collect data from up to 200 kittens.	mains powered	N/A	1 year	CO2-sensor-datasheet-v-2.3-1.pdf (purrmetria.com)
Gateway unit	Purrmetrix	PMTX020017	N/A	N/A		10 seconds	Gateways are radio recievers that listen to kittens, collecting data from up to 200 kittens where they are in range. They deliver data to the web application via an ethernet connection.	mains powered	N∤A	1 year	Purmetrix-gateway-datasheet-v5-1.pdf
Wireless Temperature Sensor	tado		±0.01oC	Not provided	Not provided	Not provided	Connects to an internet bridge via radio waves. The internet bridge is plugged into your rooter via USB. Can connect to smart systems such as alexa and google. ('tado' is compatible with most smart home systems')	battery		2 year	https://www.tado.com/gb-en/wireless-temperature-sensor-specifications
Wired Smart Thermostat V3+	tado		±0.01oC	Not provided	Not provided	Not provided	wired connection to boiler/ underfloor heating. Connects to internet bridge via radio waves, which is plugged into router. ('tado' is compatible with most smart home systems')	battery		2 year	Save Heating Energy With Wired Smart Thermostat Ltado."
Internet Bridge	tado		N/A	Not provided	Not provided	Not provided	plugged into router	plugs into thermostat via USB		2 year	Save Heating Energy With Wired Smart Thermostat I tado
Temperature & Humidity Sensor	Aeotec		±3% RH ±0.8oC	Not provided	humidity: 0 to 80% BH temperature: -10 to 65°C dew point: -10 to 65°C humidity: 20 to	Not provided	Can connect to a Z-wave gateway/controller e.g. SmartThings Hub	battery	2 years	1 year	aërQ Sensor – Aeoteo
Multisensor 6 (motion, temperature, light, humidity, vibration, UV)	Aeotec	ZW100	± 3% RH (at 25°C/77°F) ±1°C	Not provided	humidity: 20 to 90% RH light: 0 LUX to 30000 LUX, UV: 0 to 10 UV	Not provided	Can connect to a Z-wave gateway/controller e.g. SmartThings Hub	battery	2 years	1 year	Multisensor & technical specifications.: Aeotec Help Desk (freshdesk.com)
Aeotec Smart Home Hub	Aeotec		N/A	N/A	N/A	Not provided	can connect Z-Wave, Zigbee or Wi-Fi devices, which are Works with Smart Things certified. All these devices are connected directly to the Hub and can be controlled and managed	mains powered		1 year	Smart Home Hub technical specifications : Aeotec Help Desk (freshdesk.com)
Thermo-Hygrometer	Govee	H5179	±0.3oC ±3% RH	Not provided	temperature: -20 to 60°C	2 seconds	No need to connect to a hub from my understanding	battery		1 year	Govee Wi-Fi Temperature Humidity Sensor - Indoor - UK-GOVEE
Smart Temperature and Humidity Sensor, comes with smart hub	meross	MS100	Temperature Acouracy (0°C*40°C): ±0.3oC Temperature Acouracy (Full Range): ±0.7oC Humidity Acouracy (@25°C 177°F from 20% *80%): ±3% RH Humidity Acouracy (@25°C 177°F from 0% *100%): ±4.5% RH	Not provided	humidity: 0 to 100% RH temperature: -10 to 50°C		Connects to Mercos hub, which allows it to access the internet. They both support a wide range of third- party smart home hubs, including Homekif, Alexa, Google Assistant, SmartThings, and IFTTT: https://www.techhive.com/articlef579037	battery		2 year	3242777.pdf (d2utgrzbxqaq8t.oloudfront.net)
Multipurpose Sensor (temperature, doors opening and closing, vibration)	Samsung	3P-U999SJVLAEA	: Not provided	Not provided	temperature: 0 to 40°C		Sends data to 'SmartThings' hub	battery	Up to 2 years	1 year	https://www.samsung.com/uk/smartthings/sensor/smartthings-multipurpose-sensor-gp u999siylaea/





Manufacturer	Which services?	Smart technology	Connection	Access to data mechanism/ control mechanism	Controls	Additional notes! special features	Hardware	Links
Daikin	Air conditioning systems and heating systems List of connectable units: https://www.daikin.co.uk/en_gb/product-group/control-systems/daikinonline-controller/connectable-units.html	yes	Connect to internet with cable or WLAN	Cloud and onecta app, also offer Individual control systems with user interfaces to adjust temperatures ect.	thermostat, set temperature schedules, review your energy consumption, set temperature set point, set operation mode, set fan speed,	voice control functionalities available with Alexa and Google home WLAN/SD card included with the indoor unit. Comes pre-fitted with the cloud and app control functionality. Simply insert the included SD card into the indoor unit to initiate. "Daikin cloud services" portal for commercial hps	Daikin control board	Daikin Altherma 3 H HT_787.pdf
Kensa	Genesis System Manager in the Kensa evo	yes- although a bit unclear	"Kensa's heat pumps can be integrated with smart controls" "Kensa heat pumps are cleverly designed to work with any smart control app or system!"	touch screen display, also mentions potential for remote/online control	Programmable to control two different heating set points, production of domestic hot water, cooling as well as passive cooling control".  Optional use DHV boost controller synchronised to the heat pump cycles, minimising any additional energy use.  Ability to call a hot water tank immersion heater for a period of time after the heat pump has finished its hot water cycle. Designed for instances where the installation demands stored hot water at higher than 60°C or where high system heat losses mean that 60°C hot water is not achievable with the heat pump alone.  Ability to call a hot water tank immersion heater for pasteurisation.  Ability to call a hot water tank immersion heater for pasteurisation. Ability to call an external supplementary heat source. Particularly useful in open loop systems when the open loop source gets very cold resulting in the heat pump struggling to reach temperature.  Ability to cut out additional heating circulation pumps when the heat pump is in domestic hot water mode.	Live CoP reading displays the real-time system efficiency.	Genesis System Manager: The control board is a universal controller for all products manufactured by Kensa Heat Pumps.https://www.kensaheatpumps.com/gen esis-system-manager/	https://www.kensaheatpumps.com/genesis-system-manager/ https://www.kensaheatpumps.com/homeowner/energy-saving-tips/
Samsung	ClimateHub; EHS Monobloc; EHS Split ASHP; EHS TDM Plus	yes	Wifi Kit is connected to hp and presumably sends information to a cloud using Wi-Fi, so it can be accessed from the Smart things app.	SmartThings app, smart devices (Alexa google ect. ), touch controller	room temperature can be automatically set at the desired level when the user approaches within a pre-set distance from the building. Energy usage monitoring allows you to view your daily, weekly, and monthly energy usage.		With the Birby 2.0 Artificial Intelligence (Al) system', user voice commands' can be carried out by the device. It even analyses the environment, preferred mode, temperature and suggests the best settings enabling optimate	https://www.samsung.com/uk/business/olimate/heat-pumps-home/ https://images.samsung.com/is/content/samsung/p5/uk/business/olimate/for-installer/SEACE_EHS_Catalogue_2020_2021- single_LB_df0/bwt.pdf
Mitsubishi	MELCloud for Ecodan. For some HPs wifi control I sinbuilt, for others it is optional (see spec).	yes	Vifi	Cloud based solution for controlling your heating system locally or remotely, MELcloud app	On/OH; Mode; Set point; Hot water boost; 2-Zone control; Holiday mode; Timer; Frost protection	Can control multiple HPs in different locations Wi-Fi Control is Amazon Alexa and Google Home enabled so you can take		Ecodan MELCloud Product Information Sheet - Document Library - Mitsubishi Electric https://www.mitsubishi- electric.co.nz/materials/aircon/brochures/@HeatPumpRange.pdf
LG	LG Monobloc	yes	USB connection into HP then presumably to server/ cloud via Wifi	LG SmartThinQ™ app, Also a touch screen UI	• On/Olf • Operation Mode Selection • Current temperature • Set temperature • On/Olf Reservation • Eneroy Monitoring			CT32004443_1641.pdf (lg.com)
Viessmann	Vitocal	yes	Vitoconnect is an interface between the HP and ViCare. It is connected to hp with a cable is connected to the monected to the Wi-Fi. Then gou soan a QR code to access the data on	ViCare app	You can set the required room temperature via the touchscreen, and switch between standard and party mode. You can also use the app to mointor if your heta pump is fuctioning as it should and offers to contact contractors.			1908 Vitocal-Heat-Pumps-Brochure VD.pdf (viessmanndirect.co.uk)