ARUP

Green Homes Finance Accelerator

Leeds Low Carbon Accelerator

Discovery Phase - Evidence Report

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1. Executive Summary

1.1 Introduction, aims and objectives

The Leeds Low Carbon Accelerator (LLCA) aims to design and deliver at speed a scalable, replicable, hyper-local, place-based concept for retrofit and decarbonisation of homes. In collaboration with Leeds City Council (LCC) and the West Yorkshire Combined Authority (WYCA), Lloyds Banking Group (LBG) and Octopus Energy are partnering to establish a 'one-stop-shop'(OSS) that will provide a first-of-its-kind hyper-local, fully supported end-to-end customer proposition to enable homeowners to retrofit their homes. LCC is working with LBG and Octopus Energy Leeds OSS as a way to create and test green finance retrofit offers, including the potential for a new product such as Property Linked Finance (PLF).

The aim of the GHFA Discovery Phase has been to investigate governance and delivery model development options for the OSS:

- undertake market testing on consumer attitudes towards retrofit to inform the OSS customer journey,
- undertake market testing on consumer attitudes towards retrofit finance products including PLF,
- investigate the potential for smart tariffs in combination with retrofit to provide additional financial savings and reduce payback times, and
- develop new partnerships to progress the LLCA proposition and PLF more widely.

While the OSS set up and activities, such as the design of the customer journey, marketing, provision of retrofit advice etc, are not within the scope of the GHFA Discovery Phase, the Discovery Phase has provided valuable findings to support the development of the OSS customer journey and the customer proposition, while priming the wider market and supply chain for growth in retrofit demand.

1.2 Project structure

The total forecast project cost for the LLCA Discovery Phase was £486,950 and the Department for Energy Security and Net Zero (DESNZ) grant contribution was £194,780.

The LLCA is made up of Leeds City Council in a consortium with Lloyds Banking Group (LBG) and Arup, with support from the UK Infrastructure Bank (UKIB), West Yorkshire Combined Authority (WYCA) and close collaboration with Octopus Energy.

Leeds City Council is the lead consortium partner. LCC has been responsible for administering the partnership and procurement under the GHFA Discovery Phase, while also participating in the project through overseeing customer research on retrofit, maintaining regional and national links to share learning, particularly with WYCA, Green Finance Institute (GFI), and UKIB.

LBG led the work package on PLF, including extensive customer research on financing retrofit and research into the development of PLF. In parallel, LBG is currently partnering with GFI to develop property-linked retrofit finance.

In collaboration with Octopus Energy, LBG also led the development of the governance and delivery model research for the Leeds OSS. This work package included input from KPMG on research into possible delivery models.

Arup led on project management and coordination of work packages, GHFA reporting, and on research into the additional benefit of smart tariffs in combination with retrofit.

Finally, local SMEs Otley Energy, Social Communications and Snook were subcontracted to develop the customer value proposition and engage with the local community to test and develop the customer journey.

1.3 Key barriers and challenges

This project seeks to address three core challenges which are slowing down energy efficiency retrofit amongst more affluent, or 'able-to-pay' householders. The key barriers facing this consumer segment are: a complex customer journey, a fractured supply chain and an unattractive financial proposition. Responding to these challenges, the LLCA has identified five core components and objectives for the desired delivery model:

- Retrofit interventions: assessing combinations of retrofit interventions resulting in the selection of suitable retrofit "packages", as well as investigating combining them with a smart tariff to unlock greater financial savings;
- Customer journey: providing a simple process and a long-term relationship across multiple intervention phases;
- Delivery vehicle: an OSS solution with a separate delivery entity and finance provision from the wider market;
- Customer engagement strategy: making the case and building customers through local influencers and leaders within the community;
- Financial offer: exploring PLF to decouple the retrofit intervention finances from the homeowner and link it to the property itself.

1.4 Key findings

The Discovery Phase has led to a number of findings that will support ongoing development of a retrofit OSS and retrofit finance propositions. These include:

Attitudes to retrofit

Customer perception: retrofit is generally perceived as a practical rather than an emotional purchase, driven by financial benefits rather than intangible benefits. This is problematic when capex costs are significant and paybacks up to +30 years, making retrofit appear unattractive and unaffordable. Hence further effort is needed to simultaneously reduce upfront costs and increase the perceived value of retrofit.

Customer journey features: focus group testing highlighted a number of features that would be sought from a retrofit customer journey. These include trust, personalisation of retrofit advice, local delivery and marketing, and availability of low cost of finance. A one-stop shop approach could provide all of these features.

A hyper-local approach: local engagement and local partnerships are key to developing trust and supporting customers through their retrofit journey, as well as a hyper-local approach to marketing.

Personalisation: in order to increase the take-up of energy efficient technologies, customers want a highly personalised service that recognises their individual needs and circumstances. Our feedback showed that people's motivations to improve their home's energy efficiency were closely connected to the type of property they live in, and messaging and communications must recognise this.

Attitudes to retrofit finance

Finance as an enabler: customer research findings suggest that retrofit finance is much more likely to enable retrofit for those already interested and motivated, rather than drive retrofit demand.

Retrofit finance product features: customers were found to focus primarily on the financial terms of the product. The key product features that would help consumers with decision-making for financing retrofit are: affordable monthly payments, low interest rates, finance attached to property, public sector backing.

Appeal of PLF: we found that there is generally a lack of awareness of retrofit financing available, and unfamiliarity with a product such as a PLF. However, once explained, the concept of PLF was considered to be appealing, particularly for younger, more affluent homeowners. A recurring concern for this homeowner group was the potential negative impact on selling their property. Older, less affluent homeowners also ranked PLF favourably compared to other methods of borrowing such as a credit card, personal loan or a further advance on an existing mortgage. The positive sentiments from both these groups were that PLF is innovative, considered to be offering good value and is fair.

PLF market building: to address this particular barrier, cross-industry work is needed to build confidence and understanding of PLF, at both a national and local level, such that it becomes as well-understood as products such as a help-to-buy ISA. Uptake will be limited unless a PLF product is available as a national offer from multiple lenders, and is recognised across the local house-buying chain.

Reducing energy bills: reducing energy bills remains a primary concern for homeowners. Smart tariffs in combination with retrofit could support the overall financial proposition of retrofit by further reducing energy bills and reducing payback times. However, the current electricity and gas pricing mechanisms and the variation of energy prices over time challenge this. Currently, the cost of carbon is reflected in the electricity price but not in the gas price, therefore carbon costs need to be captured to make electrification more appealing.

1.5 Key process learnings

The GHFA Discovery Phase has enabled essential research and development for the LLCA to build on, putting us in a strong position to continue with subsequent phases of the project. The Discovery Phase has helped build relationships and supported the wider development of a delivery partnership.

A specific learning for us would have been to have a firm partnership with an energy supplier prior to beginning on the smart tariff work, such that the level of engagement with the findings could be higher, and more actionable recommendations could have been identified.

In addition, we have learned that much more work is needed to develop PLF, and on a wider scale, than we had anticipated before beginning the Discovery Phase.

The work we have undertaken in the Discovery Phase is closely linked to other work happening in the industry, which has not been progressing along the same timescales as the Discovery Phase. Therefore, due to the relatively short time frame of our project, we have not been able to benefit from outputs from these external activities. A longer Discovery Phase could have been beneficial for this reason.

The pause as we await the outcome of our Pilot Phase funding application means that we are losing momentum. To prevent this, we would recommend a longer-term grant that progresses through stage gates to a Pilot phase.

1.6 Reflections on key outcomes achieved

Key achievements of the Discovery Phase work include:

- Identifying valuable customer insights to generate guiding principles to be applied in the development of an effective customer journey for the Leeds OSS;
- Aside from the three barriers to retrofit that we had already identified, namely the complex customer journey, fragmented supply chain and unattractive customer proposition, we have identified a fourth: disruption, or perceived disruption, of retrofit works, which the Leeds OSS will aim to address;
- Validating the concept of a OSS that provides end-to-end retrofit advice to customers and signposts to potential financing options;
- Highlighting the specific barriers that need to be overcome to enable the deployment of PLF, enabling us to plan subsequent phases of work;
- Highlighting the features of green finance products that are most likely to be adopted, to inform the future development of retrofit finance products;
- Establishing a robust partnership among the project partners, and widening the LLCA consortium to further develop the proposition with the addition of two partners, GFI and Octopus Energy, putting the consortium in a strong position to address market failures;
- Initiating engagement at a hyper-local level in Chapel Allerton, Leeds, which has provided valuable insights into how best to structure and target further engagement and buy-in from the community.

2. Product introduction

2.1 Overview

The Leeds Low Carbon Accelerator (LLCA) aims to design and deliver at speed a scalable, replicable, hyper-local, place-based concept for retrofit and decarbonisation of homes. The vision is to utilise a one-stop-shop (OSS) delivery vehicle to create and test green finance retrofit offers, including the potential for a Property Linked Finance (PLF) product. The target is to go live in early 2024 with a prototype delivery organisation and then adjust and develop the programme in response to successes and failures along the way.

The LLCA would like to achieve whole house retrofit and decarbonisation, while recognising that this might be achieved in practice over time with more than one package of works to each property. Thus, homeowners should have the freedom to select their own retrofit measure (or package of measures) in line with their own life triggers and home improvement plans.

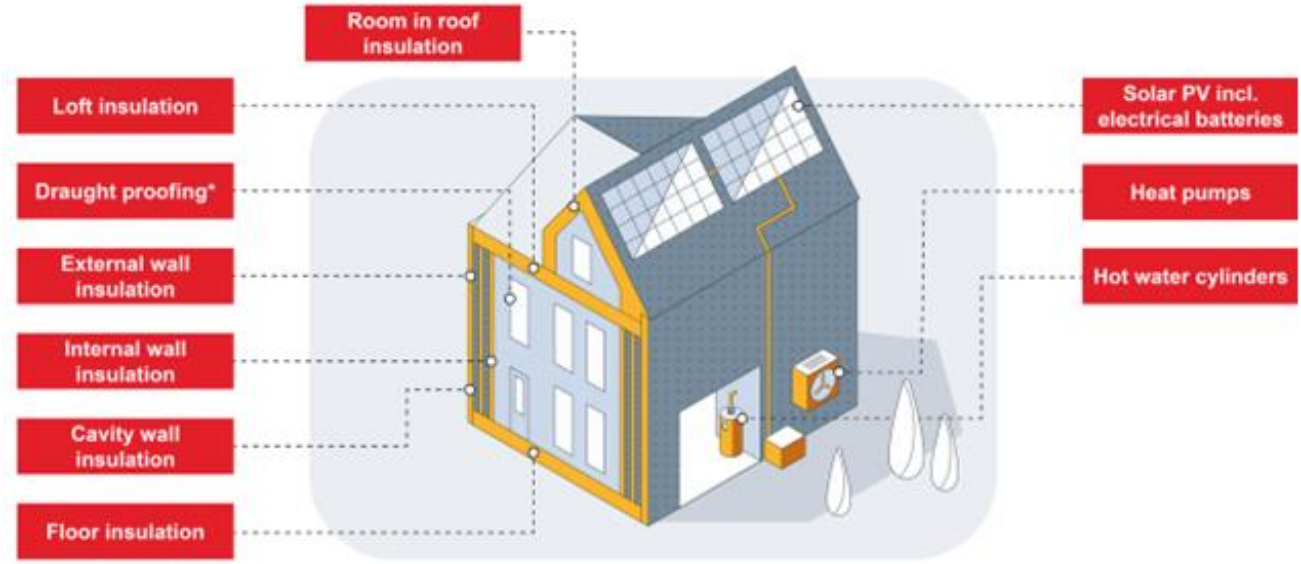

Figure 1: Likely retrofit interventions for customers

The target audience

This project seeks to focus its offer on owner-occupied households, and those identified as middle income, or 'able-to-pay'. Across the UK, 29m homes need to be retrofitted by 2050 – yet this commitment is a challenge for both Government and Local Authorities (LAs). The Government's 2021 Heat and Building Strategy[1] sets out the right ambitions: whole buildings and system approach; driving innovation and supply chain development; ensuring affordability and targeting support for those in need. Delivery programmes accompanying the strategy are a good start, with the Social Housing Decarbonisation Fund (SHDF) 'pump priming' the market through support to the social housing sector and

[1] Department for Energy Security and Net Zero, *Heat and Buildings Strategy*, Available Online: Heat and buildings strategy - GOV.UK (www.gov.uk) [2021]

HUG2 and ECO providing low-income household assistance. However, the 'able-to-pay' market, which mainly consists of owner-occupiers, have little support in navigating their retrofit journey.

Fewer than half of homes in England and Wales have an EPC of C or higher, and with about 2/3 of households in the UK being owner-occupied. This signals a significant demand for a product that is targeted at homeowners[2]. With around 28 million households in the UK, the share of those that are owner-occupied and below an EPC rating of C is likely above 9 million households. Traditionally this customer group has had minimal support in understanding, starting or undertaking their retrofit journey.

Financial products and associated costs

The Discovery Phase has highlighted that consumer choice is important and that a range of products is needed to suit customer preferences. The OSS will therefore need to trial different iterations and/ or products to test customer interest for different finance products including responses to different interest rates, product terms, monthly repayments etc. to pilot a spectrum of financial products specific to domestic retrofit.

2.2 Overcoming consumer barriers

The LLCA is taking a whole-system approach to tackling the barriers to retrofit by placing the development of a compelling offer at the heart of a series of enabling interventions to stimulate the market. This combines a longer-term approach with immediate and foundational market testing and development, allowing the concept of agile delivery to be tested with a segment of the housing market, whilst simultaneously building the longer-term capability and model required to retrofit all homes in the future.

[2] Office for National Statistics, *'Energy efficiency of housing in England and Wales: 2021'*, Available Online: Energy efficiency of housing in England and Wales - Office for National Statistics (ons.gov.uk) [10 Nov 2021]

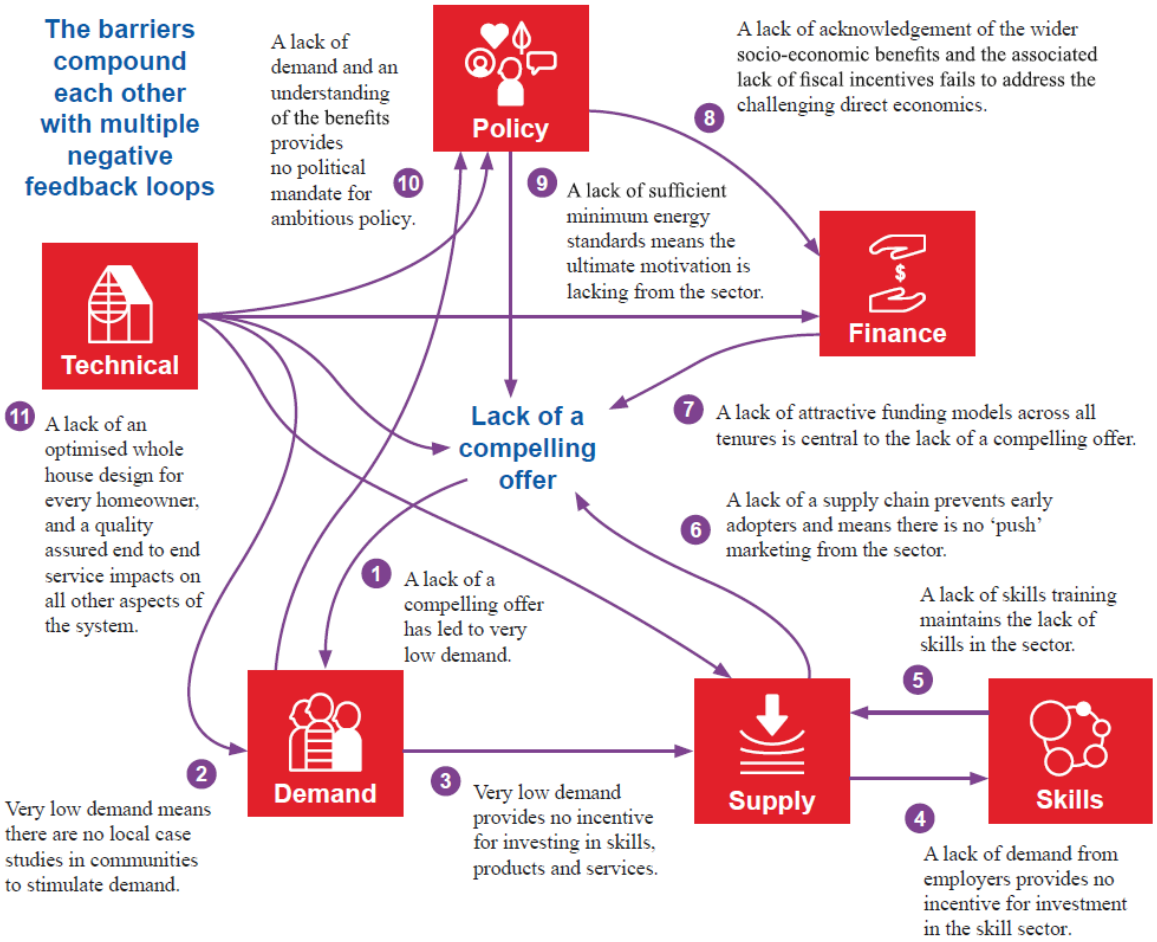

Figure 2: Barriers to retrofit and their feedback loops (Otley Energy)

With minimal existing support, the key barriers facing the LLCA consumer segment are a complex customer journey, a fractured supply chain and an unattractive financial proposition. Responding to these challenges, the LLCA has identified five core components and objectives for the desired delivery model:

- Retrofit interventions: assessing combinations of retrofit interventions resulting in the selection of three retrofit "packages";
- Customer journey: providing a simple process and a long-term relationship across multiple intervention phases;
- Delivery vehicle: a OSS solution with a separate delivery entity and finance provision from the wider market;
- Customer engagement strategy: making the case and building customers through local influencers and leaders within the community;
- Financial offer: exploring PLF to decouple the retrofit intervention finances from the homeowner and link it to the property itself.

3. General scoping research and other activities

3.1 Initial research and methodology

During the Discovery Phase, the LLCA team undertook a range of desktop research, qualitative and quantitative market engagement, modelling of energy consumption and bills reductions, governance structure options appraisal, as well as direct engagement with the local community in Chapel Allerton, Leeds. This followed an initial Blueprint Report developed with the support of the Prime Minister's Business Council at the end of 2022, prior to the GHFA Discovery.

Findings are discussed from section 3.3.

3.1.1 Blueprint report

The Blueprint Report (Appendix 1) sets out the ambition and outline structure of the initial ambition of LCC, LBG and other key partners in addressing retrofit of homes in the Chapel Allerton area of Leeds. It was developed as an outline over a 10-week programme and the findings were used in the development of the GHFA Discovery Phase application. It seeks to address three core challenges which are slowing down energy efficiency retrofit amongst more affluent householders. These challenges are a complex customer journey, a fractured supply chain and an unattractive financial proposition.

Through our research we have concluded a OSS model is key to incentivise and enable homeowners in the uptake of retrofit measures, while allowing contractors to mobilise.

A OSS is a general term for an organisation that walks homeowners through different elements of the retrofit journey. Figure 3 outlines Energy Cities' four tiers of business model for OSS, with increasing aggregation of services, typically for the able-to-pay market[3]. The West Yorkshire Better Homes Hub represents an additional 5th tier including coordination of regional infrastructure. This tackles market failures and ensures the OSS is a success and establishes an area-based approach to drive scale.

These elements need to be brought together in a customer journey that understands where people are coming from, emphasises the role of different groups in supporting the journey, leads homeowners through the complexity, and engages with them in a way that capitalises on local connections and trust.

[3] J. Cicmanova, M. Eisermann, T. Maraquin, '*How to set up a one-stop-shop for integrated home energy renovation ?'* Available Online: https://energy-cities.eu/wp-content/uploads/2020/07/INNOVATE_guide_final.pdf [page 9] [July 2020]

Business model	Roles & Responsibilities	Practical example of what the one-stop-shop offers to homeowners
1 Facilitation model	• Raise awareness on energy renovation benefits • Provide general information on optimal renovation works • First advice at the 'orientation stage'	It advises on how to renovate your house and can provide you with the list of suppliers.
2 Coordination model	• Coorfinate existing market actors (suppliers) • Make sure all one-stop-shop services are offered to homeowners • No responsibility for the result of renovation works (only overlooking the whole process) • No responsibility for the overcall customer journey (just the first part)	It advises on how to renovate your house and will push suppliers to comply with their promises. Suppliers remain responsible for the final result.
3 All-inclusive model	• Offer a full renovation package to homeowners • Bear responsibility for the result of renovation works • Bear responsibility for the overall customer journey	The one-stop-shop is a contractor that sells you the whole service package and is your main contact point in case something goes wrong with suppliers.
4 ESCO-type model	• Offer a full renovation package with guaranteed energy savings to homeowners • Bear responsibility for the result of renovation works • Bear responsibility for the overall customer journey	The one-stop-shop sells vou the renovation package and guarantees the energy savings for the contract duration. The one-stop-shop is paid through energy savings achieved.
5 Better Homes Hub	• Offer a one stop shop service for all tenures and through area based schemes • Incorporate a blended funding approach and 'financial coordinator' role to support all circumstances • Coordinate the regional 'infrastructure' that needs to be in place to make the one stop shop a success	The one stop shop is a service that works with individual homeowners and entire neighbourhoods, coordinating finance, the appropriate supply chain and wider stakeholders.

Figure 3: One-stop shop business model options[2]

The LLCA aims to incorporate the 5th tier of the Better Homes Hub, to tackle a specific element of the housing sector by using a combination of an 'all-inclusive model' (tier 3 in the Energy Cities framework) and the development of a finance route to refer to existing sources of finance and to innovate to create and supply new retrofit specific financial products, where there is currently unmet need.

3.1.2 GHFA Discovery

This second phase of the project, enabled by the GHFA Discovery funding, MCSC Charitable Funding, WYCA funding and Lloyds in-kind support, set out to research and test green finance retrofit offers, including the potential for a PLF offer, with retrofit delivered via a local OSS. In addition to this, modelling was undertaken to understand the impact of interventions such as solar PV/battery/heat pump linked to a smart tariff and how this could improve the financial proposition to homeowners undertaking retrofit.

The project was split into 5 work packages as follows:

- **WP01: Project management and reporting**
  Focused on coordination of both group and WP meetings across the board, as well as GHFA engagement, monitoring and reporting.
- **WP02: Governance and delivery model development**
  Focused on the testing and development of the outline governance for the OSS and progressing the formulation of the OSS.
- **WP03: Market testing**
  Focused on developing the customer value proposition and engaging with the local community to test how target customers might respond to different aspects of the 'offer'.
- **WP04: Financial products and smart tariff modelling**
  Focused on the product research and scoping to identify how and which finance products can best enable retrofit. Secondly, modelling the benefits of adopting smart tariffs on the energy bills and intervention paybacks for customers.
- **WP05: Partnerships**
  Focused on expanding the reach of LLCA and establishing new partnerships to progress the LLCA proposition and PLF more widely.

The research activities specific to each of the work packages are described below, and the findings of the respective activities are described in subsequent sections:

WP03 Customer research: Chapel Allerton focus group

In July 2023 a focus group event was held in Chapel Allerton for residents and potential customers for LLCA. Focus groups are an established qualitative approach to collecting data through group interaction in order to gain a deeper understanding of social issues. Our group was designed to bring together a mixture of different people, ages, social backgrounds and genders from Chapel Allerton to understand:

- Local perceptions and attitudes in relation to energy saving, green home upgrades
- Motivations and barriers
- What language, messaging and communications works best to support people on the customer journey

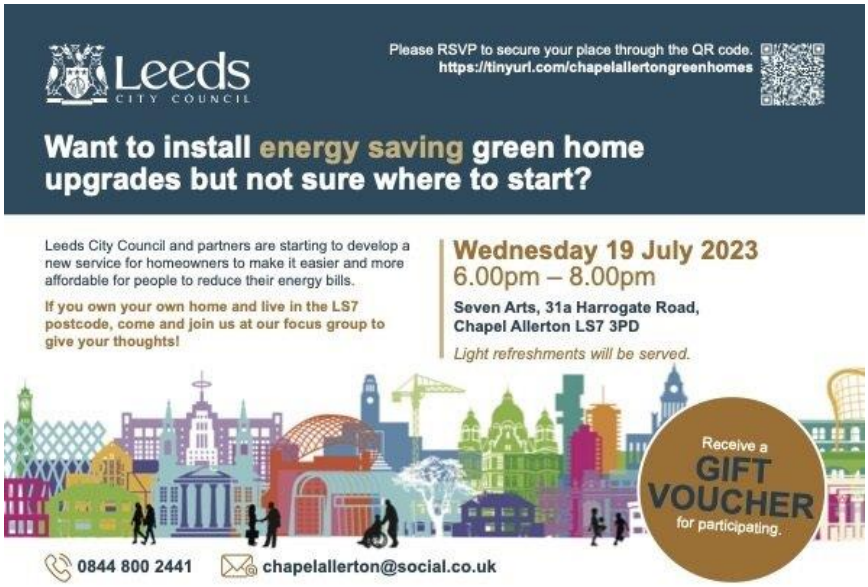

Figure 4 Invitation to the Chapel Allerton focus group

There were 27 participants covering a broad age range from 29 to 81. The group was broadly gender-balanced but the majority of participants (over 60%) identified as White English. They were recruited by promoting the event through a range of channels, such as mailers, engaging with local community groups, and through social media, following extensive stakeholder mapping and engagement with the Council's communications team.

WP04 Financial product desktop research

Research firstly focused on financial products targeted at home retrofit customers in the UK as well as PLF models on a global scale. Secondly, analysis of product features to gain a deeper understanding of the product components and features of these products. Both research findings are captured in Appendices 6 and 7. All research was based on publicly available information including previous research undertaken by the Green Finance Institute (GFI) in 2021 and 2022 on the likely appetite for a PLF products amongst UK homeowners[4].

Further desktop research was undertaken on financing owner-occupier retrofit to better understand customers preference and provide answers to the following questions within the customer journey:

- What are the motivations to retrofitting?
- How would customers finance retrofitting now/ in an ideal world? What is stopping them today?
- Which product features are important for retrofitting finance solutions?
- Does the type or package of energy saving assets impact on choice of which finance product is selected?
- How important is the return on investment for customers, including duration of payback?

[4] Green Finance Institute, '*Property Linked Finance*', https://www.greenfinanceinstitute.com/wp-content/uploads/2022/09/GFI-PLF-SUMMARY.pdf [2022]

WP04 Qualitative market testing

Following the desktop research on financing owner-occupier retrofit, three 90-minute Focus Groups were completed in July 2023. Respondents were UK-based homeowners where energy-efficient improvements could be made to their property. One focus group was made up of a 'Pre-Family' (25-39) segment and conducted via video call. The second was the 'Family' (35-49) segment also conducted via video call. The third was with the 'Older/No Family' (50-64) segment held in person in Leeds.

The focus groups represented a mix of property types and mortgage values, and participants were pre-screened as open to considering energy efficiency retrofits and willingness to use savings or financing to complete renovations.

The focus groups explored homeowner attitudes, motivations, and barriers to financing energy efficiency retrofits.

Key objectives included:

- Understanding motivations for considering retrofits (e.g., sustainability, cost savings) and how these differ from other home improvements.
- Assessing which retrofit solutions homeowners would prioritise and why, both ideally and within a budget.
- Exploring current ability to finance retrofits via savings and attitudes towards creating 'retrofit savings pots'.
- Investigating lending preferences including desired features like interest rates, ease of application and repayment structures.
- Gauging interest in government financial support options
- Assessing expectations on return on investment for different retrofit interventions

WP04 Quantitative market testing

A programme of online interviews was undertaken in September 2023 with 1,000 consumers. The chosen interview sample was nationally representative, but the sample did disregard individuals who were strongly opposed to retrofit or decarbonisation, in recognition that not all households will be looking or needing to retrofit. This was justified as we have established through previous research that financial products are unlikely to draw people to retrofit, rather, it will enable those already interested.

The research set out to measure:

- The appeal of PLF alongside other financing options;
- Consideration under normal circumstances versus if consumers were forced to make improvements;
- Barriers and motivators to adopting property-linked finance, building on findings from the qualitative customer research; and
- Detailed feedback on the PLF proposition, including potential costs and potential returns.

WP04 Smart tariff research and modelling

Techno-financial modelling was undertaken by the LLCA team to model packages of residential intervention measures linked to smart tariffs to understand the impact on household energy consumption and bills across a range of typical homes, or archetypes, in Chapel Allerton.

The analysis sought to determine additional savings unlocked by smart tariffs and the effect of different smart tariff structures, as well as the impact of smart tariffs on household demand profiles and intervention package capex payback times.

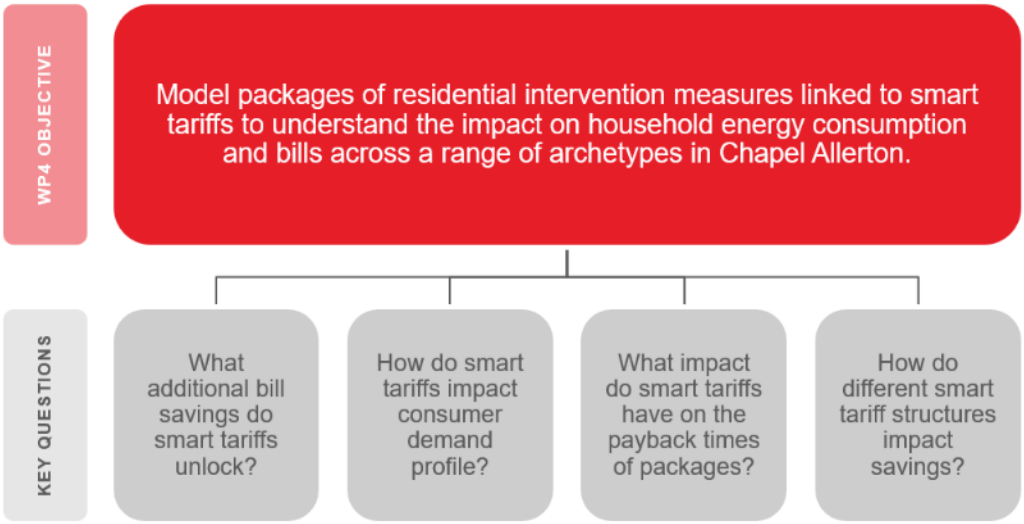

Figure 5: Objective and key questions for LLCA modelling (Arup)

3.2 Existing market solutions and project differential

3.2.1 Existing solutions

The popularity of OSS retrofit support facilities has grown nationally, as the monumental challenge which lies ahead for retrofitting UK homes becomes ever more urgent. However, these are primarily LA or community led projects with none that we are aware of led by commercial banks or energy retailers.

Within West Yorkshire, the 'FurbNow' project provides a tailored retrofit plan for homeowners including support through installation. But they do not directly provide an installation service, the bottom-up neighbourhood-focused approach, or financial products. This makes the LLCA and proposed OSS offer unique to Leeds as well as nationally.

When looking at PLF products and retrofit specific financial products, the current market is largely limited to specific local offers, also identified in our research, and with no current PLF products available in the UK. The main precedent was set by the Green Deal from 2012 – 2015 but only saw 15,000 green deal plans made nationally.

3.2.2 The LLCA differential

Our proposed approach to deploying a PLF product is turned on its head, from a top-down Government proposition to a bottom-up product developed alongside residents. Specific advantages of the OSS over existing solutions include the following:

Delivery vehicle: the LLCA will bring trust to all stakeholders through the involvement of LCC and WYCA, and the delivery and financing role of Octopus and LBG as the private sector partners, will provide commercial experience. This will enable innovation from

across the sector, establish a more agile organisation and development environment, and tackle all elements of the identified challenge as part of a strategic roadmap. By providing immediate delivery capacity through the inclusion of Octopus we will overcome the key challenge facing other models and build the local supply chain over time.

Value proposition: by increasing awareness of the non-financial benefits of low carbon homes, the LLCA can shift the value judgement away from the challenging economics of whole-house retrofit. The customer journey will focus on a supportive and frictionless journey to increase conversion rates at each stage and thereby uptake. An attractive finance package will increase uptake, open the mass market, and provide confidence for the supply chain to invest in capacity-building. We know that householders will sometimes want to install retrofit measures over time, so our customer journey is tailored to this and designed to provide aftercare, including monitoring and tariffs to support further energy efficiency and pay-back improvements where possible.

Area-based: approaching one neighbourhood at a time will provide economies of scale and hyperlocal marketing will utilise important social relations, word of mouth and community networks. These positive feedback loops will compound awareness of and therefore demand for the service and its benefits, by de-risking many of the identified perceived customer barriers.

3.3 Customer research findings

The LLCA proposition is to a large extent fully dependent on customer buy-in and uptake, so better understanding these customers, what will drive them towards undertaking retrofit interventions, and which financial products will best enable them to pay for these is core to the whole project. The below sections represent some of the key findings across core topics.

Attitudes to retrofit interventions

The customer research revealed an engaged customer base who recognise the benefits of undertaking retrofit projects, particularly the potential for significant energy and cost savings. This positive attitude is likely driven by rising energy prices and increased awareness around reducing waste and inefficiency, which is discussed further below. While younger demographics also acknowledge the climate change impact of energy efficiency upgrades, financial motivations remained the emerging benefit perceived across most customer segments.

Beyond cost savings, consumers also see value in non-financial benefits such as improved comfort and usability. However, retrofits are generally perceived as practical rather than emotional purchases, driven by financial over intangible benefits.

While many express interest, actually undertaking retrofit projects remains a hurdle. Perceived barriers that prevent interest from translating into action include a reluctance to take on disruptive projects, a lack of knowledge and confidence in newer technologies such as heat pumps, and uncertainties about the high cost, financing, payback, and the expected length of time they will continue to live in the property.

To assist in understanding the different attitudes and drivers behind potential customers' drivers for retrofit, we have developed six "proto-personas". These are based on existing research and were validated as relevant to the LLCA during the focus groups. These 6 proto-personas are Smart Life Enthusiasts, Committed Greens, Home Improvers, Home Buyers, Busy and Unsure, and Property Improvers.

Trigger points for retrofit interventions

A key finding from the research is that the provision of finance is likely in most cases to enable retrofit instead of driving demand. While the customer research highlights a perception that retrofit interventions are practical decisions driven by a desire to reduce household bills, costs and financing options are not the main triggers for retrofit interventions in practice. Instead, upgrades are primarily driven by wider home renovation projects, which may then spark consideration of energy efficiency improvements.

This approach to retrofit was also reflected in a research piece conducted by a team based at the Universities of Leeds, Sussex and Strathclyde, titled 'More than Money' which was reviewed as part of the desktop study[5]. The research team conducted 40 in-depth interviews with property owners to better understand how retrofit decisions are based on more than just 'rational' (e.g., cost-saving) behaviour alone. The research found upgrades were often triggered by renovations, new home purchases, or emergency repairs rather than energy bill savings.

Tangible observations of benefits and advice from trusted media coverage, trusted knowledge providers (e.g., installers and energy companies) and social networks such as friends, family, and community groups play a further role in boosting considerations of retrofit interventions among homeowners. This was an observation emerging across the quantitative and qualitative research and the targeted focus groups in Chapel Allerton. In the 'More than Money' research piece it was noted that throughout the retrofit customer journey, households are drawing on advice from close networks, and seeking new relationships and interactions with trusted information sources.

Retrofit finance customer profile

The qualitative customer research revealed that the life stage of homeowners affects their liabilities, project appetites and payback objectives, all of which influence how and when they spend money on their home. The availability of funds and finance options varied across the consumer groups and was primarily dependent on personal financial circumstances.

Younger, first-time buyers are more focused on cosmetic upgrades to personalise their first home but tend to have limited funds available for larger renovations. They prioritise improving home enjoyment and resale value, and the expected duration in their property is a key influencer in making retrofit decisions and payback calculations for retrofit work.

Families in the active parenting stage are looking to expand or better utilise their living space as needs grow. They undertake necessary renovations but face constraints from mortgages and dependent expenses.

Older homeowners without dependents have more disposable income to spend enhancing their current home for comfort and convenience. However, from the quantitative research, customers in older age groups are less likely to consider energy efficiency improvements, compared to customers under the age of 45. A lower willingness to take on projects due to a desire to avoid domestic disturbance and feeling overwhelmed by the options was noted, particularly in older age groups.

[5] J. Emden, Institute for Public Policy Research, *'More than Money – Moving Towards a Relational Approach to Retrofitting'*, Available Online: more-than-money-sept23.pdf (ippr.org), [September 2023]

Customer attitudes towards retrofit financing

Throughout the research, it has become apparent that financing options are not a driver for retrofit options but rather a secondary factor that enables projects. When engaging with customers on the options available for retrofit finance it was found that the selected solution largely depends on the nature and motivations for energy efficiency improvements. Overall, there is a general aversion to debt-financing across customer segments. Projects are currently primarily financed through earmarked savings. In emergency cases, savings, credit and supplier financing are leveraged. Efficiency upgrades embedded in wider home improvements are more likely to be financed via focused savings, extended mortgages, or bank loans.

It was found that customers generally lack awareness and oversight of the specific financing options available to them for energy efficiency retrofits. There was also a broad assumption that most government grants are means tested and generally not available for owner-occupied properties. Where there was awareness of financing options and government support, this primarily came from hearsay and media coverage, or directly from installers at a stage when customers were already undergoing works. This further reinforces the idea that finance is not a primary driver of retrofit demand, but rather an enabling factor once homeowners decide to undergo upgrades.

In selecting financing products for retrofit, customers were found to focus primarily on the financial terms of the product. The key product features that would help consumers with decision-making for financing retrofit are listed below:

- Affordable monthly payments – term of the finance can be tailored to suit a monthly budget and not exceed bill savings.
- Low interest rates – the charge for borrowing finance, usually expressed as an annual percentage.
- Finance attached to property – finance secured against the property.
- Public sector backing – flexible lending in partnership with local councils.

Customer guidance on retrofit financing

From the quantitative customer research, the top priorities for consumers in choosing retrofit financing options are focused on the financial terms including the overall cost, monthly payments, loan length and interest rates. However, beyond the financing itself, homeowners also value additional incentives and support in choosing their retrofit financing solution.

A new concept, Property Linked Finance (PLF), was researched and tested amongst homeowners. It was seen as largely positive by homeowners, who viewed it as an innovative way to encourage investment in energy efficiency improvements. However understanding the impact on selling their property before fully repaying the loan was the highest ranked factor outside of the core financial terms.

The key factors captured in the research include:

- PLF is seen as positive and innovative, and largely expected to offer good value and to be fair, however it is important for homeowners to understand the impact of selling properties with PLF.
- Simple application process – financing that is easy to apply for removes barriers to starting retrofit upgrades.

- Interest free period – an initial interest free period can appeal to homeowners wanting to keep costs down initially.
- Tax incentives – incentives like salary sacrifice that provide tax relief could be considered as attractive add-ons.
- Cashback options – a cashback sum with the loan is another incentive, however this option was ranked lower than others by customers.

3.4 Cost of living and energy price cap barriers

The LLCA has faced some challenges and barriers related to the cost-of-living crisis and the energy price cap. Recognising the financial constraints faced by homeowners due to the overall high cost of living, and the primary driver of retrofit being reducing energy bills, the project identified the critical importance of maximising possible bill savings. This both drives up the demand for retrofit but is simultaneously also a considerable barrier due to the current high interest rates.

As part of the smart tariff modelling component of the project, smart tariffs were viewed as a potential tool to assist households in navigating the cost-of-living crisis, particularly by optimising energy usage and subsequently reducing energy bills. While it was found that smart tariffs could contribute to the cost savings and efficiency improvements, they introduced a new layer of complexity and price variability.

As shown in Figure 6 below, we found that smart tariffs could provide additional bill savings of up to £350, additional to savings provided by retrofit measures such as insulation (package A), insulation + PV + Battery storage (package B) and insulation + PV + battery + a heat pump + EV charging (package C).

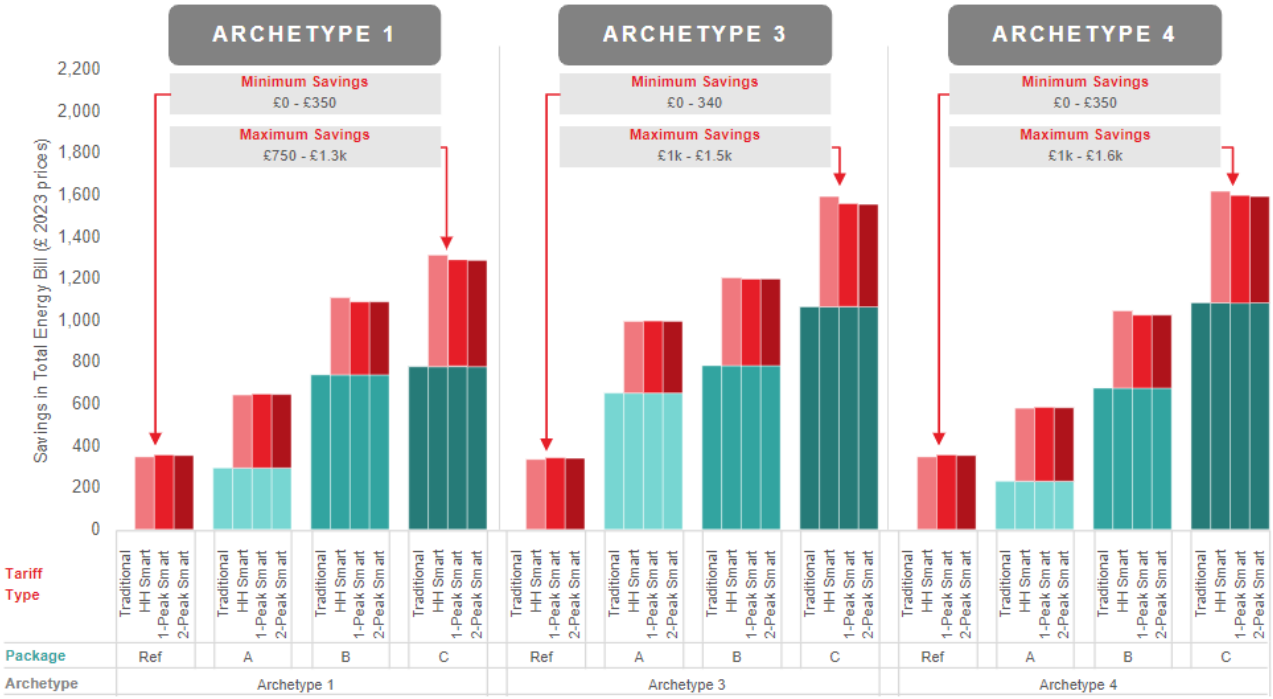

Figure 6 Energy bill savings by archetype and retrofit package

The price volatility associated with smart tariffs, particularly those with a dynamic pricing structure, can result in unpredictable fluctuations in electricity costs. This poses financial

risks to households, particularly concerning where there is not a price cap in place. Such unanticipated surges in electricity prices can present challenges to those that are already struggling with financial constraints. The price cap within smart tariff structures is an essential component not only for protecting consumers from extreme price volatility but also as a response to the broader cost of living crisis, contributing to households' financial stability and uncertainty.

The price cap offers other benefits to consumers such as fostering consumer trust and confidence in engaging with energy-saving measures linked to smart tariffs, while contributing to additional savings enjoyed by consumers. It also aligns with the greater objective of making sustainable energy practices financially viable and appealing to a wider range of consumers, even in the face of volatile energy prices.

3.4.1 Upfront capital costs

One of the principal challenges with implementing energy-efficient measures for households is the substantial upfront costs associated with home retrofitting packages. For households aspiring to install these measures, the initial financial burden presents as a major barrier, particularly with the current economic vulnerability faced by households.

A crucial concern arises due to the elevated interest rates accompanying these financing options. The burden of interest rates coupled with the loan amount, can escalate the overall project cost. It also perpetuates a prolonged financial commitment for homeowners, extending the duration over which they must pay the financing.

The impact of high interest rates manifests in two ways: first, it discourages potential participants from engaging in retrofitting measures, and second, it hampers the financial feasibility of the project. As households are faced with financial consequences of high interest rates, they may opt for partial retrofitting packages to mitigate the economic strain. Thus, compromising the overall energy savings, carbon reduction and quality of life benefits households could otherwise enjoy.

3.4.2 Addressing the identified barriers

The PLF proposition is particularly favourable in addressing many of the barriers discussed above. It has the potential to enable homeowners to distribute the high upfront costs of retrofitting over a longer period while also linking the loan to the property rather the individual owning it. It thereby helps alleviate the immediate strain on household budgets and extend it out in a similar format to the energy reductions benefits achieved.

The LLCA methodologies employed in the smart tariff modelling also looked to address and better understand the price and cost sensitivities at play. The modelling undertaken as part of WP04 was tailored to provide a comprehensive assessment of retrofitting interventions, considering the fluctuating prices and market dynamics. There were several assumptions/limitations associated with the modelling, due to data availability and the ability to capture consumer behavioural response, see Appendix 3.

As part of the modelling approach, the reduction of savings over time due to declining wholesale energy prices and decreased market volatility was guided by the National Grid Future Energy Scenarios. These considerations were important in understanding the dynamics of the energy market and how these would affect the overall benefits of the retrofitting interventions. The recognition of this trend highlighted the importance of continuously factoring in changing energy price dynamics as the country moves towards renewable and low carbon energy.

3.5 Future price fluctuations

The methodologies used in the smart tariffs modelling were designed to create an assessment of the retrofitting interventions while considering the dynamic nature of prices and market conditions over time. The model utilised Arup's Energy Market Model which is underpinned by the National Grid Future Energy Scenarios – System Transformation Scenario for its wholesale electricity price forecast. For gas, wholesale prices from the National Grid FES data were used. A trend of falling wholesale energy prices in the long run, helped inform how changing energy costs might influence the economic viability of the interventions long-term. Additionally, the assumptions considered a holistic approach by factoring in the historical contribution non-energy costs such as network, supplier and policy costs have on the overall energy bill. These were based on the historical breakdowns of the Ofgem price cap to derive the historical average percentage to offer a comprehensive view of the costs of electricity.

To address potential future fluctuations in installation costs, a sensitivity analysis on capital costs was conducted. This involved exploring ranges to capital costs to understand how changes to costs could affect the payback times of the retrofitting interventions. The analysis was refined through benchmarking capex assumptions, comparing them to industry standards and research. This allowed for a comprehensive analysis of the interventions against future price fluctuations.

Moreover, sensitivities on payback time were calculated, enhancing the understanding of how variations in capital costs could impact the economic viability and payback period of the interventions. The modelling assumed no replacement or refurbishment of intervention measures, as the lifetime of measures exceeded the modelling horizon. However, this approach may not reflect reality as there would be additional capex associated with refurbishment and or replacement of certain measures such as battery storage. Nonetheless, this sensitivity approach provided valuable insights into the potential financial risks associated with different capital cost scenarios, contributing to a more comprehensive analysis of retrofitting interventions.

3.6 Expanding the customer group

The LLCA will seek to prove the concept within Chapel Allerton, Leeds, and anticipate expanding the offer across Leeds, West Yorkshire and beyond, as the model becomes more efficient. It will seek to expand to serve private landlords as local penetration increases, and the OSS reputation helps de-risk perceived customer barriers. These barriers are often much higher with private landlords, as they do not receive the 'quality of life' benefits which are critical to the value proposition of the OSS and whole house retrofit in general.

The simplest potential market for early versions of PLF is able-to-pay homeowners in a freehold owner-occupied property, due to the limited number of stakeholders and complexity. However, as PLF becomes an established solution it could be expanded to other segments of the able-to-pay market, including freehold private-rented properties and leasehold properties. PLF could also support less able to pay households, however only with government support mechanisms such as credit enhancement guarantees or grant funds.

4. Relationship and partnership building

4.1 Discovery Phase partnerships

The LLCA has further developed its partnerships over the course of the Discovery Phase and presents a unique combination of recognised market leaders in their respective fields, providing all the complementary skills and capabilities required to successfully deliver impactful change and unique insights towards advancing retrofit finance.

The core delivery partners for the Discovery Phase were made up of LCC, LBG and Arup with support from UKIB, WYCA and Octopus Energy. Aspects of the work were also subcontracted and delivered by KPMG as well as local SMEs Otley Energy, Social Communications and Snook.

LCC is the second largest local authority and third largest city in England with a population of over 800,000 in 330,000 households. They have made a strong commitment to decarbonisation, having declared a climate emergency in 2019 with a commitment to be carbon neutral by 2030. A major part of meeting this challenge will be the decarbonisation of domestic heating, which accounts for a quarter of emissions in Leeds. Through the LLCA they have overseen the customer research elements, and maintained regional and national links to share learnings, particularly with WYCA, GFI and UKIB. They have also been progressing the partnership and collaboration around the privately led OSS entity with LBG and Octopus.

LBG has extensive insight and knowledge from their experience in retail and commercial banking, which they have brought into the research. This included their experience in developing new financial products that can respond to customer demands, as well as regulatory requirements. LBG are currently partnering with the GFI to develop property linked retrofit finance.

Arup has brought both project management and delivery expertise to the LLCA managing the work packages and ensuring cross learning and communication was facilitated. In addition, they also brought in their Energy Market Analytics Team to lead on the smart tariff research and modelling, to understand the cost savings potential this could have on customers.

LLCA and WYCA have worked together over the Discovery Phase to align their programme, giving access to a low-cost loan product and independent impartial advice. Locally the LLCA has built a strong working relationship with organisations such as Otley Energy and Social which specialise in communications and developing thriving net-zero communities.

GFI work on PLF

Earlier in 2023 the Green Finance Institute (GFI) issued an RFP to seek a banking partner to jointly develop a minimum viable product (MVP) of PLF for the UK market, offering an exciting opportunity to develop a new-to-market solution supporting UK households to reduce their energy bills and carbon footprint. One potential solution is PLF – a financial instrument that can support homeowners to fund up to 100% of the upfront costs of energy efficiency improvements. PLF is not currently available in the UK.

The aim of the project is to collaboratively design, develop and launch a Minimum Viable Product (MVP) of PLF for the UK market. This will include the following:

- Developing a ‘blueprint’ for PLF that defines the legal process of linking finance to a property, financial model, operations, customer journey, regulatory treatment, housing market implications, and integration along the retrofit supply chain.
- Testing the blueprint with key stakeholders including legal experts, retrofit specialists, property surveyors, conveyancers, regulators, local and central government, solicitors and investors (inc. development banks).
- Identifying the target market for an MVP that aligns with the banking partner’s customer base, alongside market testing to refine the blueprint and messaging to customers.
- Operationalising the blueprint in a manner that allows for iterative improvements and future scale. This may include partnerships with third parties to deliver services outside the banking partner’s remit (e.g. quality assurance of retrofit installations) and, where appropriate, establishing administrative bodies to oversee the market as it scales.

While the two projects have separate drivers and programmes, we have been collaborating with GFI to ensure PLF progresses overall, as market-making will be critical for a PLF product.

Further expansion of the LLCA partnership

While involved in the LLCA throughout the Discovery Phase both Octopus Energy and GFI have both formally joined the LLCA partnership to further expand the expertise and capabilities as the project moves forward.

This is particularly to address the need to engage with the house buying chain in order to both prime local supply chains, but also to expand learnings from the LLCA at a national scale through the GFI’s existing platforms and organisational aims. We aim to pilot several financial solutions designed to unlock retrofit funding for owner-occupied and privately rented homes in the region.

4.2 Knowledge sharing

The Discovery Phase has had a very strong collaboration and knowledge sharing focus with all four work packages meeting on a monthly basis to ensure regular communication. In addition, each work package also had representation in their fortnightly progress meetings from across the working group.

Further knowledge sharing outside of the core consortium was managed through WP05 and included engagement with members of UKIB and WYCA, who were both represented in WP04 and WP03 respectively, as well as monthly project meetings.

Building on the PMBC engagement, LCC and UKIB jointly hosted a knowledge sharing event on 9th June with C-suite representatives from all partners, industry, government and non-governmental bodies such as Homes England. This considered motivations for retrofit, delivery via OSSs and using innovative finances together with the skills challenges and provided a unique opportunity to push the emerging learning from the Discovery Phase.

While separate to the LLCA, the GFI PLF blueprint project has also had a strong focus on knowledge sharing and will build a strong communication platform to disseminate achievements with other professionals including HM government, development banks, investors, financial institutions, retrofit specialists, property sector, and international organisations. There are highly experienced communication teams in GFI, who will promote the PLF solution.

4.3 Partnership challenges

The main barriers identified through the LLCA work, which is preventing the owner-occupier market from undertaking retrofit to a greater extent are a complex customer journey, a fractured supply chain and an unattractive financial proposition. These three barriers have been the focal challenges which our proposition and products aim to resolve.

At this stage of the LLCA the focus has been on building the core partnership to deliver this innovative private/ public collaboration to tackle domestic retrofit for our target group.

Limited engagement has therefore been established with the local supply chain and house buying chain, as the discovery focus was on building the enabling OSS structure and undertaking market research and modelling around to build evidence base.

This has however been identified as a core element for future work for the LLCA and a route to overall success of an PLF product locally and nationally. The new partnership with the GFI which was developed during the Discovery Phase will help to support more in-depth engagement locally.

4.4 Knowledge and expertise gaps

During the Discovery Phase, it has become clear that further industry research is needed on PLF in order to roll it out at both a local and national scale. PLF will only be attractive to the customer where it is offered widely across mortgage providers and housing market, and for this to happen further system-level work is needed.

The smart tariff modelling suggests that there is a real potential for smart tariffs to facilitate savings, but this will be dependent on some potential policy and consumer barriers. It is still unclear what the benefits of smart tariffs represent for suppliers. If suppliers could retain some of the smart tariff benefits realised (i.e. share the benefits with the consumer), this may help with the balancing costs they face on the wholesale market. Without clear incentives for the supplier, product offering could be limited. In terms of licence conditions, rules would need to be implemented to ensure any sharing of benefits between supplier and consumer are reasonable to ensure the consumer sees genuine savings.

5. Finance product research

5.1 Key activities

As set out in Section 3.1 both desktop research, qualitative and quantitative market testing was undertaken to build a deeper understanding of the customer needs and wants in the market.

The desktop research explored previous and current products which might support delivery of retrofit locally or nationally, as well as research on PLF products from a global perspective.

Following this, qualitative interviews were conducted to gain a broader view of customers in this segment and their views on retrofit and PLF.

A more extensive programme of quantitative interviews then took place with 1,000 participants to explore in detail their views on PLF, their perceived concerns and barriers to a PLF product as well as specific retrofit interventions and associated costs.

Separately, extensive modelling was undertaken to establish the likely financial benefit of adopting smart tariffs and how this might impact paybacks on different packages of interventions, modelled on typical households in Chapel Allerton.

5.2 Key lessons learned

This section presents some of the core findings from the financial products research and findings on the consumers attitudes towards a PLF product.

Financial product features

The desktop research included a comprehensive review of existing retrofit financing schemes (including PLF schemes) and product in both the UK and global markets. From this existing industry standards and market leading approaches were identified, offering valuable perspectives on product features that cater to the diverse needs and preferences of homeowners.

Key findings are that there is a wide variety of financing retrofit schemes which rely on product features which are broader than just financial terms to influence success. These include repayment methods which can range from standard mortgage-linked payments and separate billing to more innovative options such as council tax integration, energy bill inclusion or salary sacrifice. Monthly repayment has emerged as the prevailing norm, but the research has also noted features such as interest-free periods, flexible billing and “buy now, pay later” arrangements, which could play a pivotal role in scheme participation. Additional features such as finance limits, integration with government grants, and incentives such as tax relief and cashback options were also captured. The findings outlined in Section 3.3 have captured the customer perspective on the key product features that emerged from the desktop research.

Consumer attitudes to PLF

The qualitative and quantitative market research revealed that PLF has moderate appeal overall. As a mostly unfamiliar concept, PLF was not well understood by most research participants initially, but was reasonably clear when expressed in broad terms. PLF is seen as positive and innovative, and largely expected to offer good value and to be fair.

However, it raised some concerns about disrupting the home buying process and was seen as potentially requiring legislative and procedural changes to enable smooth loan transfers.

Many assumed PLF could deter prospective buyers and reduce a property's value given its novelty. While the impact on affordability is uncertain, PLF's perceived higher interest rates and costs versus alternatives made it less appealing to consumers, given the priority placed on monthly payments and total loan costs when choosing financing products.

The extended repayment term was also seen as a barrier for many, who prefer rolling high-cost improvements into mortgages. But some (55%) agreed that PLF encourages potential fairness in sharing costs between old and new property owners for upgrades which results in financial savings, e.g., reduced fuel bills.

While younger, more affluent homeowners seemed more comfortable with the PLF concept in general, older, and less affluent customer segments were more likely to actually consider it as an option for financing projects. Worries about sales impact were common, especially in younger homeowners looking to move up the property ladder. Customers noted that loans attached to the property could deter prospective buyers unwilling to take on debts they didn't choose.

In general, PLF elicited stronger consideration for high-cost upgrades like heat pumps and solar panels, with appeal rising for projects which were perceived to be more expensive.

A key lesson learnt from engaging with prospective customers is that while broadly perceived as an innovative idea, affordable PLF pricing and addressing sales impact concerns are critical to win key segments like younger, affluent homeowners. Focusing on higher-cost upgrades where financing needs are greater may be an effective initial strategy. Tailoring PLF offerings to suit different consumer segments will be key, as product feature preferences vary. Building awareness, competitive pricing, and mitigating sales impact worries will be essential to improving PLF's appeal and resonance.

5.3 Alternative finance options

As highlighted in Section 3.1 a wider group of retrofit specific financing was included in the desktop research and learnings taken from these. The LLCA does not wish to limit itself to a single product, rather we are interested in identifying a range of products which may help to unlock wider uptake of retrofit in the short and longer term. Our customer testing also suggests that people want different products depending on their circumstances, age amongst other factors.

5.4 Key regulatory considerations

Offering products for retrofit may need to consider relevant regulatory consumer credit regulations, one area which has been considered are the Section 56 and 75 of the Consumer Credit Act (CCA). Therefore, work is required to develop the product journey in line with S56 & S75, as well as additional capability and process set up to manage the increase in demand. Engagement with the FCA will be required at a certain stage, to further progress the financial products offered through the LLCA, as well as PLF at a national scale.

6. Advice and information research

6.1 Approach to retrofit advice

This section provides a more detailed understanding of the activities necessary in understanding, engaging, and supporting customers on their journey.

For the first phase of LLCA a high-level customer journey was developed, this includes: its stages, steps, and related supporting activities. The design principles from our research were also presented along with their relationship with the customer journey. Below, the design principles are outlined, giving a brief amount of detail as to what the principles will consist of operationally.

Through an analysis of customer journeys, best practice, and existing research within the sector, we have developed a set of key design principles which underpin each stage and step of the LLCA customer journey. Our current assumption is that to be successful, the customer journey for the programme and for the OSS should be:

- Simple: facilitates simple decision making, hassle-free, low-friction processes and low-disruption delivery, allowing customers to move through each step with ease.
- Understandable: provides easy to understand and jargon-free information about the retrofit process and its related benefits, and its reports and plans should be in an accessible format.
- Attractive: communicates the benefits, relevance, and overall attractiveness of the offer successfully to the customer, improving uptake of the compelling offer.
- Trusted: gives customers confidence in the process through local authority involvement, quality assurance, a professional supply chain, and consumer protection.
- Supportive: supports the customer throughout the journey with input from the scheme and gaining confidence from neighbours who come along on the journey with them.

These design principles have informed the development of the LLCA customer journey. The next section lays out the key activities within each stage of the customer journey. Additional detail and backstage activities will help to form the simplicity needed for the customer journey and programme to succeed.

Figure 7 below describes the proposed approach to the customer journey.

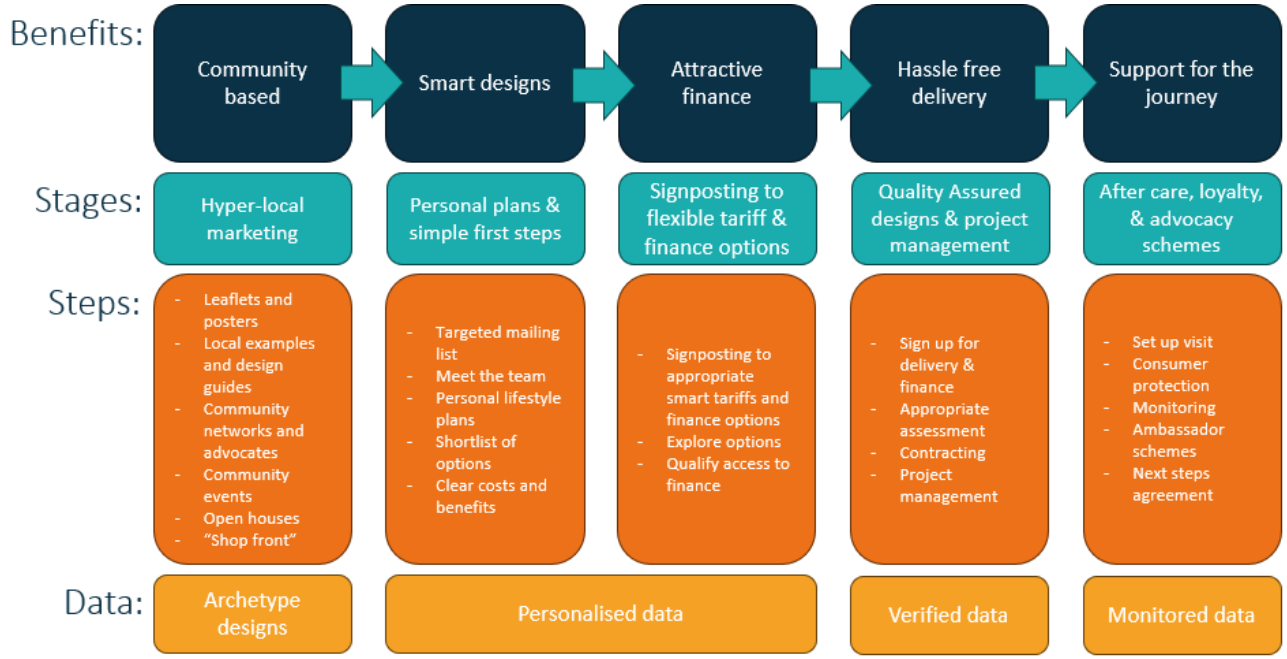

Figure 7 How a hyper-local strategy could support a streamlined customer journey

6.2 Alternative approaches considered

A range of commercial models were considered during the Discovery Phase to explore which structure might best support the desired delivery function. Each model differed in terms of whether certain risks sit with the OSS entity (including contracted parties i.e. subcontractors) or with the customer.

As part of this analysis, it was important for LLCA to consider and test what would be needed for potential customers to sign-up and then assess if that would sit within the risk appetite of the LLCA partners. It was generally concluded that:

- In order to respond to the challenges that underpin the delivery concept and objectives, the OSS demonstrator needs to take a more active role in the customer journey, extending beyond a simple facilitator role.
- In order to maximise learnings, a model which allowed the demonstrator to play a more extensive role post-delivery, with active participation in monitoring and data collection related to performance, was preferred.

Behavioural considerations for retrofit delivery

To achieve residential decarbonisation at scale, the actions of all actors in the system need to work in a coordinated way. Taking a systems perspective can help to improve decision-making and avoid the unintended consequences that have characterised previous UK Government policies.

It is important to design any residential decarbonisation strategy with an understanding of the behaviour of owner-occupiers, landlords and tenants at its heart. Energy efficiency technologies will only deliver benefits when people install and use them correctly within homes, and decarbonisation of home heating will also critically depend on reduced demand for heating in the first place. The importance of understanding human behaviour has been highlighted by several groups.

The failure to test the finance design of the Green Deal with consumers was identified by the National Audit Office (NAO)[6] as one of the reasons for poor uptake. The NAO report's recommendations included the following: "For energy-efficiency schemes this means, in particular, testing designs with consumers to ensure policies have the desired impact on behaviours and being realistic about the motivations of energy companies in fulfilling their obligations."

According to the Confederation of British Industry[7]: "To retrofit the UK's housing stock at scale, consumers need to be at the heart of the domestic energy efficiency agenda."

Research by the Cabinet Office Behavioural Insights Team[8] showed that: "Research indicates that social, cognitive and behavioural factors are important in explaining why many people have not – yet – introduced changes that could help them to enjoy cosier homes and lower energy bills."

Influences on key behaviours can be identified using the COM-B model of behaviour which has been widely used to inform UK policymaking[9] [10]. The COM-B model forms the hub of the Behaviour Change Wheel (BCW), an evidence-based framework for designing and delivering interventions to change behaviours at the individual, organisational, community and population level.

The COM-B model identifies three factors that need to be present for any behaviour to occur: capability, opportunity and motivation. Capability refers to a person's physical (e.g. strength, dexterity) and psychological attributes (e.g. understanding, memory). Opportunity refers to attributes of the physical environment (e.g. finances, policy content, material resources) and the social environment (social norms, culture). Motivation refers to the reflective (e.g. beliefs, identity) and automatic psychological processes (e.g. habits, emotions) that drive a behaviour when the capability and opportunity are present.

These three factors form an interacting system with behaviour (Figure 8). If just one of these is not in place, then the desired change will not occur. Therefore, it is important to not only remove barriers to the behaviours required for scaling up low carbon heating technologies, but also put in place targeted enablers to support capability, opportunity and motivation where needed.

[6] National Audit Office, *Green Deal and Energy Company Obligation* (nao.org.uk), Available online: Green Deal and Energy Company Obligation - National Audit Office (NAO) press release [page 11] [14 Apr 2016]

[7] Confederation of British Industry, '*Consumer demand – the key to a sustainable energy efficiency market'* [2015]

[8] Cabinet Office Behavioural Insights Team, '*Behaviour Change and Energy Use',* [2011]

[9] Social Change UK, '*A guide on the COM-B Model of Behaviour'*, Available Online: 02.09.19_COM-B_and_changing_behaviour_.pdf (social-change.co.uk) [2019]

[10] GOV.UK, *'Domestic private rented property: minimum energy efficiency standard – landlord guidance',* Available online: https://www.gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance

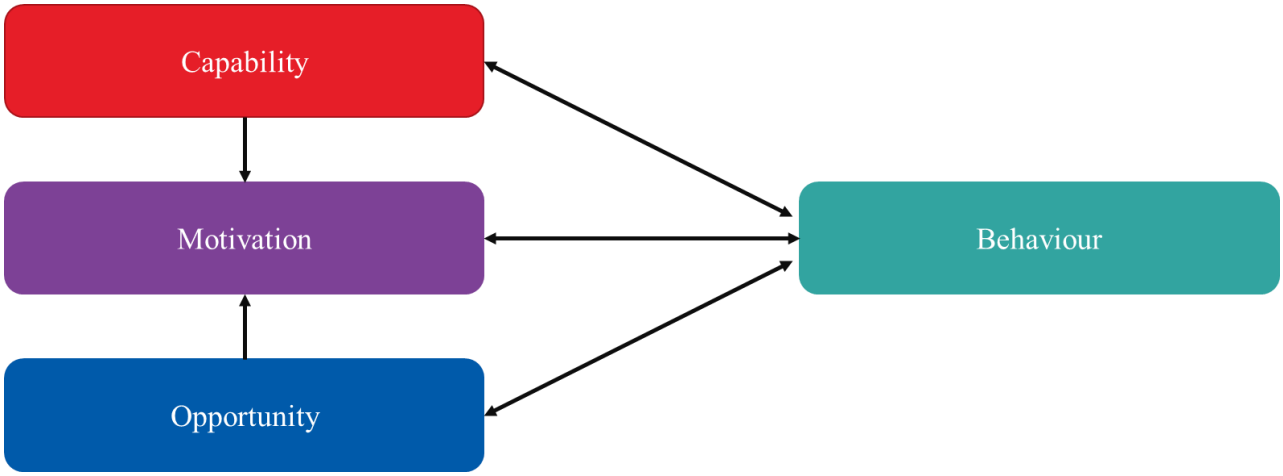

Figure 8: The COM-B model of behaviour

6.3 Consumer preference on advice and information

While the LLCA has not progressed any specific research on how the technical and financial advice is specifically provided as part of the Discovery Phase, areas of this were covered in the focus group held in Chapel Allerton in July.

Here group discussions covered areas such as people's understanding of the language of retrofitting, how they would want to receive information about retrofitting, levels of trust in information sources and referrers, perceptions of different interventions, motivations and barriers, and service-specific elements such as finance.

While each participant had unique circumstances and needs, there were some common themes that could be drawn from our discussions and frequently overlapped with different groups.

Trust

A notable finding was that consumer confidence was holding people back from investing in retrofitting their homes. This was linked to a trust deficit, with attendees showing reservations towards suppliers and messaging relating to the customer journey. This was complicated to unpack, as the lack of trust extended to confused government messaging, concerns around local suppliers and, in some instances, specific technologies. This also included concerns of a rise in advertisements, particularly on social media, making it difficult to identify trusted providers.

Personalisation and local delivery

Closely linked to the issue of trust was a desire among attendees to be able to access trusted local providers. Concerns were raised at a lack of information available on who could provide the services that attendees wanted and some also expressed frustrations at local plumbers not having the right skills to fix heat pump problems. A consensus formed around a need for trusted local providers who could support people on their customer journey to make their house more energy efficient and environmentally friendly. The view was expressed that a service promoted or supported by the Council would garner greater trust.

Time and effort

There was a heavy emphasis on the need to simplify the customer journey and advice process. Participants did not want to feel they had to invest many hours of work in

researching technology, looking at providers across the country and trawling through complicated finance options. They wanted a simple, local network that could answer their questions and demonstrate a track record of delivery in their community. The concern of the impact of disruption from having work done to customers' homes was also commonly cited.

Because of the combined concerns around trust, finding reliable local providers and the desire for a personalised customer experience, the LLCA is targeting a streamlined customer journey that is supported through a hyper-local marketing strategy.

6.4 Integration of retrofit advice and financial products

From a governance perspective there are certain complications when fully combining the retrofit advice and financial products into one entity, such as limiting consumer choice, which the research shows is important as customers have different circumstances and will require a range of products. This element was also a key driver for the current outline of the LLCA where the OSS combines delivery and finance into a seamless customer journey, but the entities providing the different elements are separate.

Ideally this is where a nationally recognised and accepted PLF product provided by multiple lenders would provide the best consumer choice and market competition. The LLCA and external research confirms that the PLF or other financial products will not attract more people to retrofit – comprehensive advice and support through the 'technical decision making' will. What PLF and other retrofit financing will do is enable more people to undertake the identified interventions, by offering financial products that suits customer needs.

6.5 Bespoke service vs. signposting

There is extensive research to suggest that significant market failures can occur where customers are simply signposted to high level retrofit advice, rather than being provided with a personal advice service, as the customer journey is far too complex. The importance of taking a customer and behaviour centred approach is also set out in Section 6.2 above.

The focus group held in Chapel Allerton also confirmed that the majority of participants identified as 'busy & unsure' when identifying their stance on retrofit. This highlights the reality that most households do not have the time to familiarise themselves with the complex nature of retrofit, due to the large number of technologies, options and decision points that currently exists. Our customer engagement research and focus group has also emphasised the importance of offering customers a bespoke service, and that most people disengage with the whole concept as soon as generalising terms or language is used to engage with them.

After several years of growth in retrofit activity supported by various government grants, according to DESNZ, installations decreased by 55% in 2022, to just over 200,000 measures[11]. This clearly demonstrates the market need and opportunity for a better and more holistic and bespoke retrofit service for homes.

[11] DESNZ, *Household Energy Efficiency Statistical Release 2023*, Available Online: Household Energy Efficiency Statistical Release (publishing.service.gov.uk) [2023]

7. Verification methodology research

A robust installation verification methodology is crucial to identifying quality insights to enable useful and actionable learnings from retrofit interventions, but this has not been a core focus of the current scope of work in this Discovery Phase.

That being said, the LLCA aims to verify both installation quality and use of finance in the future development of the project, as described below:

Installation quality

Exact processes will be put in place once the OSS is launched, but we will have in place the following measures, drawing on Octopus' experience and industry best practice:

- Scrupulous supply chain on-boarding, with technical and legal due diligence.
- Performance monitoring, including independent audit.
- All installed products will be backed by third party warranties and contractor obligations.
- Adherence to relevant industry standards (e.g. MCS, PAS 2035 or Trustmark).

As highlighted by the Discovery Phase, expectations of energy bills post-retrofit are crucial for decision-making. Therefore, alongside the appointed retrofit evaluator, in future phases of work we will work with social researchers to understand any behavioural factors contributing to higher energy use than expected. This insight can be used to improve the information provided to residents during handover, increasing awareness of rebound effects and how to maximise the benefits delivered by the interventions.

8. Marketing related research

8.1 Customer marketing preferences

For the focus group held in July in Chapel Allerton, several marketing approaches were deployed to attract the attendees. These included direct mailers sent to all households in the Chapel Allerton ward boundary; emails to key stakeholders such as politicians, estate agents and community groups; advocacy through local businesses and the ward locality officer; and promotion of the event using local community and Council social media channels. Anecdotal feedback on the evening suggested that the direct mailer was the most effective recruitment tool.

OSS marketing

The wider marketing approach for the OSS service and retrofit advice itself was also explored during the focus group. There was considerable pushback on anything that looked like a uniform service and didn't recognise participants' personal needs. This included strong resistance to marketing messages along the lines of "people like you" but support for the concept of a one-stop shop, providing a personalised service which helps homeowners find the right solutions for their home and circumstances and navigate what is perceived as a complex range of options. Feedback showed that people's motivations to improve their home's energy efficiency were closely linked to the type of property they live in, and messaging and communication should reflect this.

This is, in part, due to a lack of trust and confusion over national messaging and resistance to being treated as a single amorphous audience whose individual needs will not be catered for. This trust deficit is a significant barrier that must be conquered to build confidence in the value proposition.

The LLCA hyper-local marketing approach should target potential customers in Chapel Allerton with localised messages, promotions, business tie-ins and event-based marketing. It would also be supported by local advocates who could help share their experiences of the customer journey, ensure interventions are tailored to a local context and advise on do's and don'ts.

By focussing efforts on a relatively small locality, building a presence in the area and working with early adopters that will share positive experiences, this strategy can begin to narrow the trust deficit and make people more confident about investing in energy saving home upgrades.

Language and jargon

Priority messages should be those that emphasise simplicity, personalisation, expertise and a recognition that people are all on different stages of the customer journey. They should not make generalisations about people's houses, circumstances or make promises or claims that may not sound credible. This should also be supported by a simple and straightforward tone of voice that provides impartial guidance and explanations. Jargon and any language that implies any sort of marketing speak should be avoided at every turn, even terms like retrofit did not resonate at the focus group.

8.2 LLCA marketing proposal development

The marketing strategy that has been developed for the LLCA captures how the OSS could most effectively promote its products or services to its target audience. It includes the following components and the development of these through this GHFA phase is explained in this section:

1. Value proposition: a statement that describes the unique benefit the service provides to its customers.
2. Target audience: the group of people who are most likely to buy the service.
3. Market research: the process of gathering information about the target audience, competitors, and industry trends.
4. Marketing mix: the set of tactics that the LLCA will use to promote and deliver its service. It includes the four Ps of marketing:
    a. **Product**: the services that LLCA offers.
    b. **Price**: the amount that customers pay for the service.
    c. **Place**: the channels through which customers can purchase the service and the customer journey.
    d. **Promotion**: the marketing plan that the LLCA will use to communicate with its target audience and promote its services.

8.2.1 Value proposition

The value proposition is the key organising foundation around which the LLCA is built and involves understanding the customer and designing the offer from this understanding.

This 'human-centred' approach involves understanding the customer from the perspective of things they need to get done, problems they want to solve, and benefits they want to enjoy.

Building on the initial development phase for the LLCA, and developed further through this GHFA phase, we have produced the following outline for the value proposition, which has been tested and validated with project partners and through the focus groups:

*"**Making it easy and affordable to upgrade your home.***

A Better Home is affordable to heat, cosy in winter and cool in summer, looks good, is healthy, more valuable, and is great for the planet.

We will upgrade your home and your life in a simple, hassle free, and affordable way.

We do this by helping you in four key ways:

- *Reduce the amount of energy it takes to enjoy your home how you'd like it and get this from green sources.*
- *Produce and store your own energy to reduce how much you need to buy.*
- *Buy low using smart tariffs to buy energy at the cheapest time of the day.*
- *Sell high with smart tariffs that allow you to sell your excess energy and storage to the grid at the best time of the day.*

We do this by understanding what better looks like for you and helping you start a Better Home Journey with the right first steps for you:

Quick wins: low carbon technologies; home improvements; insulation and ventilation; smart controls & tariffs; finance"

This includes important elements of the value proposition relating to **how** the service is delivered to overcome known barriers to retrofit through the customer journey as well the benefits of **what** measures are delivered.

Additional features of the value proposition were identified which will need to be addressed:

- Simple steps: the importance of being able to offer bundles of measures to suit all circumstances, so that everyone can start the whole house journey based on their priorities, as well as the need to recognise that the markets for different measures are currently separate and have different levels of maturity.
- Cost effective engagement: there is agreement amongst all partners that a hyper-local marketing approach is attractive but there is a key concern about how it can be both cost effective and scalable. Testing and learning from the conversion rates from different tactics and the associated 'cost per acquisition' of customers will be key.
- Signposting: the intention is to signpost to the market for smart tariffs and financial products rather than building them directly into the offer. This raises issues about how the marketing and customer journey can still benefit from some level of integration.
- Role of the Local Authority: the proposal for the delivery vehicle to be privately owned and operated raised questions about how the trust and influence associated with the Local Authority can still support the business through the marketing strategy.
- Whole House Plan: there is a common concern about the cost associated with Whole House Plans as a potential barrier. The discussions identified service design opportunities to ensure the cost is minimised, they are only commissioned when necessary due to the measures being proposed, after careful qualification of customers, and with communication around the importance of these Plans and the work involved.
- Benefit stack: the approach of categorising the elements of the measures that generate benefits was well-received. Feedback on the structure and language has fed into the development of the messaging for the service.

8.2.2 Target audience

The target audience is intended to be the 'able to pay' market and the proposal is to deliberately target early adopters and actively utilise their positive experience and influence in the community to encourage others to take up the service.

The work in this phase reinforced the view that for the market to scale the service must be attractive to a wider group than the 'able to pay' and early adopters, and must include those 'able to finance' if attractive finance packages are brought to market and those who will follow the early adopters.

This requires the service to be capable of becoming mainstream and must provide something for all customer circumstances taking into consideration individual demographics, motivations, influences, triggers and barriers. These will influence both the initial packages of measures and the associated finance mechanisms taken up.

This was reinforced in the Focus Groups which included a broad range of potential customers. To assist in understanding these circumstances, 'proto-personas' were developed based on existing experience and research[12] [13] [14]. These 6 proto-personas are Smart Life Enthusiasts, Committed Greens, Home Improvers, Home Buyers, Busy and Unsure, and Property Improvers.

Each proto persona has its own nuance in personalisation. Based on the learnings from the focus group, we reflected that for the Committed Greens, a personalised retrofit means recognising their unique homes and circumstance. For Home Improvers, it means having works conducted around their priorities and being able to recalibrate their personal journey when needed. For the Busy and Unsure it will require greater focus on overcoming their individual barriers. Subsequent work would develop a more detailed understanding through evidence-based personas and more directly consider how bundles of measures, finance packages, customer journey and messaging can be better tailored for these.

8.2.3 Market research

The market research including literature reviews, market analysis, interviews and focus groups are outlined in greater detail elsewhere in this report (Sections 3.3, 5.2, 6) and in Appendix 4

8.2.4 Marketing mix

Product – the offer

The offer incorporates both the measures that will be delivered to customers (the what) and the way they will be delivered (the how'). The combination of these are important to overcome the multiple barriers to retrofit.

We have shaped the following key features to be communicated through the marketing plan and customer journey and which align with the customer journey below and have been validated as important features through the Focus Groups:

- Community based: providing awareness, trust, and accessibility.
- Smart designs: personalised, visually attractive, advanced technology, and effective in delivering benefits.
- Attractive finance: direct financial benefits enhanced through smart tariffs, with flexible finance options that accommodate the longer-term benefits.
- Hassle-free delivery: simple decision making and quality assured designs and project management.
- Support for the journey: embedding the benefits through behaviour change, consumer protection, after care, support for further steps and advocacy.

[12] Energy Saving Trust, *Trigger points: a convenient truth.* Available online: EST GD Trigger Points report 2011[1].pdf (windows.net) [2011]

[13] Sustainable Energy Authority of Ireland, *Promoting retrofitting among homeowners in Ireland through a behavioural lens.* Available online: Promoting-retrofitting-among-homeowners-in-Ireland-through-a-behavioural-lens.pdf (seai.ie) [2023]

[14] B. Mallaband, V. Haines, V. Mitchell, *Barriers to domestic retrofit: Learning from past home improvement experiences*, Available online: Barriers to domestic retrofit: learning from past home improvement experiences (lboro.ac.uk) [2014]

Price – affordability

Attractive finance emerged from the Focus Groups as critical and the role of each of the right mix of measures, smart tariffs, and finance products are all important in achieving this and are considered elsewhere in this report.

Smart tariffs and finance packages aren't intended to be directly incorporated in the offer. Our work concluded that the importance of affordability and the role and accessibility of flexible tariff and finance options mean they should be able to be referenced in marketing for the scheme and form a relatively seamless element of the customer journey.

Place – the customer journey

The development of the customer journey and our proposal are described in Section 6.1.

Key assumptions that fed into this include the following, which have been mapped out at each stage of the customer journey.

1. Simple steps onto the journey: we assume that by providing simple steps into engagement with the OSS service, such as access to energy saving information, we will convert residents into future customers.

2. Hyperlocal marketing: we assume that a hyperlocal marketing strategy will help raise awareness, stimulate networks of influencers, and build trust in the OSS across all target customer groups.

3. A visualisation tool: we assume that being able to visualise future home improvements and ROI will help people weigh the benefits and costs of their decision.

4. Financial information: we assume that having the provision of financial guidance as part of the OSS journey will increase people's trust in the service and confidence in paying for improvements.

5. Personal plans: we assume that creating personalised and flexible home improvement recommendations is fundamental to creating long-term customer engagement.

6. Financial products: we assume that people need finance products to fund their improvement work and each proto persona is attracted to a different offering.

Note: the detailed assumptions map and customer journey map are available here: Service design.

Promotion – marketing plan and messaging

The marketing plan is described in detail in Appendix 5. In summary, the marketing plan and messaging are being developed to incorporate:

- The key proposal for a **hyper-local marketing approach** has been validated.
- The importance of **trust** has been reinforced.
- **Personalisation** in communication, design, and service is critical.
- **Myths and misconceptions** need to be addressed in marketing from trusted sources.

8.2.5 Other insights from LCC prior experience

A key insight from the Discovery Phase focus groups was the importance of trust in the service, with participants highlighting the Council as a trusted local brand. The Council's

endorsement of the service should be leveraged through the branding approach, messaging and channel mix.

LCC has significant experience of generating a groundswell of interest in communities, leading to extremely high whole house retrofit uptake levels from homes of all tenures, even in deprived areas with very high proportions of privately rented properties. The approach used was to start by installing external insulation to a handful of social homes to show the community what the solution looks like, then, with a physical presence in the community, to identify early adopters and influential individuals and encourage them to take up the offer. This creates a word-of-mouth buzz in the area and, by ensuring that customer service and installation quality are both high, creates unofficial ambassadors in the community. The council has a role to quality assure contractors and engage with the community, but the most important aspect is trusted recommendations from neighbours.

9. Future plans for green homes finance

9.1 Lessons learned for further use and refinement

There is potential for a mass market for a PLF product, with GFI analysis indicating it could reach £70bn across England, Scotland and Wales. But it is evident that further work is needed to both define a 'blueprint' for a national PLF product as well as mature the understanding and benefits of PLF in the supporting house buying chain.

The product and hyper-local model which the LLCA is investigating can be applied elsewhere in Leeds, regionally in WYCCA, but also nationally as a model that other LAs can help support and drive forward to improve retrofit uptake.

9.2 Lessons learned for LLCA partners

All the learning highlighted in the report has been used as evidence to shape both the focus areas for the next phase of work, as well as wider partnership making to support this. LBG has confirmed they have gained a deeper insight into the practicalities of retrofit interventions including how disruptive retrofit can be on homes and how this is a significant barrier to customer demand for retrofit and supporting green financial products.

9.3 Using and disseminating learnings

The learnings from the Discovery Phase have enabled us to develop a compelling application for continuation of the project through to the Pilot Phase. The learnings have enabled us to design a Pilot Phase with high chances of success, and the potential to uncover further important learnings.

The approaches for disseminating learnings used in the Discovery Phase were discussed in Section 4.2. These will be continued and built on and will include;

- Collaboration with GFI for engaging with the industry on PLF and disseminating findings from this work to a wide range of stakeholders. This will be achieved through GFI's confirmed participation in the next phase of the LLCA and will be key to priming the market for PLF.
- We will continue to showcase and share findings from our work at public events where relevant, as national and local engagement are key to the success of the LLCA.
- We will continue the strong collaboration between LCC and WYCA to promote regional engagement.

9.4 Key challenges for green home finance

A number of challenges for retrofit and green finance have been discussed throughout the report. The most substantial barriers which could significantly limit the LLCA's ability to expand its offers include:

- While saving money motivates many customers, there is a general lack of understanding of and motivation for energy efficiency improvements and retrofit amongst homeowners;

- High upfront costs limit accessibility to energy retrofit solutions and although financing which can spread the cost plays a role, the relatively greater repayment cost compared to bill savings remains an issue for many, made worse by current high interest rates;
- New innovative finance products such as PLF can help accessibility by reducing monthly costs and has high levels of appeal, however there is still lot more needed to bring a solution to market.

9.5 Addressing barriers

Smart tariffs

Collaborating with industry stakeholders, particularly suppliers, is essential to bolster the effectiveness of smart tariffs. Their valuable insights and expertise can significantly contribute to a more precise and reliable modelling development, aligning the goals of our research to provide accurate assessments and meaningful policy recommendations in the context of green homes finance.

When looking ahead to future plans for green homes finance, our research highlights the critical need for policy considerations to maximise the benefits of smart tariffs within this framework. Understanding and incentivising suppliers to actively engage with and benefit from smart tariffs for their successful integration and widespread adoption. Additionally, establishing clear and effective regulatory frameworks is paramount to ensure equitable distribution of smart tariffs benefits between suppliers and consumers, fostering the economic viability of smart tariffs. Furthermore, addressing the integration of carbon costs into gas prices is pivotal to incentivise the transition to electrification for heating purposes. Moreover, accelerating the deployment of smart meters such as SMETS2 meters and half-hourly metering, serves as a first step toward efficient energy consumption behaviour and maximises the advantages of smart tariffs. This approach is vital for the successful implementation and broader acceptance of smart tariffs.

Securing skilled labour

Government has previously committed to creating two million skilled ‘green jobs’ across the UK by 2030 and has claimed in the Net Zero Strategy that the heat and buildings sector alone could create up to 175,000 jobs across the supply chain by 2030. Ensuring the skills are available and the labour market has capacity to deliver retrofit at scale will be critical for scaling up retrofit action at a national level. The Government should consult with employers, educators, and local authorities to develop and publish a strategy setting out how the UK will deliver the national commitment to create these green jobs.

The private sector has an important role to play in training and recruiting retrofit jobs however the potential for a market-based solution is currently being constrained because of a lack of market confidence due to policy uncertainty and a lack of long-term investment in retrofit and low carbon building.

Retrofitting privately-owned homes will not take place in a vacuum and many of the workers and skills required will be transferable both to and from other decarbonisation projects, including the retrofit of social housing and public buildings as well as the construction of new, thermally efficient buildings. Therefore, the Government could invest in capacity building by providing long-term, scaled up funding for retrofit of social housing and public building. The Public Sector Decarbonisation Fund and Social Housing Decarbonisation Fund are welcome initiatives, however their design and scale could be

optimised to give private sector installers and supply chains more confidence to invest in the skills and capacity that will be needed for the scale of retrofit required.

Other regulations could also support capacity building by signalling to the market the expected demand for these skills. The introduction of the Future Homes Standard and Future Buildings Standard will have a positive impact. However, the current planning system is widely considered in need of reform to ensure that legislation and national guidance is appropriately aligned with the Net Zero Strategy.

Other barriers addressed in the report

A number of barriers and solutions have already been discussed in the report including:

Gas prices and carbon: Currently, the cost of carbon is reflected in the electricity price but not in gas price. Carbon costs need to be captured to make electrification more appealing. Failing to account for carbon emissions will otherwise continue to distort the energy market by making natural gas appear more economically competitive than it would be if its environmental costs were considered.

A national PLF market: It is evident that PLF will not be successful where it is not supported by multiple lenders and the full house buying chain, at a national scale. This is therefore a core focus as the LLCA collaboration with GFI expands and they are able to help address these national market-making challenges.

10. Further information

10.1 Smart tariff desk based review

LLCA performed a desktop review of "smart" tariffs available to residential users in the UK market. Information on "smart" tariff type, effects, pricing structure, and any prerequisites was collected from the majority of suppliers by market share.

Smart tariffs offered in the UK residential power market can contain or rely on any of several key components, which incentivise users to shift their demand profiles towards off-peak and greener periods of supply, reward users for this shift, or automate this shift via smart appliances and software. Because the gas market settles daily instead of half-hourly, smart tariffs are not offered for gas.

There is no one consistent definition of a smart tariff – definitions in the market include: "any tariff that is not a flat rate, a tariff that requires a smart meter, a tariff that works well with Low Carbon Technologies (LCTs) and other devices to reduce bills and cut carbon"[15]. A range of smart tariff types and definitions are outlined below.

The analysis considered traditional, Time of Use (ToU), and dynamic tariff types in the WP4 modelling to reflect the common products available.

The **traditional gas and electricity tariffs** in Arup's modelling are based on historical Ofgem price cap information and a projection thereof driven by Arup PLEXOS wholesale electricity and gas price curves (using half-hourly pricing for electricity and daily pricing for gas – see an annual summary in Appendix 3).

The **smart electricity tariffs** in Arup's modelling are based on Arup PLEXOS wholesale electricity and gas price curves and Ofgem/DESNZ/ESO data on proportion of energy bills made up by wholesale costs. Arup models three smart tariffs:

- A periodic ToU tariff with 1 peak period and 1 off-peak,
- A periodic ToU tariff with 2 peak periods and 2 off-peak (example shown in second chart opposite), and
- A per-half-hour dynamic smart tariff pinned to the movements of the wholesale electricity market (capped at 100p /kWh, in line with the cap observed for current Octopus tariffs).

[15] J. Wilson, J.Cooper R.Carmichael, A.Level, M.Ravishankar, O.Richards, T.Anderson, G.Shutter, L.Baker, *'Smarter Tariffs – Smarter Comparisons'*, Available Online: Smarter Tariffs – Smarter Comparisons project final report (publishing.service.gov.uk), [2019]

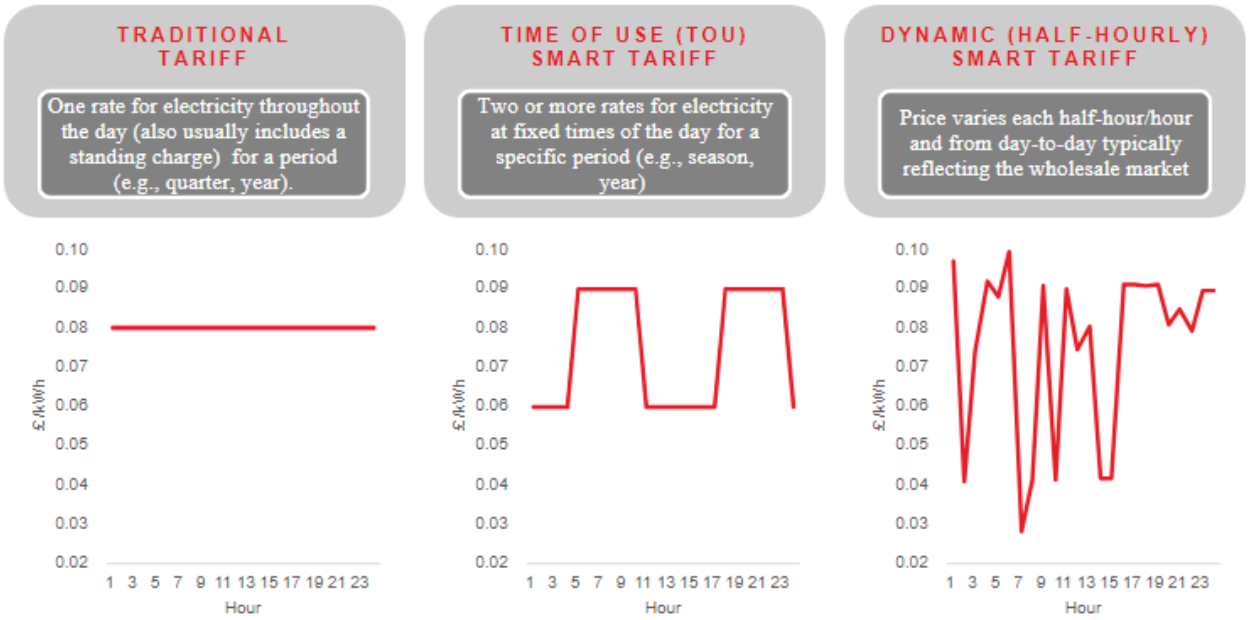

Figure 9: Typical tariff types

The tariffs being offered in the UK residential market has found that most branded as "smart" by suppliers are typically Time of Use (ToU) tariffs.

10.2 Changes in energy demand from retrofit

As part of WP4 and the wider modelling Arup calculates the change in energy demand associated with rolling out each smart tariff-linked Package of interventions for each Archetype.

These resulting scenarios of annual household energy demand are later multiplied by a range of smart tariffs and compared to a traditional energy bill under reference case demand to determine energy bill savings.

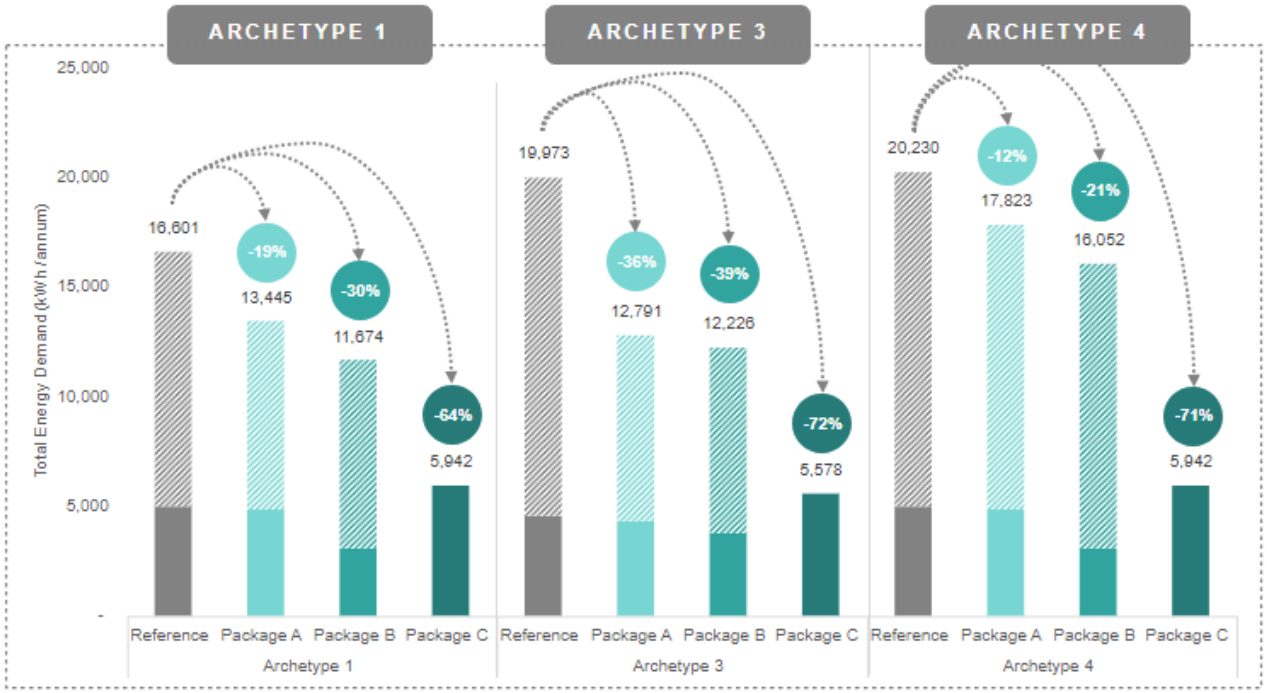

Figure 10: Annual Energy Demand by Archetype and Package: Electricity vs Gas (not including demand met by home generation)

Figure 10 summarises the energy savings observed for both gas and electricity in 2024. As shown, the greatest overall savings are seen for Package C largely due to the electrification of heating via the installation of an air-source heat pump (ASHP), which eliminates the need for gas.

In terms of archetypes, the greatest energy savings are observed for Archetype 3 due to the specific insulation measures installed (i.e. external wall insulation and suspended floor), which lead to lower energy losses and thus lower overall energy requirements

Impact of smart tariffs

We then applied a selection of smart tariffs to the energy savings from the interventions to understand what share of the savings could come from smart tariffs and how this could impact pay-back terms.

Smart tariff savings average approximately 40% of overall savings across packages and archetypes. Smart tariff savings range from £300 under Package A to £500 under Package C. Greater reductions in demand lead to increased total smart tariff savings.

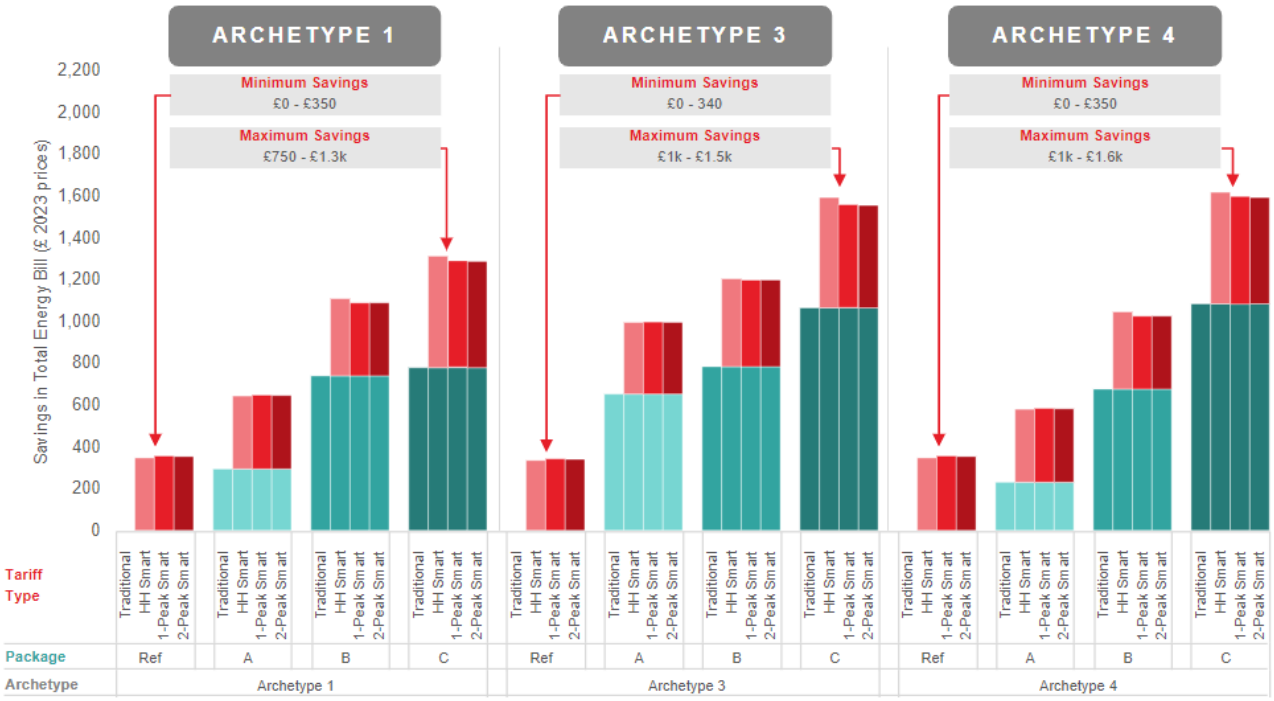

Figure 11: Savings in 2024 from total energy bill scenarios

The packages of intervention measures considered range from £3,500 for Package A for Archetype 1 to £50,000 for Package C for Archetype 3. Most of the packages considered have significant capex costs and whilst they yield energy costs the simple payback times calculated remain substantial. These payback times range from 21 to 87 years.

External wall insulation is a key driver of the long payback times for Archetype 3 given its capital cost of £21,500[16]. Of the packages considered, Package C is on average the most expensive and therefore has the longest payback times. This is driven by the suite of measures considered, which include various insulation measures, solar PV, battery energy storage system (BESS) and ASHP.

[16] Note: Archetypes 1, 3 and 4 were selected for the modelling as the three archetypes most representative of properties in the focus area, Chapel Allerton, Leeds.

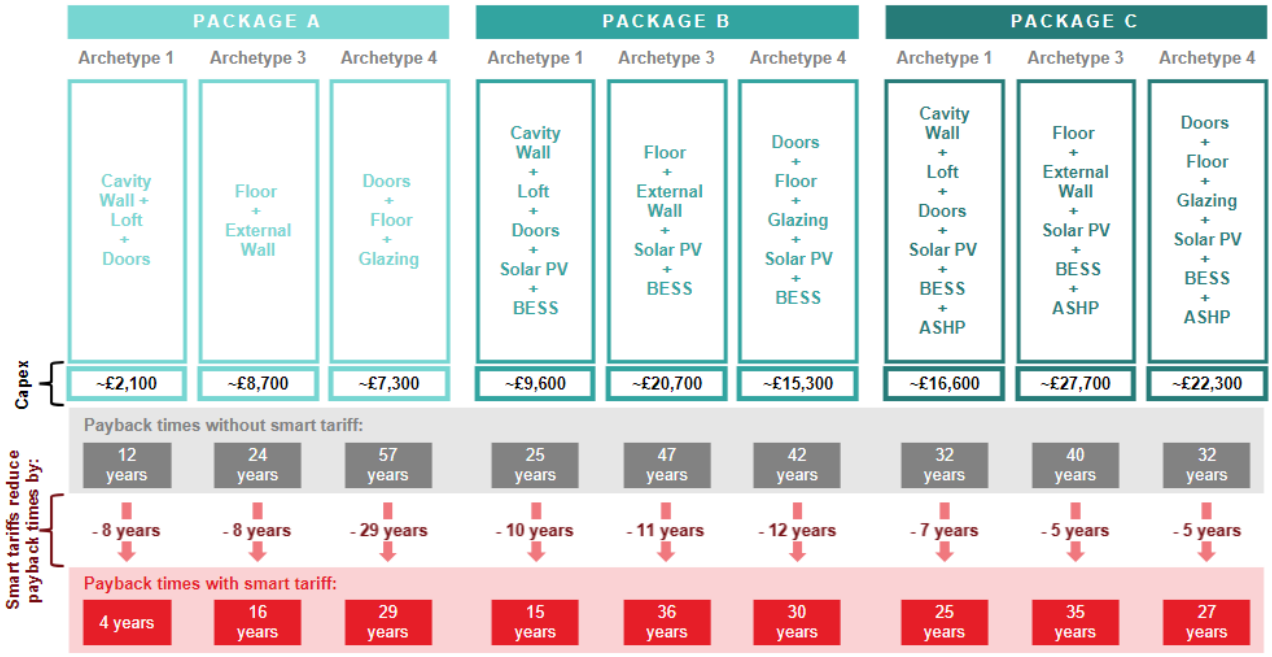

Figure 12: Capex and Payback Time, with and without Smart Tariff

Our modelling has shown that smart tariffs help reduce payback times by 5-29 years across the packages and archetypes studied. This sees the payback time range reduce to 4 to 36 years. The greatest reductions in payback times are observed for Package A due to the lower capital costs associated with the measures implemented.

Appendices

Appendix 1: Better Homes Leeds Blueprint Report

Arup

Appendix 2: Data Thought Piece

Arup

Appendix 3: Smart Tariffs Modelling

Arup

Appendix 4: LLCA Focus Group and Community Engagement Findings

Social

Appendix 5: Marketing Plan

Social

Appendix 1: Better Homes Leeds Blueprint Report

Arup

ARUP

Leeds City Council

Better Homes Leeds

Blueprint Report – Exec Summary

Reference:

Internal | January 2023

Job number 289901-00

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Executive Summary

Better Homes Leeds (BHL) is a project with the goal of designing and delivering at speed a scalable, replicable, hyper-local, place-based concept for retrofit and decarbonisation of homes.

Our target is to go live in 2023 with a prototype delivery organisation, and then adjust and develop the programme in response to successes and failures along the way. This Blueprint Report represents the first step towards meeting the project goal. The report has been prepared to support decision-making gateways for Leeds City Council (LCC) and other project partners.

We believe we have developed a delivery solution which has sufficient definition and evidence to merit the political and funding support of the Council and its project partners to be prototyped and live tested in our target neighbourhood. We recognise that much detail is missing and uncertainties remain, but there is no longer time to wait to get all the answers. Indeed, the answers will only come through doing.

Delivery concept

The vision for BHL is to design a scalable proof of concept of domestic retrofit for homeowners in the able-to-pay market in Leeds. It seeks to address three core challenges which are slowing down energy efficiency retrofit amongst more affluent householders. These challenges are a complex customer journey, a fractured supply chain and an unattractive financial proposition. Responding to these challenges, we have identified five components to the delivery approach:

- Retrofit interventions: offering a limited range of core measures
- Customer journey: providing a simple process and a long-term relationship over multiple interventions
- Delivery vehicle: a one-stop shop solution
- Customer engagement strategy: making the case and building customers through local influencers and leaders
- The financial offer: property-linked finance to expand the customer base

User centred hypotheses

We have drawn on significant user research to form hypotheses on what the BHL service should look like and how it should operate in order to be successful. Our hypotheses are that:

- An excellent customer journey for more intrusive whole house retrofit can only be delivered through a strong local presence which understands and engages with the local community.
- There is a need for a compelling offer that delivers both tangible savings and non-financial benefits, such as more comfortable homes, with suitable and flexible financial products that allow the householders to either self-finance or access grants or loans.
- Getting customers engaged with the proposition of lighter touch measures, as a first step in a longer-term delivery journey and roadmap. This first stage is crucial for ongoing participation and engagement.
- A national prime contractor solution is needed in the short term to overcome an existing fractured and immature local supply chain, but sustained growth in demand could enable this to shift into a more strongly local market with a pool of qualified suppliers.

These hypotheses will be tested through a research phase in 2023 and validated or disproved, allowing the model to be refined and improved based on evidence before the service is put into place.

Retrofit Interventions

The delivery concept aims for an overall goal of whole house retrofit and decarbonisation, while recognising that this might be achieved in practice over time with more than one package of works to each property.

Thus homeowners should have the freedom to select their own retrofit measure (or package of measures) in line with their own life triggers and home improvement plans.

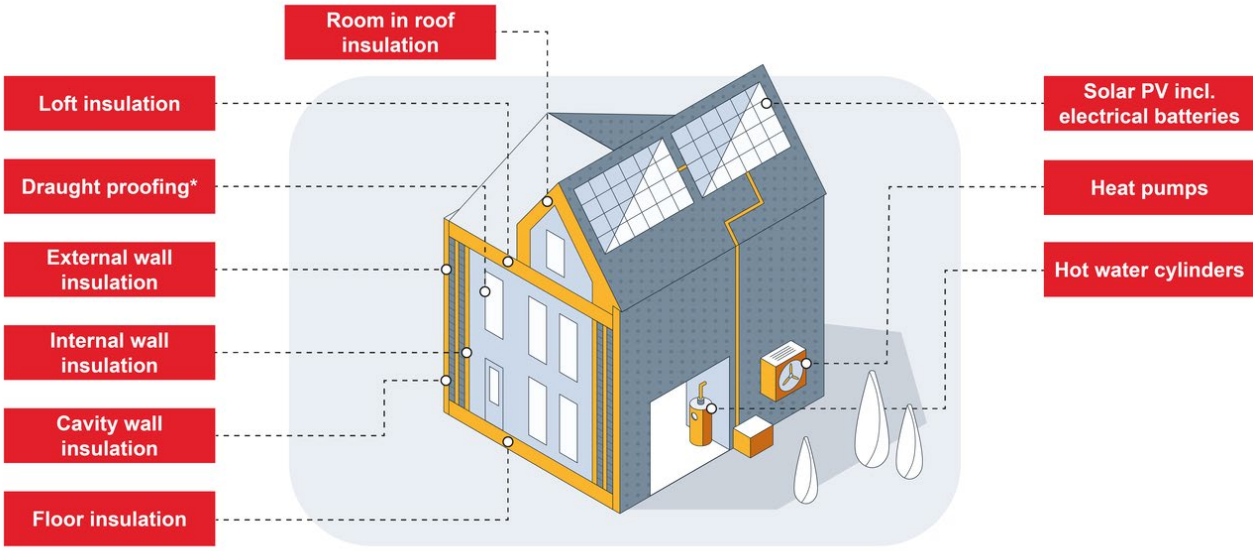

Figure a: Interventions offered to homeowners

*Enough ventilation must be provided to ensure that moisture/mould does not become a problem.

The customer journey

Understanding the target customers – i.e., homeowners – is critical for a user-centred approach to delivery. Without a compelling offer, the project will not succeed. Through our analysis of customer journey best practice and existing research in the sector, we have developed a set of key design principles which underpin each stage and step of the BHL customer journey. The principles suggest that an effective customer journey for the BHL programme and broader agenda should be simple, understandable, attractive, trusted, and supportive.

Figure b: BHL customer journey approach

Customer engagement

We have undertaken desktop research on consumer attitudes to retrofit and developed proto-personas to inform engagement approaches. The proto-personas identify likely triggers which could prompt homeowners to consider undertaking a retrofit project. From this we have developed an initial engagement strategy with the following core communication objectives:

- Clear messaging around a series of benefits to appeal to the variety of individual motivations.
- Showcasing the impact of retrofit by securing the support of local advocates and ambassadors
- Development of stakeholder relationships by creating a community liaison group, alongside engagement with the local installer and supply chain.
- Creating an identity for BHL, including a website, that would communicate in a consistent tone of voice which is linked into wider LCC climate communications.

Retrofit delivery mode

We have concluded that a one-stop-shop (OSS) model is key to incentivise and enable homeowners in the uptake of retrofit measures, while allowing contractors to mobilise. An OSS is a general term for

organisations that walk homeowners through different elements of the retrofit journey. Our proposed goal is to establish an OSS that is aligned to the West Yorkshire Better Homes Hub approach, summarised below:

Table 1: BHL one-stop shop delivery model features

OSS roles and responsibilities	• Offer a one-stop shop service for all tenures and through area-based schemes • Incorporate a blended funding approach and 'financial coordinator' role to support all circumstances • Coordinate the regional governance infrastructure that needs to be in place to make the one-stop shop a success
Practical example of what is offered to homeowners	The one-stop shop is a service that works with individual homeowners and entire neighbourhoods, coordinating finance, the appropriate supply chains and wider stakeholders.

We propose that the BHL prototype be launched in 2023 with a Minimum Viable Product (MVP) to test and learn while we deliver, starting with a lighter touch approach to retrofit measures and aiming to overcome initial supply chain challenges.

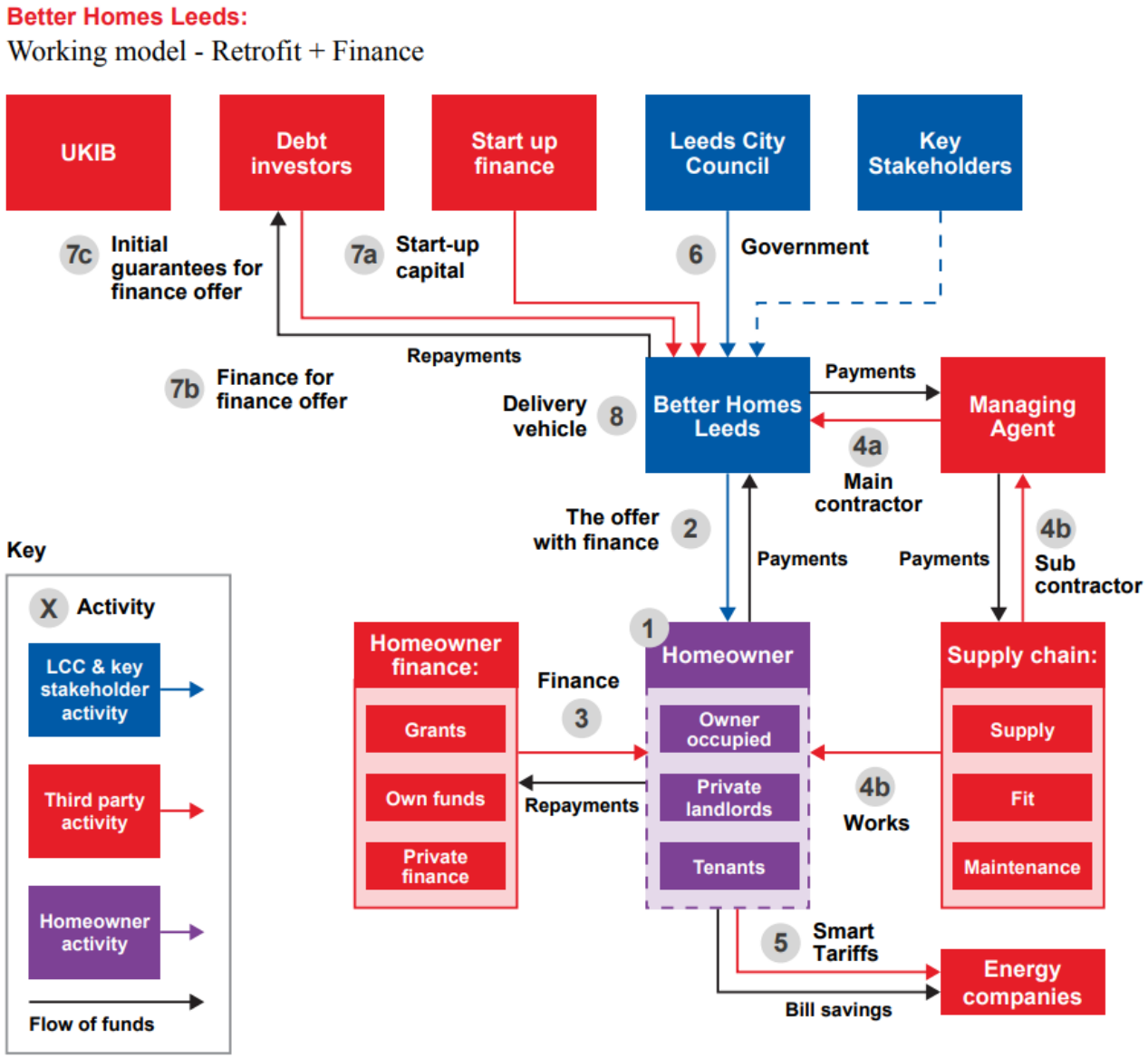

Figure c: Outline BHL delivery model

Financial savings and payback

The area-based approach proposed in this blueprint report, is ground-breaking with its focus on the able-to-pay market. We have chosen the Chapel Allerton neighbourhood in Leeds for the prototype delivery model we are seeking to launch in 2023. Modelling of qualifying homes in Chapel Allerton across six retrofit scenarios provides a picture of the potential savings available and overall payback to participating homeowners, as shown in the figure below.

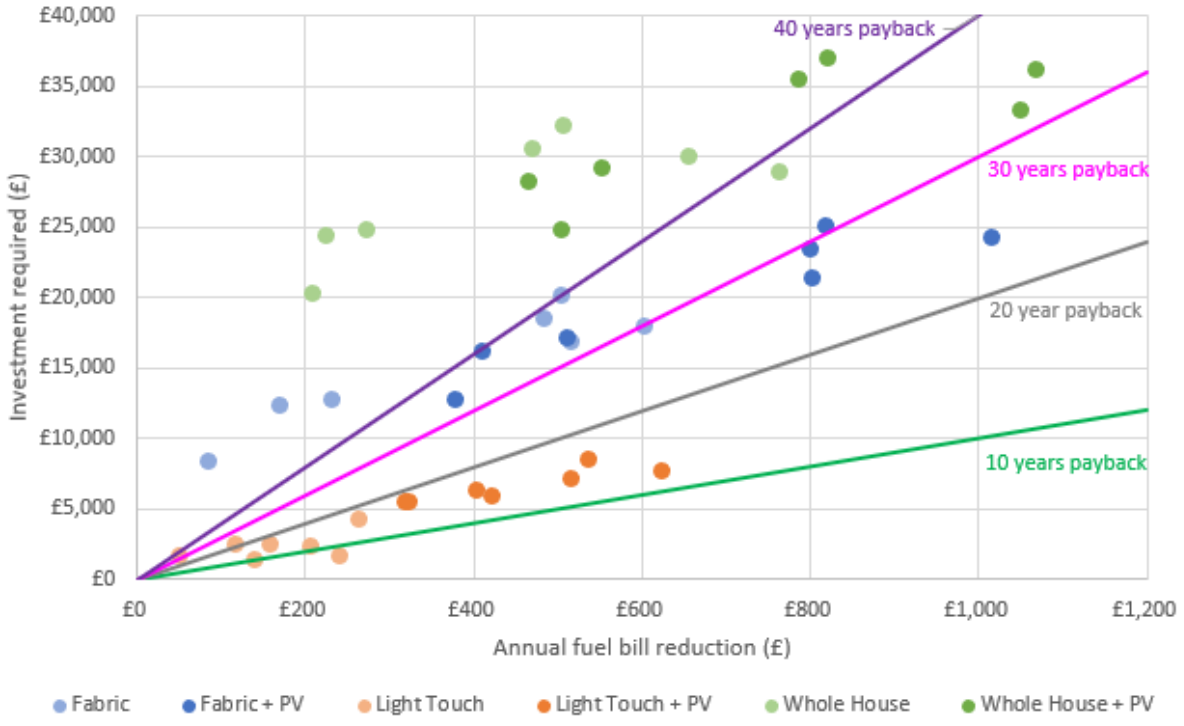

Figure d: Indicative payback time for different retrofit scenarios, in real 2022 prices.

The results provide a clear indication that only the light touch measures provide a full payback within an acceptable timeframe for most homeowners. Deep retrofit measures will likely depend on a fall in costs or provision of funding or financial support. Nevertheless, the relatively modest absolute costs and material savings available under light touch scenarios provide strong encouragement that there is an accessible market right now with which BHL can begin.

Ask of Government

Progress has been too slow on the retrofit of homes, with little policy activity to drive acceleration, especially among owner-occupied homes. Barriers to scaling need a matching set of enablers from Government to support and amplify the effects of on-the-ground efforts such as BHL:

- Funding support for retrofit delivery vehicles
- Policy reform to enable property-linked finance
- Government or UKIB insurance and guarantees to de-risk retrofit programmes while the market is still immature
- Clear and consistent regulatory road maps
- Long-term funding for the fuel poor, and fiscal incentives for the able-to-pay sector
- A national retrofit coordination agency to support the efforts of local actors

Appendix 2: Data Thought Piece

Arup

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Data to enable retrofit

Leeds Low Carbon Accelerator: Data strategy and wider considerations

September 2023

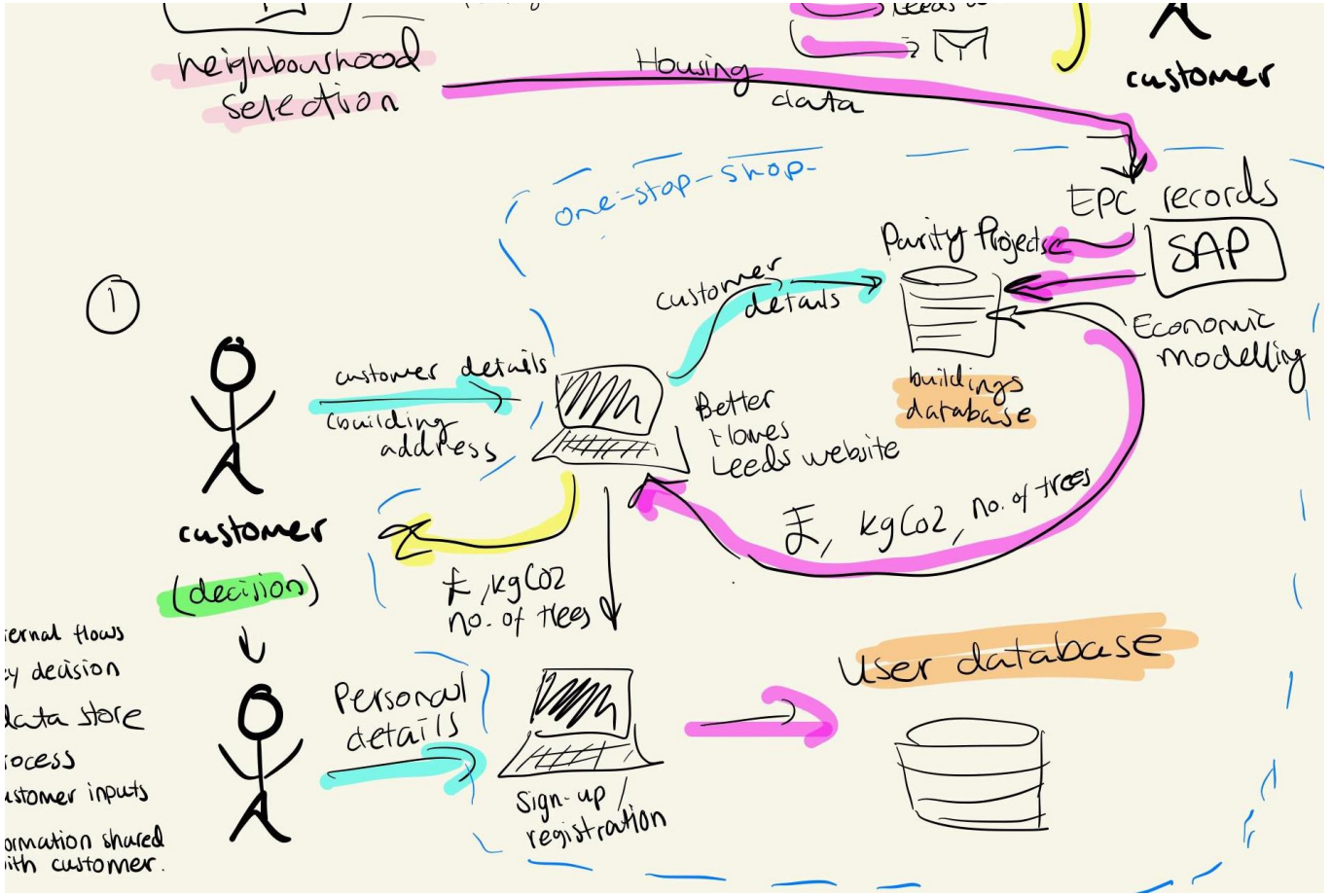
Introduction

Use of data in domestic retrofit and the wider energy system

Making the built environment more energy efficient by providing domestic retrofit interventions lies at the heart of the Leeds Low Carbon Accelerator (LLCA) project. An understanding of the use of data and data exchanges in the energy system is crucial for the successful delivery of retrofit at scale and pace.

In Part 1, this document highlights the necessity of an integrated data strategy to enable the One-Stop-Shop (OSS) solution which aims to streamline customer journeys, reduce costs and simplify supply chains. This is particularly important as the existing obstacles faced by homeowners seeking retrofit are exacerbated by a lack of useful and comprehensive data exchange.

In Part 2, the discussion shifts to the wider energy system and how data flows can facilitate information exchange in an innovative way. As the energy sector is shifting towards a decarbonised, decentralised and digitalised system, navigating across the system will require new roles, skill sets, tools, and processes. There will be opportunities for generating value and income, not only from the data itself but also from managing data flows, that could benefit both the OSS and other stakeholders.



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Data strategy for a retrofit journey

Part 1

Data strategy

The need for an integrated data strategy

The LLCA project aspires to transform the domestic building retrofit landscape, making energy efficiency interventions accessible and hassle-free for homeowners.. It also presents a unique opportunity to establish and adopt a sustainable data strategy that fosters integration and collaboration throughout the retrofit value chain.

The core goal of the data strategy is to support the OSS to expedite the scale, pace, and quality of residential decarbonization. To achieve this, the data strategy should aim to facilitate the efficient flow of information and data among the diverse components within the proposed OSS. It should also seek to encourage the integration and combination of data across a network of organisations and individuals involved in domestic retrofit initiatives. This collaborative effort ensures the reliability of shared data and builds trust in the service offering, thus playing a pivotal role in advancing the overarching goal of residential decarbonisation.

The strategy should aim to:

1. Map specific data flows:
Outline the diverse data needs and flows at three critical stages of the OSS:

1. Initial customer identification and attraction
2. Ensuring a dependable service offering to customers
3. Sustaining relationships and ongoing development

2. Develop data governance and management protocols:
Define and implement a comprehensive and standardized data process that not only guarantees reliable and efficient data sharing but also ensures the collection, maintenance, and validation of good quality data. These protocols should also comply with data protection regulations

3. Foster a culture of data sharing and collaboration:
Set out how the OSS can become a catalyst for data sharing and collaboration, ensuring interoperability between different stakeholders.
Pages 6-8 present high-level data flow diagrams, illustrating how information and data moves at three key stages in the OSS delivery process.
These diagrams aim to map the data exchanges which are necessary for ensuring a consistent service experience for homeowners engaging with the OSS.

However, it is important to note that these three stages are not exhaustive, and that the OSS will rely on a significant amount of data and information from the wider energy and retrofit ecosystem, which isn't fully represented in these diagrams. To create a comprehensive data strategy, a next step is to explore and understand this wider system.

Pages 12-20 in this document introduce data exchanges in the wider energy system, including the revenue-generating opportunities that this presents for the OSS to play a key role in a progressively interconnected energy system.

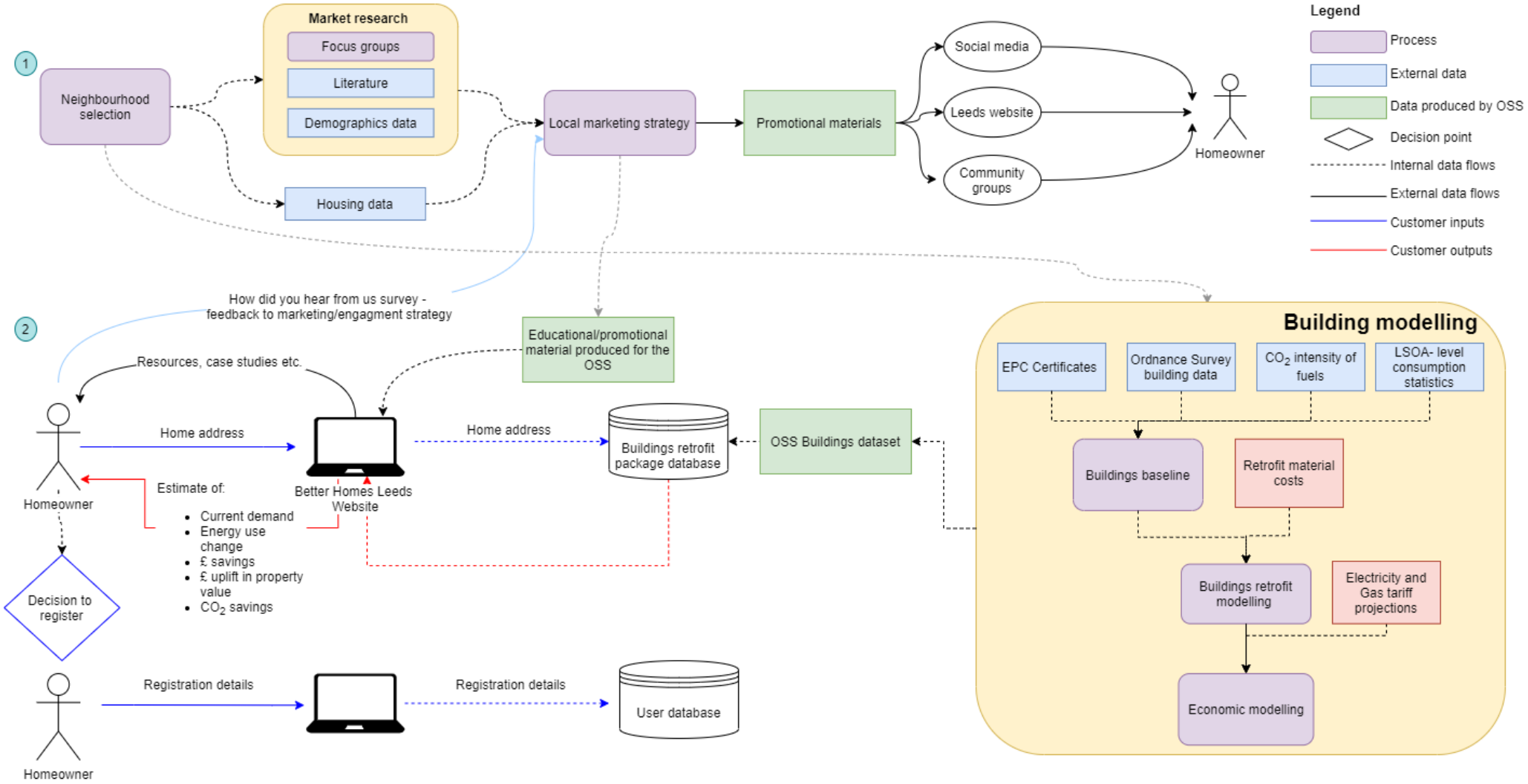
Data needs

Understanding the data needs and challenges across three stages of the OSS

	Initial customer identification and attraction	Ensuring a dependable service offering	Sustaining relationships and ongoing development
What?	Identifying potential customers and employing effective strategies to attract them to the OSS service. This will include focusing on specific customer segments, building trust, and effectively communicating the benefits of participation. Engagement can be tailored, to appeal to the needs and preferences of specific customer groups.	Delivering a dependable and consistent service offer to customers, ensuring that they are kept informed in a timely manner throughout process and that the retrofit interventions meet their expectations.	Nurturing relationships with customers over time and continually improving the services offered by the OSS. This includes sharing lessons learned and insights across the wider retrofit value chain.
What are the data needs?	• Neighbourhood characteristics: EPCs, Conservation status, Local Development Orders. • Current energy consumption (e.g., BEIS LSOA level consumption statistics) • Cost of different retrofit packages • Benefit of different packages: Change in energy use and uplift in property value • Potential timescales: lead times for purchasing products and materials, expected duration for employing local builders/installers and completing the retrofit work. • Case studies of retrofitted homes/specific interventions • Projections on materials/contractor requirements • Demographics of the household	• Logistics data: scheduled appointments, database of assessors, database of contractors, construction oversight • Data captured in home assessment (Building passport) • Simulation of packages: Updated (improved) cost/benefits • Financing options • Transactional (payment) data • Customer communication data – documentation of milestones, progress, issues and resolutions	• Real consumption data (metering, smart devices) • Validation of estimated vs actual benefits - improving simulation of packages • Customer satisfaction • Follow-up reporting • Reporting KPIs • Smart controls and automation
What are the data challenges?	• Capturing diverse customer segments • Translating benefits into understandable metrics • Data and forecast accuracy • Presenting reliable information relating to building consumption and costs/benefits • Accessing the current energy consumption of potential customers.	• Ensuring data completeness and standardisation in home assessment data • Ensuring that the customer is updated with the relevant information at a timely manner • Protecting sensitive information	• Permissions and handling of behind-the-meter data • Data resolution – how often does data need to be captured, analysed and stored • Analysing customer data for personalised advice/ offering

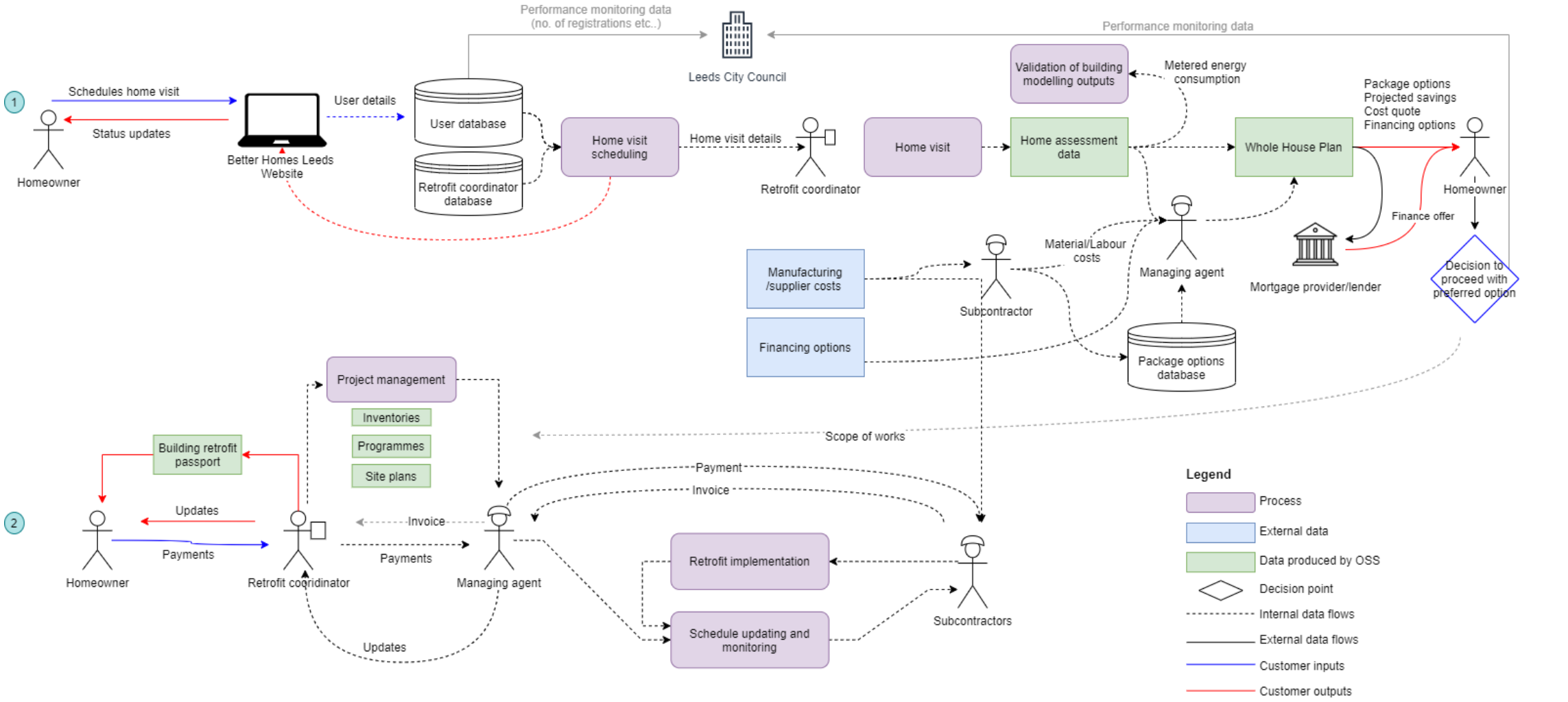
Stage 1: Customer identification and attraction

High level data flow diagram



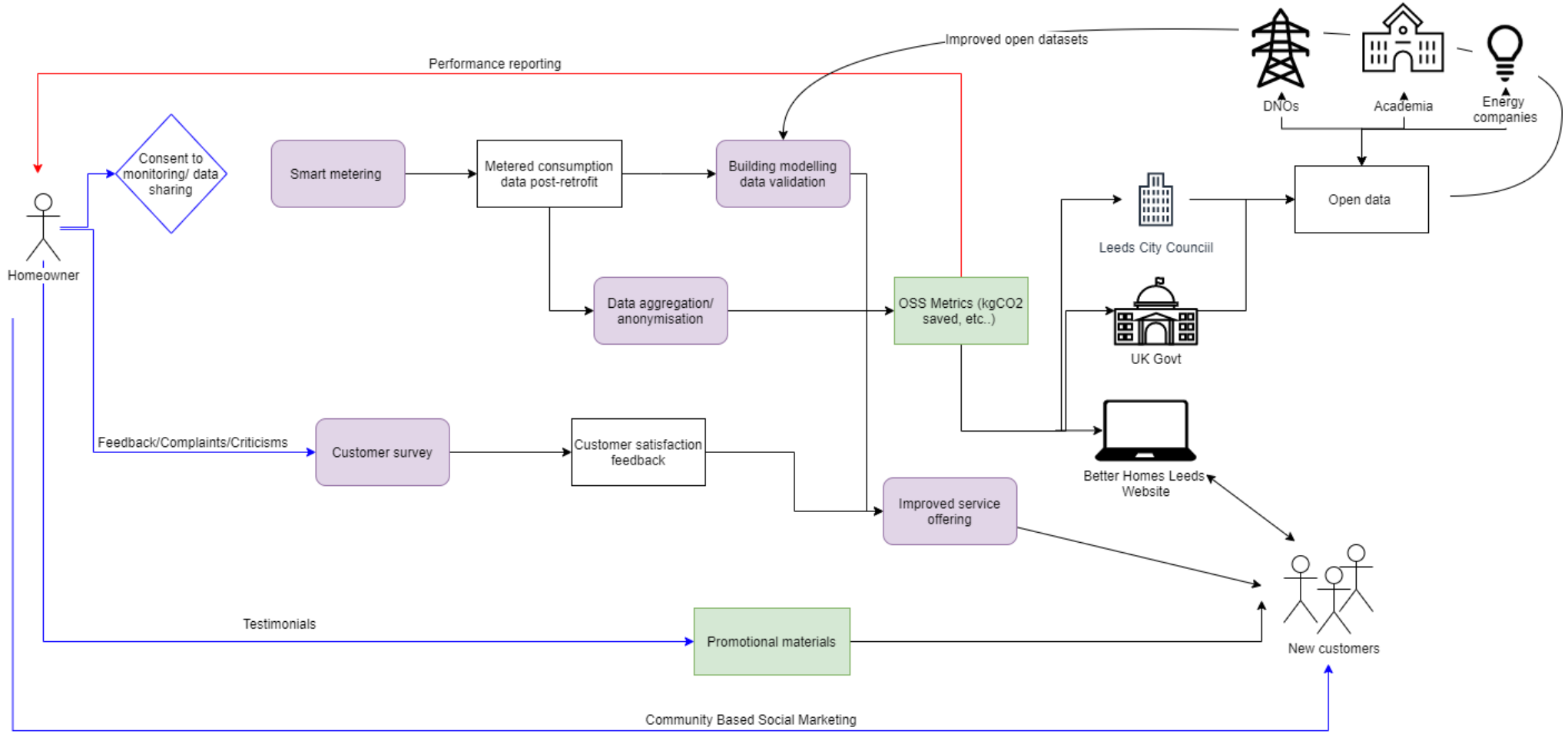
Stage 2: Ensuring a dependable service offering

High level data flow diagram



Stage 3: Sustaining relationships & ongoing development

High level data flow diagram



Data standards and protocols

To maximise the benefit of the vast amount of data which will be captured, processed and produced in the retrofit journey, data standards and protocols must be established. By establishing standardized formats and structures for collected data and outputs, as well as implementing a data governance framework, the project can ensure responsible data use, privacy protection, and security while promoting interoperability among stakeholders.

The protocol should outline:

Data Governance Framework

A robust data governance framework will be established to define clear principles and guidelines for responsible data use, privacy protection, and security. This framework will be designed to comply with relevant regulations, such as the General Data Protection Regulation (GDPR), to safeguard homeowner privacy and intellectual property (IP) protection. It should outline procedures for data handling, access controls, data retention, and data disposal to maintain data integrity and protect sensitive information.

Processes and Responsibilities

The data protocol will outline clear processes for data capture, management, storage, and sharing at all stages of the OSS customer journey. This will include identifying roles and responsibilities for data collection, wrangling, and sharing, establishing accountability for data quality and accuracy. The protocol should also ensure that data is gathered systematically, undergoes thorough validation, and is made accessible to relevant stakeholders.

Standardized Formats and Structures

The implementation of data standards will involve developing uniform formats and structures for data collected at each stage of the OSS process. This will include standard templates for capturing essential information (such as those captured in the home assessment and building retrofit passport) - ensuring consistency and ease of data exchange among different components and stakeholders. The standardized data formats will facilitate data aggregation, analysis, and reporting, enhancing overall data management and decision-making.

Depending on the intended use of the data, different standards, templates, and processes can be established. Internal data sharing between OSS functions may require standardized templates tailored to specific workflows. Conversely, data shared externally with homeowners or third-party entities (e.g., Leeds City Council) should follow protocols designed to safeguard privacy while delivering relevant and actionable insights.

Data sharing and collaboration

In the pursuit of fostering a culture of data sharing and collaboration within the wider retrofit value chain, the Better Homes Leeds project should promote open communication, information exchange, and collective learning among various stakeholders, including DNOs, academia, other OSSs, energy suppliers, financing bodies, homeowners, manufacturers, installers, and local authorities.

The overarching vision is to create an ecosystem where valuable insights and best practices are shared, leading to data driven decisions relating to energy efficiency interventions.

Data sharing:

Homeowners, manufacturers, installers, local authorities, and energy providers should be encouraged to participate in sharing relevant data, insights, and knowledge to inform the delivery of the OSS. This may require developing data sharing agreements for relevant stakeholders and collaborators. These agreements will outline the terms, responsibilities, and purposes of data sharing, ensuring compliance with data privacy regulations and protecting sensitive information.

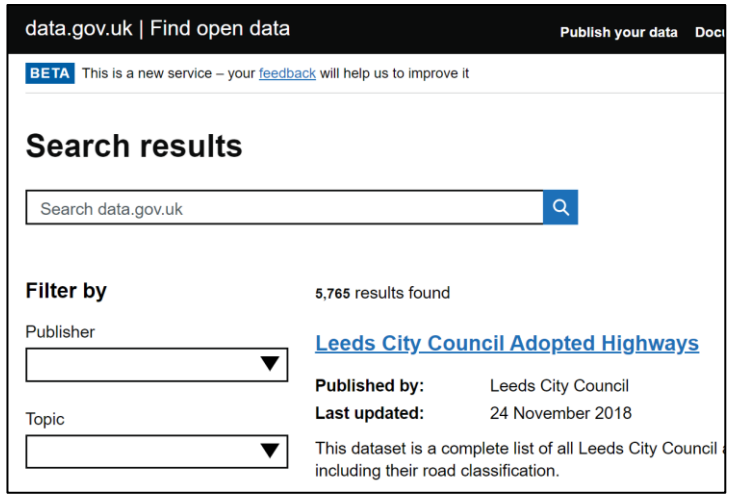
Reporting on key metrics:

As the OSS develops its service offering and takes on more customers, it should promote and report on key metrics and outcomes which could be shared with the wider community. This includes metrics such as uptake rates, energy savings, carbon reductions, and other performance indicators. Transparent reporting will facilitate performance evaluation, benchmarking, and continued improvement.

Integration with Open Data platforms:

To enhance accessibility and transparency, the project should also explore opportunities to integrate with open data platforms like data.gov.uk and Leeds Open Data. By sharing relevant data sets (e.g. anonymized energy consumption data) with these platforms, the one-stop-shop can contribute to the broader data ecosystem, enabling industry, researchers, policymakers, and the public to access valuable information and develop more innovative solutions.

Shared data should be made accessible and usable to others through proper documentation. This includes providing clear information about the data's source, collection methods, and limitations.



UK Government Data portal.

ARUP

Data exchanges in the energy system

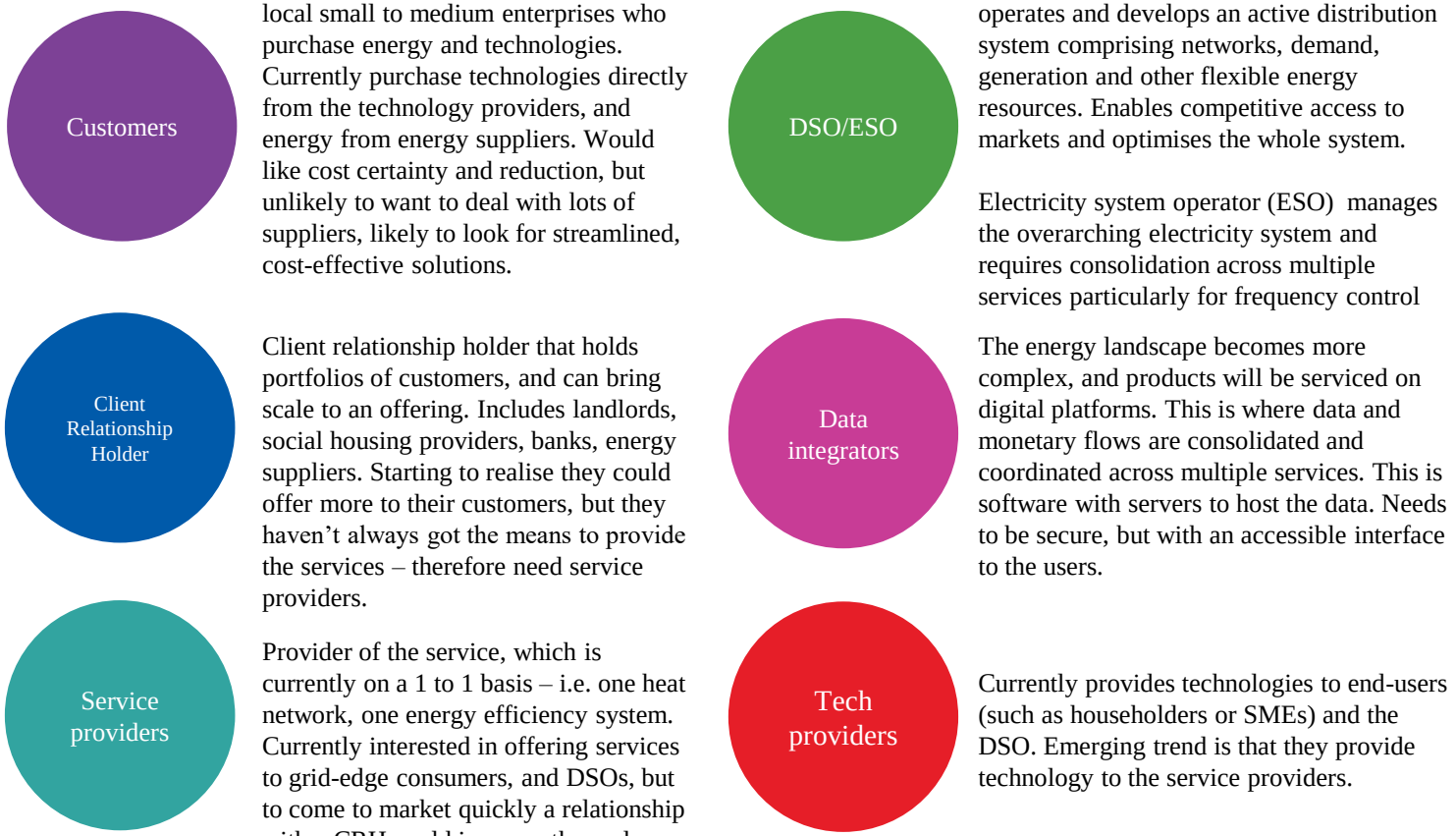
Part 2

Data exchanges in the wider energy system

Opportunities for the OSS

As the energy system transitions to a decarbonised and decentralised system, with progressively interconnected energy vectors, information exchange throughout the system will be increasingly relied upon to design and orchestrate this new complex landscape. In this new system, new players will emerge, as illustrated in the right. This presents opportunities to generate value and hence income from the data or from managing data flows, both for the OSS and for other actors, existing and new. The OSS might, for example, undertake the roles of **Customer Relationship Holder or Data Integrator.**

On slide 17, the data need of the participants in the evolving energy system has been mapped in the context of energy efficiency retrofits.



Participants in the existing and evolving energy system.

Data exchanges in the wider energy system

Opportunities for the OSS

The traditional siloed divisions of the energy sector have created an environment in which historically data sharing across organisations and energy vectors was difficult and not well understood. This creates an opportunity for innovation, facilitating new relationships and cross-organisation information flows.

Ofgem has been driving significant change with specific licence conditions for network operators to ensure open data with better interoperability is implemented by each of them. Ofgem has also highlighted key data metrics that Distribution Network Operators must share to enable neutral and transparent local flexibility markets.

Innovation within the energy industry e.g. ESO (Electricity System Operator) services, regulation and standards changes, and new and evolving markets, generates further opportunities in the future system as positions are created through new data flow requirements. Organisations providing data services to the industry will hold a core position in the future energy system and be crucial to the operation of it.

For all these areas, data exchange provides the enabler to the future operation and data flows both up and down stream are integral to a resilient, efficient system.

Digital considerations

The shift towards digitalization in the energy sector underscores the importance of data and its availability. Data analytics conducted at scale can provide invaluable insights to support the energy transition and accelerate decarbonisation efforts. This offers opportunities for generating value and income, not only from the data itself but also from managing data flows, benefiting both the OSS and other stakeholders.

Digital tools play a pivotal role in this data-driven landscape, requiring the development of new skill sets, processes, and tooling within the energy industry. This includes building energy management and monitoring tools such as smart meters, advanced energy simulation and optimisation tools, and the integration of networked systems such as IoT devices. All of these innovations introduce new services to the market and are highly relevant to the service offering of the one-stop-shop.

Further, user experience design and data handling expertise will be necessary to ensure that consumers can readily access and interpret the wealth of information generated by these tools. Embracing these digital tools and developing the necessary skill sets and processes to integrate them will be essential for the OSS to navigate the evolving energy sector successfully.

Wider data needs mapping

Other stakeholder data requirements (1/2)

People and organizations	What data is needed?	Why is it needed?
UK Governments and Devolved administrations	Retrofit progress data – rate of implementation of retrofit projects across country. Energy consumption data before and after interventions, aggregated at different statistical levels	To inform policy and funding allocations: Use of taxation, tax relief and financial incentives Use of laws, bylaws and similar legislative instruments to set the boundaries for acceptable behaviour with penalties for infringement
Local authorities	Energy efficiency data Planned retrofits including target buildings, proposed measures, timelines, and anticipated energy savings Success stories	To inform LAEPs and planning frameworks/ policies Understand planning restrictions (i.e. proposed measures in conservarion area) To help attract funding, e.g. ECO. To help engage homeowners: mass media campaigns, digital marketing campaigns and correspondence
DNOs / DSOs	Estimated changes in peak power demand data PV generation connections data: Data on planned PV installations, their capacity, and expected generation output EV uptake projections, Heat pump uptake projections	To inform decisions about transformer or feeder upgrades; or decisions about funding for residential energy efficiency to reduce cost of network reinforcement and congestion management.
National Grid ESO	Power demand information Information on the installation of batteries in homes as part of retrofit projects, including their capabilities, performance, and potential benefits to the grid	To inform decisions about funding batteries in homes that can provide enhanced frequency response, a fast-acting reserve, minimise foot room costs or even provide some black start capability.
Manufacturers and builders' merchants	Spatially/temporally projected demands for retrofit products and materials	To identify area-based future demand for production planning, inventory management, and procurement.

Wider data needs mapping

Other stakeholder data requirements (2/2)

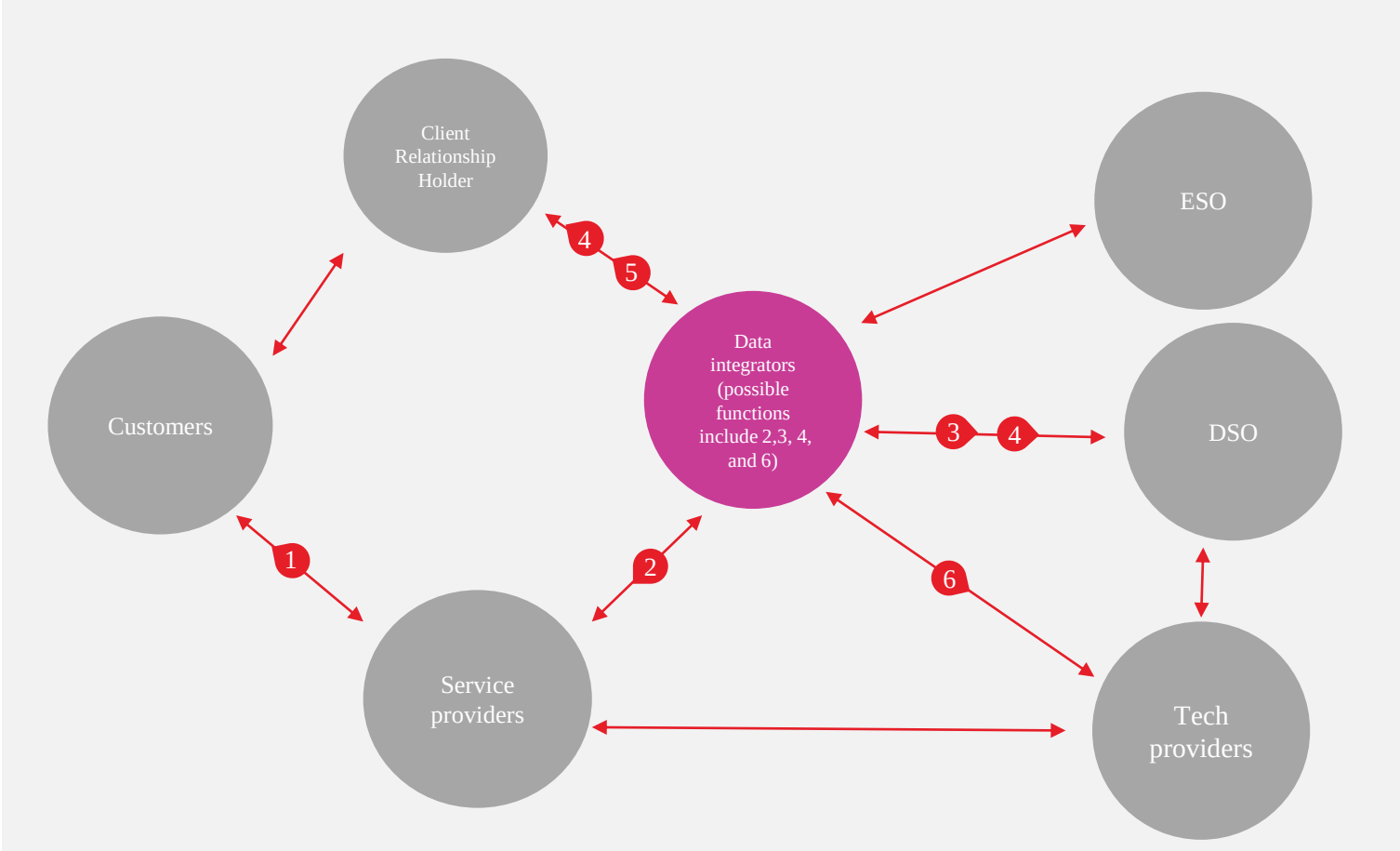
People and organizations	What data is needed?	Why is it needed?
Retrofit assessors/ designers	Information on proposed retrofit packages and strategies (building types, location, technologies considered, expected energy savings)	To inform their work in identifying pathways to net zero. For Building Renovation Passports and performance monitoring.
Funders and insurers	Costs, predicted benefits (carbon reductions, returns) Property value (before and after retrofit)	To inform their lending and investment decisions. To assess risks. To tailor the financial offers provided.
Homeowners	Costs, predicted benefit (savings), payback periods Pre-retrofit planned/proposed retrofit measures and funding mechanisms/packages Funding mechanisms (loans, PLF, salary sacrifice, grants) Information relating to materials, manufacturers, installers re- and post- retrofit – energy consumption data	For procurement and to inform borrowing/ investing decisions.
Builders, installers and training bodies	Building types, location, materials and technologies considered Spatially/temporally projected demands for retrofit installation requirements	To identify area-based future demand for specific trades and skills for construction and installation. To identify specific skills gaps and plan for training and upskilling.
Carbon accounting software providers	Whole-life carbon assessment of retrofit interventions Pre/post retrofit interventions	To inform predictions and to provide feedback on their accuracy.

Mapping of potential roles

Roles mapped to the energy system

This section outlines how potential data roles (as described on slides 18-20) are mapped to the key energy system actors shown on slide 13. This shows that several of the functions could sit within a central data integrator role, which could be adopted by the OSS, including roles 2 and 3, provision and management of data and signals, and roles 4 and 6 which are both planning and optimisation functions based on data gathered by the data integrator in collaboration with other stakeholders.

1. Data integration and platform development for consumers
2. Provision and management of data and signals for service providers
3. Provision and management of data and signals for system operators
4. Data gathering and understanding of technology options for future modelling and planning
5. Coordination of activity and knowledge sharing
6. Data gathering and design optimisation and foresight of future requirements



Roles

Potential data roles for key actors in the energy system (1/3)

Role 1.	Data integration and platform development for end customers.
Description of activity	The end customer may require a simple platform for which to control or make choices about the management of a variety of assets and appliances in the property behind the meter. They might directly control time or intensity of use, or allow others to do so under a set of defined parameters to adjust comfort levels, save or make money or optimise emissions reductions. This system might also inform on need for improvement should the performance against desired targets not be met (e.g. if the system captures that the target heat consumption is repeatedly exceeded, triggers need for further assessment of the building fabric to identify potential improvement measures. The initial data gathered can be shared with the supply chain to inform the design inputs).
Why is it needed?	This service responds to the need for cost reduction, efficiency (energy use and emissions), comfort, simplification of future complex operations. Potential for driving changes and adding value upstream on the system by gathering real data on consumption and behaviour of the demand side.
Role 2.	**Provision and management of data and signals for service providers**
Description of activity	Localised and national trading of electricity services will be enabled by the multi-directional flow of reliable data and signals to control the services. This increased data layer activity will need to be implemented, managed and transmitted reliably to enable service providers undertake the activities at the temporal and spatial resolutions required.
Why is it needed?	With distributed, intermittent generation and smart grid operation, localised trading of grid services is relied upon to operate the system reliably. Aggregators of these services must be able to respond within the regulated timeframes and be able bid within the auction period. As the grid evolves, these stakeholders must have the data and signals required to both plan their operation and deliver the services when required. The provision and management of these data and signals is crucial to the operation of a flexible system which is responsive to customer needs and able to respond to critical situations.

Roles

Potential data roles for key actors in the energy system (2/3)

Role 3.	Provision and management of data and signals for system operators
Description of activity	To manage a flexible, responsive future electricity system, the multi-directional flow of reliable data is fundamental to future operation. This increased data layer activity will need to be implemented, collected, managed and transmitted to enable stakeholders. This data needs to be accessed and visualised to a wide number of stakeholders while having the confidence in the core data as it has been managed reliably.
Why is it needed?	With increasing prevalence of distributed generation and localised trading of energy and grid services, system operators must take on responsibility for balancing supply and demand locally and interact with the numerous new and emerging actors. The timely management of data and signals is crucial to the operation of a flexible system which is responsive to customer needs and able to respond to critical situations.
Role 4.	**Data gathering & tech options for future modelling & planning.**
Description of activity	To undertake future energy modelling and planning there is a large amount of data that needs to be gathered, sorted and collated in a meaningful way. This bundle includes forecasting of load, generation and weather, and how the system could work in different scenarios, including how flexibility modelling could influence the shape of the future technology scenario and forecasting of technology uptake rates and deployment.
Why is it needed?	The future energy market needs to transition to a decarbonised one. System operators needs to understand how their future system will operate and client relationship holders need to understand where and who to target.

Roles

Potential data roles for key actors in the energy system (3/3)

Role 5.	Coordination of activity for customer relationship holders
Description of activity	Programme management and coordination of activity for customer relationship holders –this involves creating targets for each area and rolling out the provision of technology and integration with the platform. Includes stakeholder engagement and coordination with consumers and collaborators such as the DNOs through a digital tool which could include a booking system, management of installers and customer services.
Why is it needed?	The future energy system needs to transition at scale, CRHs may not have the right skills or ambition to move into service provisions, so there is an opportunity for someone to undertake this activity on their behalf.
Role 6.	**Data gathering, design optimisation & foresight of future requirements.**
Description of activity	Technology providers need to understand the rate of production needed from now and into the future. They need to optimize their designs and understand how to gain a good market share. They need foresight into the future requirements, e.g. is the technology going to need greater efficiency, less CFCs etc.?
Why is it needed?	Technology providers need to understand their future market as the energy system evolves. They may not have the knowledge to understand how their market share needs to change over the coming years.

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Further considerations

Further considerations

As the development of the OSS progresses and the implementation of the data strategy unfolds, several aspects will require further consideration and refinement to maximize the benefits of data in domestic retrofit:

Stakeholder mapping
A more exhaustive stakeholder mapping exercise should be conducted to gain insights into both direct and indirect stakeholders engaged with the OSS and the data exchanges among them.

Identifying Data Sources
It is important to determine a more comprehensive list of what data is valuable to different organizations and stages of OSS implementation. This involves identifying relevant data sources and categorizing data based on its significance and relevance to various stakeholders. Questions should be addressed relating to how data is obtained, data ownership, funding, and what physical devices (e.g., smart meters) are needed to capture and transmit data. Additionally, considerations about varying levels of data aggregation or disaggregation for different purposes should be explored.

Data management
Another key consideration is to determine how data will be stored and used within the OSS and in broader contexts. A next step can be to assess the current data management systems in place, identifying strength, weaknesses and areas for improvements. The OSS's role in data management and ownership should also be considered.

Scale
The scale at which an integrated data strategy becomes most valuable is another key factor to consider. Future work could explore varying levels of data integration, such as at the Neighbourhood, City, County, Region, or National level.

Data sharing
Determining the most effective approach for the OSS to disseminate insights and data for the benefit of the wider industry is another outstanding consideration. This could also encompass questions regarding which metrics to employ for monitoring and presenting progress in delivering the OSS.

This report and the further considerations on this page highlight the complexity and depth of using data to enable the delivery of the OSS and the broader energy transition. They raise important questions about roles, responsibilities, costs, and decision-making. In future work, these considerations should be more thoroughly explored to chart a path forward for the successful deployment of the OSS and its associated data strategy.

Appendix 3: Smart Tariffs Modelling

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Leeds City Council

Better Homes Leeds

BHL Phase 2: WP04 – Smart Tariff Modelling Results

295501-02
11 September 2023

ARUP

Contents

ARUP

Section 1

Executive Summary

1. Executive Summary

As part of the second phase of Better Homes Leeds, Arup's WP4 analysis seeks to model packages of residential intervention measures linked to smart tariffs to understand the impact on household energy consumption and bills across a range of archetypes in Chapel Allerton.

1.1 Overview

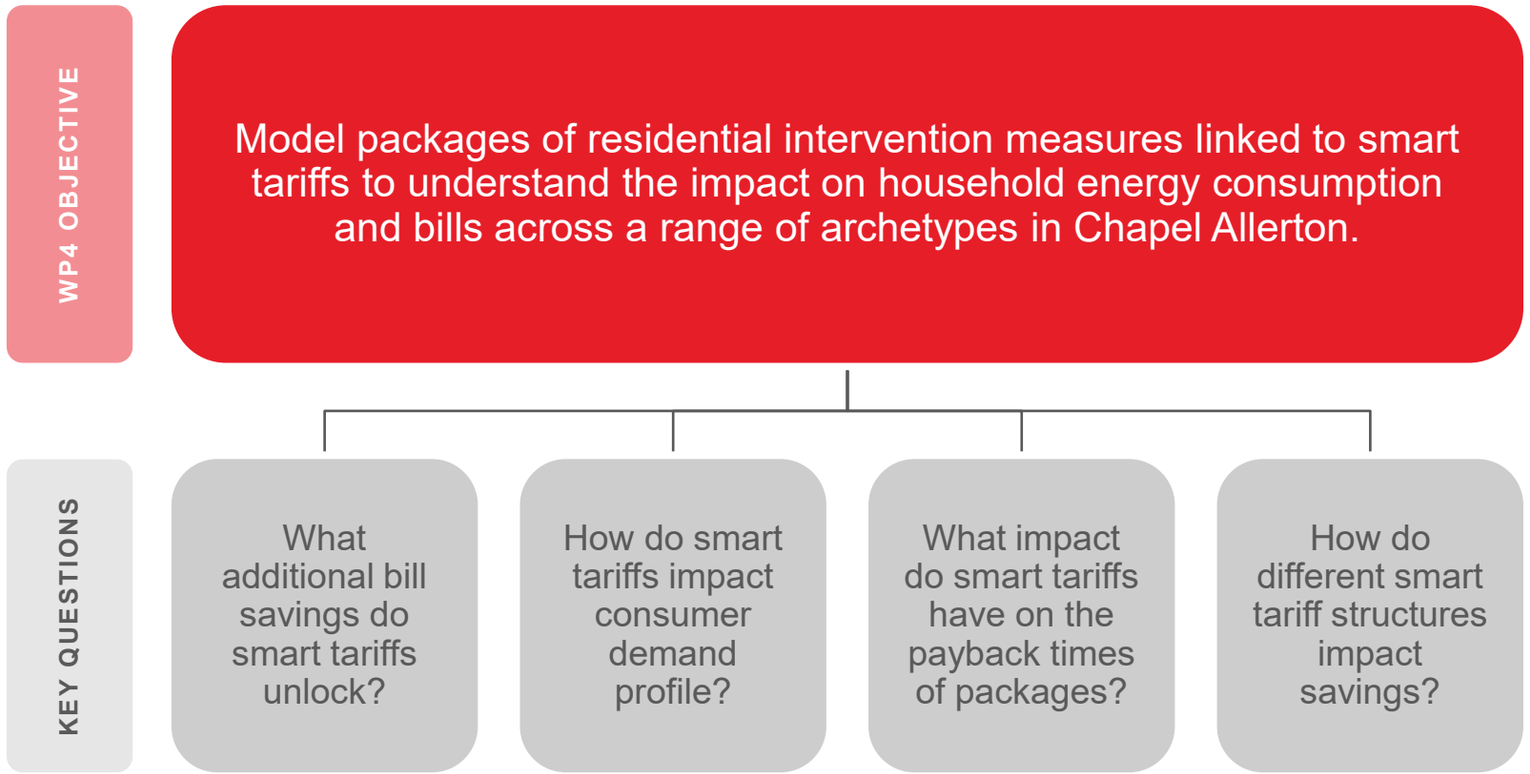
Following the first phase of Better Homes Leads (BHL) – in which, a delivery solution was developed, as summarised in the January 2023 Blueprint Report – the overall objective of the second phase is to design a scalable domestic retrofit proof of concept, including a compelling financial offer, for 500-1000 middle income homes in the able to pay market, that aims to reduce energy bills and carbon emissions. This also includes behaviour change interventions to maintain lower energy use once homes have been retrofitted, as well as a range of solutions including building fabric, heat pumps and rooftop solar.

Four work packages are included in this phase:

1. Project coordination,
2. GHFA reporting delivery,
3. Expert input, and
4. Techno-financial modelling and 'Smart Tariff' options appraisal.

This report is associated with the fourth work package (WP4). Arup's main objective in WP4 is to model packages of residential intervention measures linked to smart tariffs to understand the impact on household energy consumption and bills across a range of archetypes in Chapel Allerton.

Arup's analysis seeks to determine additional savings unlocked by smart tariffs and the effect of different smart tariff structures, as well as the impact of smart tariffs on household demand profiles and intervention package capex payback times.



Better Homes Leeds Phase 2: WP4 Objective and Key Questions

Source: Arup

1. Executive Summary

Arup's WP4 analysis determines the change in energy use between a reference case and three packages of interventions for three Chapel Allerton archetypes, as well as associated capex and payback period. Change in household energy bills is calculated based on three different smart tariff types.

1.2 Methodology

Arup's modelling determines the electricity and gas demand and profiles for each of the following three Archetypes:

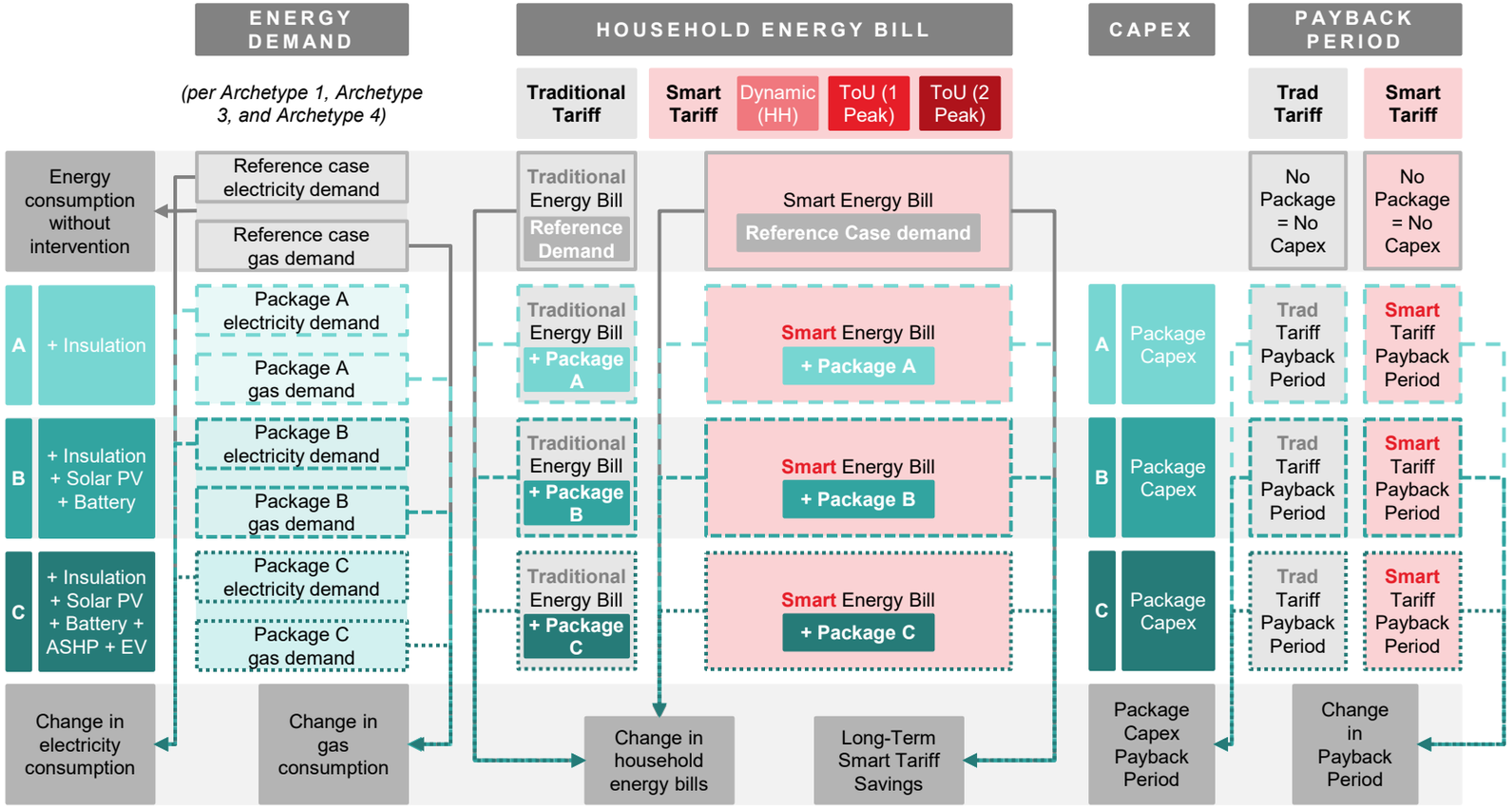
- Archetype 1: Cavity semis/detached with gas boiler
- Archetype 3: Solid brick terraces with gas boilers, not in a conservation area
- Archetype 4: Turn of the century houses with gas boiler

Measures included in the three packages of interventions affect household energy demand through means including reducing heat transfer, shifting demand off-grid, electrifying heat, and altering the profiles of demand. Packages include:

- Package A: Insulation
- Package B: Package A + Solar PV + Battery
- Package C: Package B + Heat Pump + EV Charging

Traditionally, households pay for their energy consumption via a unit and standing charge, fixed ahead of time by the supplier. This does not always reflect real time energy market prices. Households can instead use a smart tariff for electricity. Arup's modelling analyses household energy bills under a traditional tariff type and three smart tariff types:

- Dynamic (half-hourly) smart tariff
- Time-of-Use (1 peak, 1 off-peak) smart tariff
- Time-of-Use (2 peak, 2 off-peak) smart tariff



Arup WP4 Methodology Overview Diagram

Source: Arup

1. Executive Summary

Package A, with only insulation interventions, sees the smallest energy demand change. Package C sees the greatest change, with gas usage eliminated through ASHP implementation. Change in energy demand ranges from -12% to -72%. The greatest reductions are seen for Archetype 3.

1.3 Results [1/2]: Change in Energy Demand

Arup calculates the change in energy demand associated with rolling out each smart tariff-linked Package of interventions for each Archetype.

These resulting scenarios of annual household energy demand are later multiplied by a range of smart tariffs and compared to a traditional energy bill under reference case demand to determine energy bill savings.

The chart opposite summarises the energy savings observed for both gas and electricity in 2024. As shown, the greatest overall savings are seen for Package C largely due to the electrification of heating via the installation of an ASHP, which eliminates the need for gas.

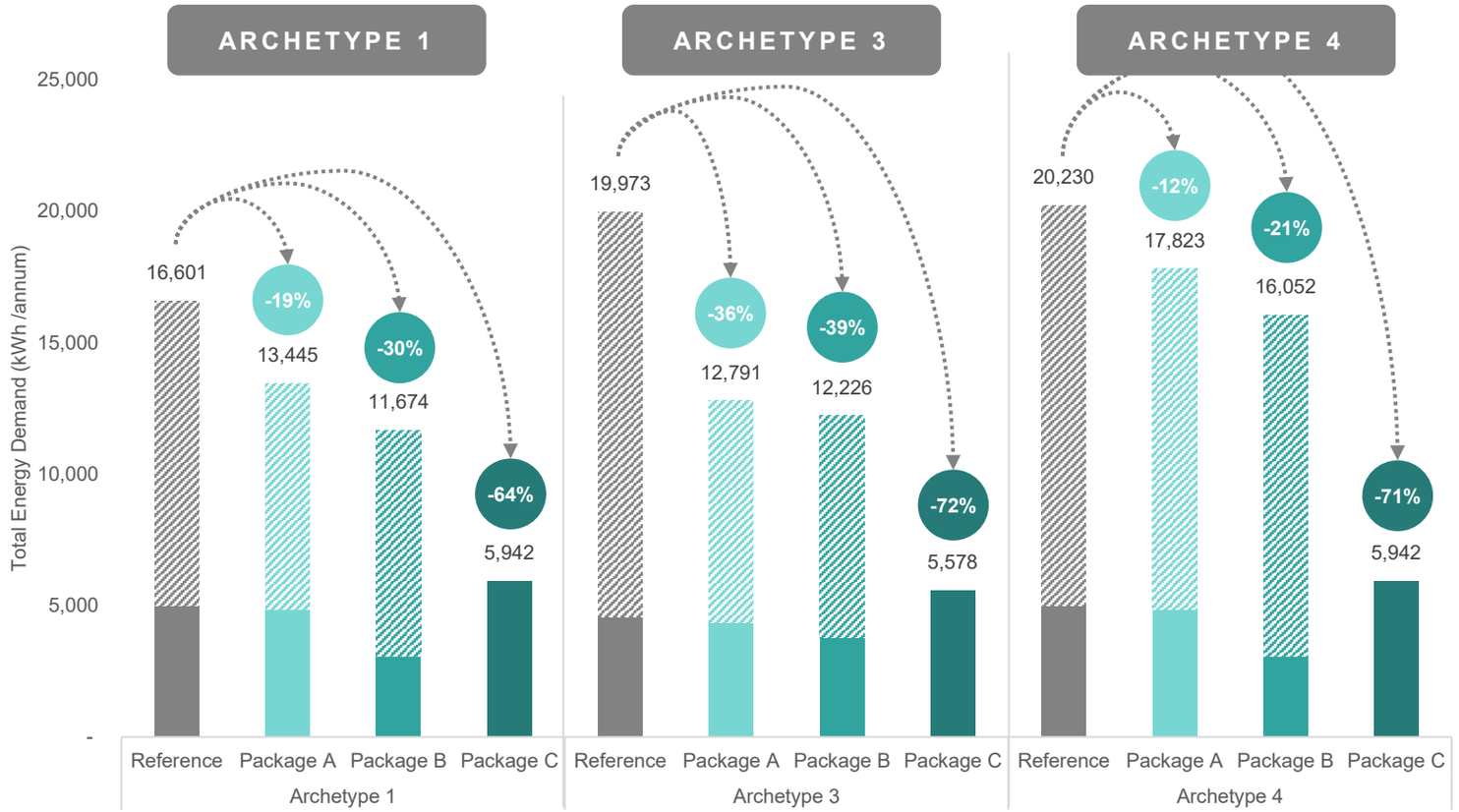
In terms of archetypes, the greatest energy savings are observed for Archetype 3 due to the specific insulation measures installed (i.e. external wall insulation and suspended floor), which lead to lower energy losses and thus lower overall energy requirements.

Fuel

- Solid fill – electricity demand
- Pattern fill – gas demand

Package

- Reference case (no package implemented) energy demand
- Package A energy demand
- Package B energy demand
- Package C energy demand



Annual Energy Demand by Archetype and Package: Electricity vs Gas (not including demand met by home generation)

Sources: Octopus Faraday Tool, Arup Gas Demand Profiling Tool, and Arup Analysis

ARUP

1. Executive Summary

Smart tariff savings average approximately 40% of overall savings across packages and archetypes. Smart tariff savings range from £300 under Package A to £500 under Package C. Greater reductions in demand lead to increased total smart tariff savings.

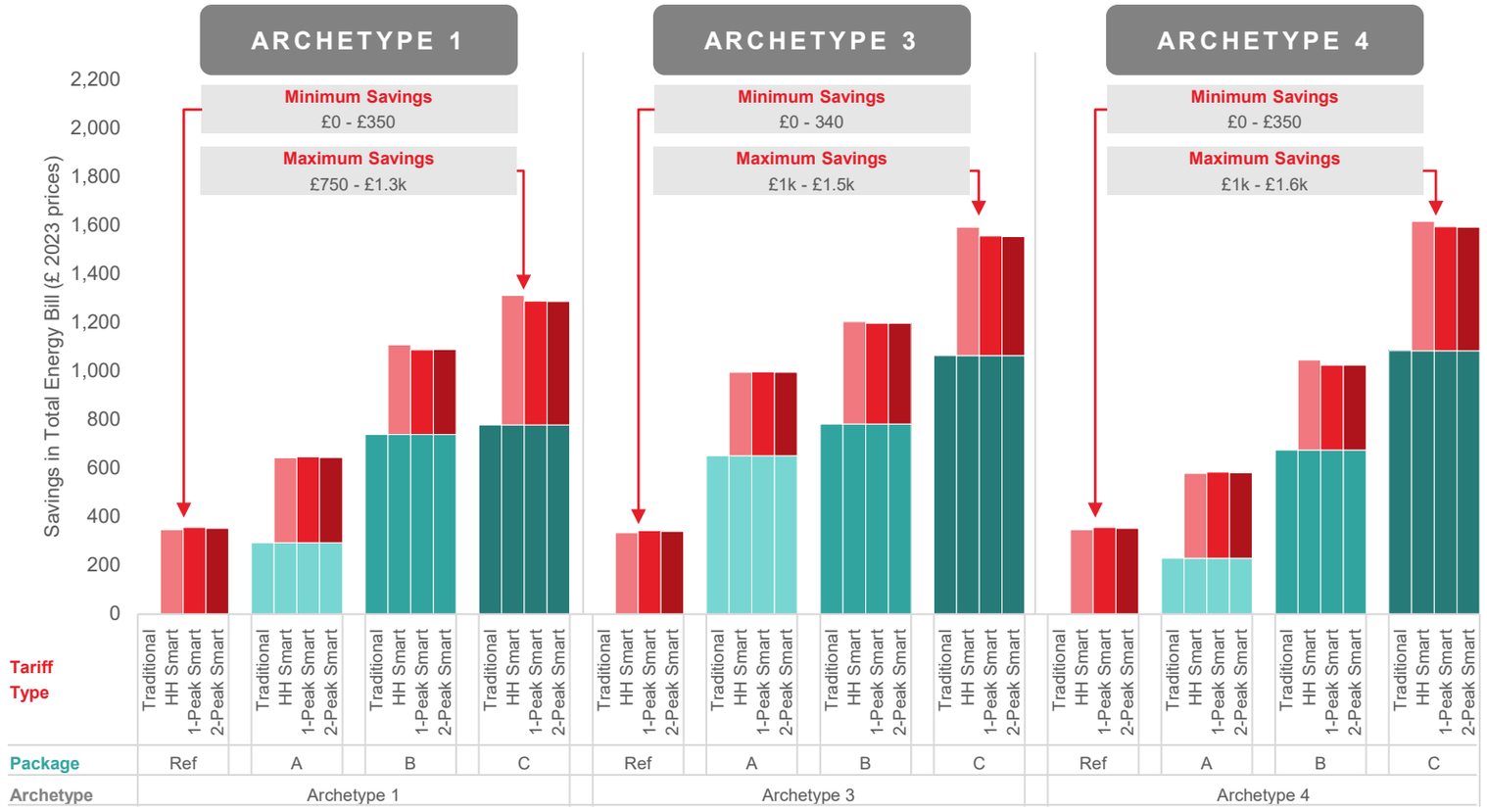
1.3 Results [2/2]: Household Energy Bill Savings (2024)

Total household energy bill savings range from £300 to £1.6k in Arup's modelled results for 2024.

Package savings stem from the **reduction in demand** resulting from implementing the interventions included in packages A, B, and C. **Smart tariff savings** stem from switching from a traditional to a smart tariff and the **improved alignment of smart tariffs to real energy market signals** of supply and demand.

Package savings under Package A represent an average 50% of overall savings across archetypes, with those under packages B and C representing 66% and 65%, respectively.

Smart tariff savings represent 100% of reference case savings across archetypes, as no package intervention is taking place. Across the package cases, smart tariff savings represent 39% of total savings (average across archetypes). Smart tariff savings represent the highest proportion of total savings for Package A and the lowest for Package B. On an absolute basis, smart tariff savings increase with greater changes in demand, with the highest smart tariff savings under Package C. **Smart tariff savings are expected to reduce over time as wholesale prices stabilise.**



Savings in 2024 Total Energy Bill Scenarios (Compared to Reference Case Demand, Traditional Tariff): Archetypes 1, 3, and 4

Sources: Arup Plexos Modelling, Octopus Faraday Tool, Arup Gas Demand Profiling Tool, and Arup Analysis

ARUP

Section 2

Introduction

2. Introduction

As part of the second phase of Better Homes Leeds, Arup's WP4 analysis seeks to model packages of residential intervention measures linked to smart tariffs to understand the impact on household energy consumption and bills across a range of archetypes in Chapel Allerton.

2.1 WP4 Objectives

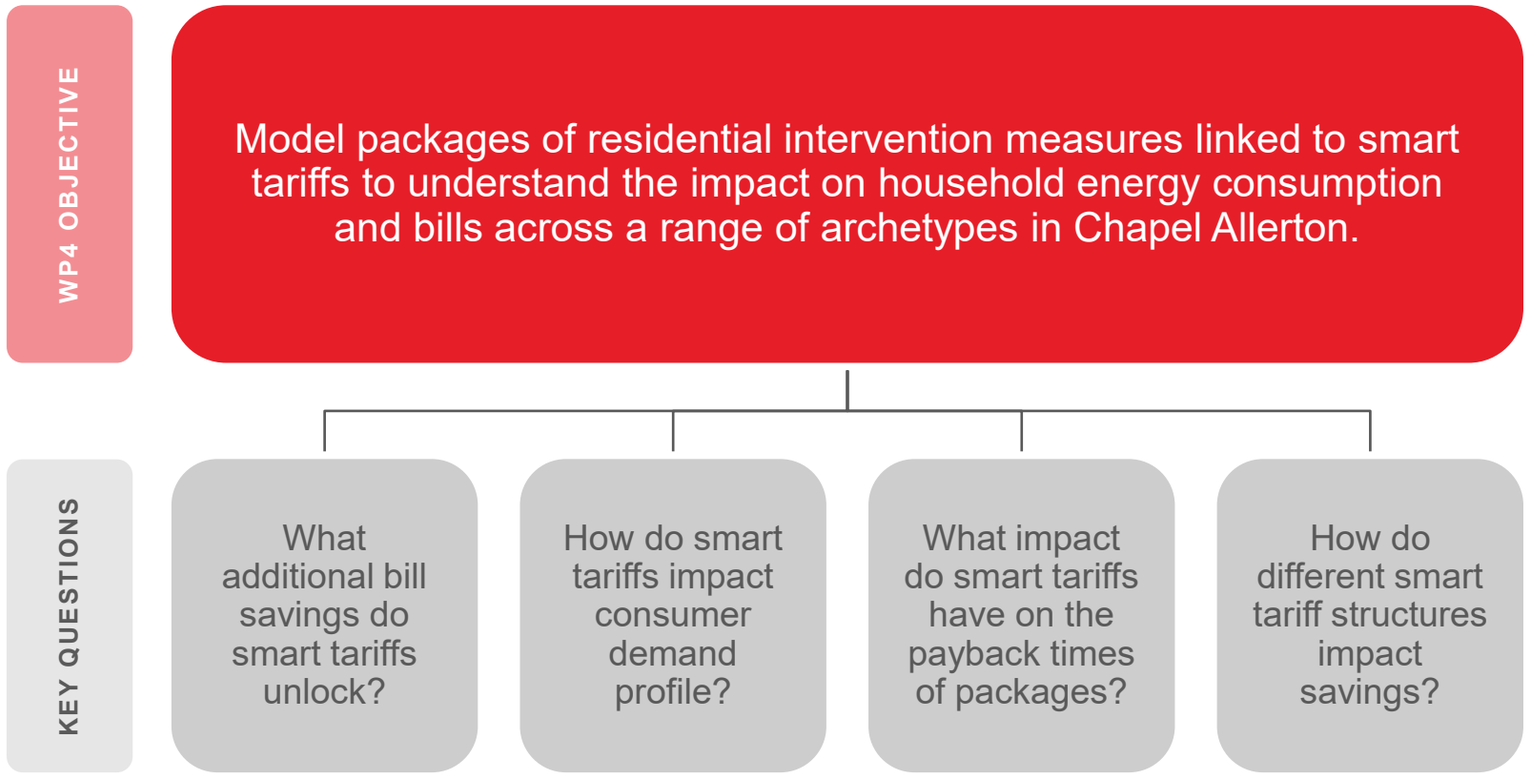
Following the first phase of Better Homes Leads (BHL) – in which, a delivery solution was developed, as summarised in the January 2023 Blueprint Report – the overall objective of the second phase is to design a scalable domestic retrofit proof of concept, including a compelling financial offer, for 500-1000 middle income homes in the able to pay market, that aims to reduce energy bills and carbon emissions. This also includes behaviour change interventions to maintain lower energy use once homes have been retrofitted, as well as a range of solutions including building fabric, heat pumps and rooftop solar.

Four work packages are included in this phase:

1. Project coordination,
2. GHFA reporting delivery,
3. Expert input, and
4. Techno-financial modelling and 'Smart Tariff' options appraisal.

This report is associated with the fourth work package. Arup's main objective in WP4 is to model packages of residential intervention measures linked to smart tariffs to understand the impact on household energy consumption and bills across a range of archetypes in Chapel Allerton.

Arup's analysis seeks to determine additional savings unlocked by smart tariffs and the effect of different smart tariff structures, as well as the impact of smart tariffs on household demand profiles and intervention package capex payback times.



Better Homes Leeds Phase 2: WP4 Objective and Key Questions

Source: Arup

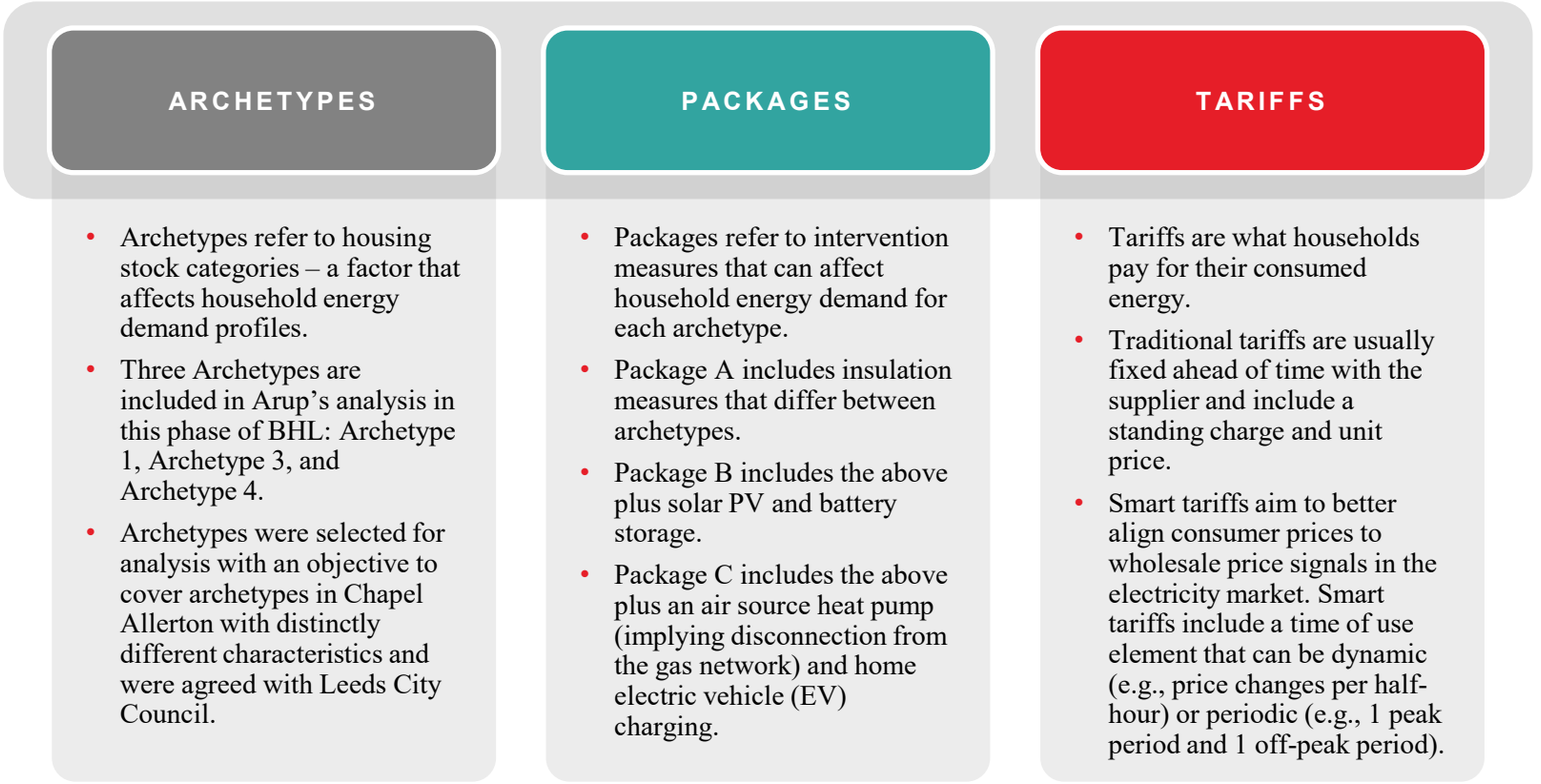
2. Introduction

Arup models energy demand for three Archetypes – with and without the effects of Package case interventions – to calculate the implied change in demand and analyse the additional impact on energy bills of one traditional tariff and three smart tariff types.

2.2 Approach

The following four slides will introduce key elements of Arup's analysis. A high-level overview is provided opposite.

- Arup determines the electricity and gas demand volumes and profiles for each of three Archetypes:
  1. **Archetype 1:** Cavity semis/detached with gas boiler
  2. **Archetype 3:** Solid brick terraces with gas boilers, not in a conservation area
  3. **Archetype 4:** Turn of the century houses with gas boiler
- Measures included in three Packages of interventions affect household energy demand through means including reducing heat transfer, shifting demand off-grid, electrifying heat, and altering the profiles of demand. Packages include:
  1. **Package A:** Insulation
  2. **Package B:** Package A + Solar PV + Battery
  3. **Package C:** Package B + Heat Pump + EV Charging
- Traditionally, households pay for their energy consumption via a unit and standing charge, fixed ahead of time by the supplier. As discussed in Section 2.5, this does not always reflect real time energy market prices. Households can instead use a smart tariff. Arup's modelling analyses energy bills under a traditional tariff and three smart tariff types:
  1. **Dynamic** (half-hourly) smart tariff
  2. **Time-of-Use** (**1 peak**, 1 off-peak) smart tariff
  3. **Time-of-Use** (**2 peak**, 2 off-peak) smart tariff



Key Elements of Arup's WP4 Modelling

Source: Arup

ARUP

2. Introduction

Three Chapel Allerton archetypes from Phase 1 were selected for the modelling: Archetype 1 (cavity semis/detached with gas boilers), Archetype 3 (solid brick terraces with gas boilers, not in a conservation area), and Archetype 4 (turn of the century houses with a gas boiler).

2.3 Archetypes

Archetypes refer to housing stock categories – a factor that affects household energy demand profiles. Phase 1 of Better Homes Leeds included seven Archetypes, or housing stock categories, in Chapel Allerton. These included:

1. **Archetype 1:** Cavity semis/detached with gas boilers
2. **Archetype 2:** Other mid-century cavity houses with gas boilers
3. **Archetype 3:** Solid brick terraces with gas boilers not in conservation area
4. **Archetype 4:** Turn of the century houses with a gas boiler
5. **Archetype 5:** Solid brick terraces with gas boilers in conservation area
6. **Archetype 6:** Older houses with non-boiler gas heating
7. **Archetype 7:** Solid brick non-terraces with gas boilers not in a conservation area

Arup selected three of these Archetypes for the more detailed analysis in Phase 2. The selected archetypes represent a combined 51% of Chapel Allerton's housing stock, with their years of build spanning more than five decades.

These Archetypes were selected with an objective to cover distinctly different characteristics of house type and build year and were agreed with Leeds City Council as part of the WP4 rescoping exercise.

Selection based on covering archetypes in Chapel Allerton with distinctly different characteristics

ARCHETYPE:	ARCHETYPE 1	ARCHETYPE 3	ARCHETYPE 4
TYPE:	Cavity semis/detached with gas boilers	Solid brick terraces with gas boilers, not in a conservation area	Turn of the century houses with a gas boiler
BUILT:	1930-1949	1900-1929	1996-2002
STOCK:	30% of dwellings in Chapel Allerton	15% of dwellings in Chapel Allerton	6% of dwellings in Chapel Allerton
EXAMPLE:	20 Miles Hill Terrace	20 Hamilton Avenue	9 Meadow Walk

Archetypes Selected for Analysis

Sources: Better Homes Leeds Phase 1 and Arup Analysis

2. Introduction

Three packages of interventions are considered for each archetype. Interventions are largely based on Phase 1 but with the addition of Battery Storage and EVs due to their relevance for smart tariffs.

2.4 Packages

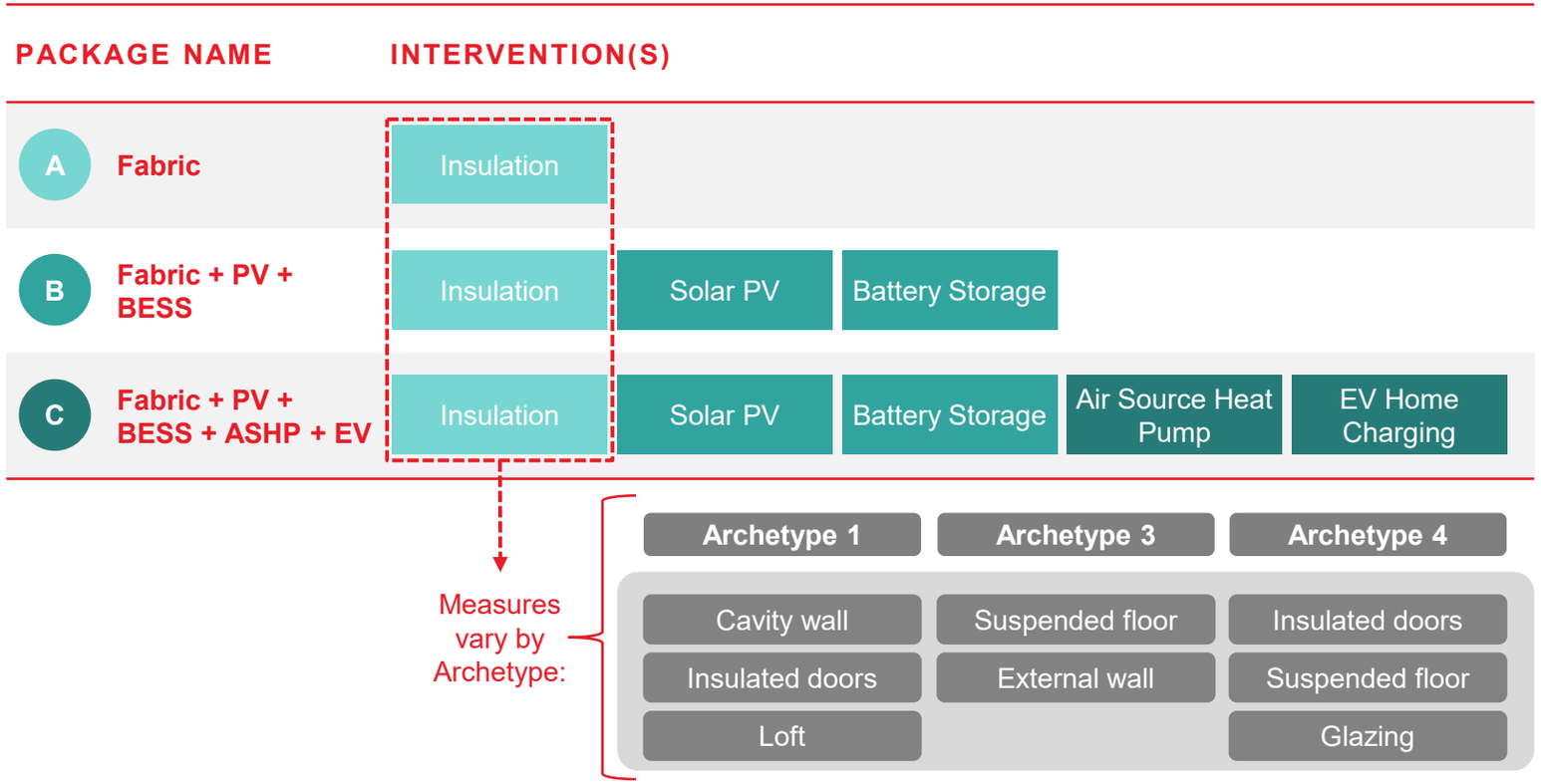
Packages refer to intervention measures that can affect household energy demand for each archetype. Packages in Arup's analysis include:

- **A** **Package A:** "Fabric" (Insulation only)
- **B** **Package B:** "Fabric + PV + BESS" (Package A interventions plus Solar PV and Battery Storage)
- **C** **Package C:** "Fabric + PV + BESS + ASHP + EV" **(**Package B interventions plus an Air Source Heat Pump and home EV Charging)

The selected archetypes dictate the interventions considered for the three packages. This is based on Phase 1 work and the specific measures applied for each archetype. Arup has added Battery Storage and EV charging interventions in this phase because of their relevance for smart tariffs.

Insulation measures included in all packages vary by archetype. For Archetype 1, these interventions include cavity wall, door, and loft insulation. For Archetype 3, these measures include suspended floor and external wall insulation. For archetype 4, door and suspended floor insulation are included, as well as glazing.

The capex associated with implementing the package measures is outlined in Section 6.



Packages of Interventions Included in Arup's Analysis

Sources: Better Homes Leeds Phase 1 and Arup Analysis

ARUP

2. Introduction

Arup carried out a desktop study of the smart tariffs available to residential customers in the UK. Three different smart tariff structures, reflective of products currently available, were considered for each package of interventions.

2.5 Tariff Structures [1/2]: What is a Smart tariff?

When retail suppliers purchase electricity to sell on to end users, their costs are dictated by the wholesale power market. The wholesale electricity market settles half-hourly, meaning there is a price for each half-hour period. The price is driven by the market's supply and demand during that half-hour period.

Traditionally, households pay for their consumed energy based on a daily standing charge and unit cost that are fixed ahead of time for a period. This can be quarterly, as is typical of a standard variable tariff, or for a longer period (e.g., one year) on a fixed rate tariff. The supplier fixes these prices the term based on its energy purchasing costs, other costs, and target margin, and they remain the same over the entire day.

The wholesale price of electricity, on the other hand, changes throughout the day, week, and year. Prices are typically higher in the morning and evening peaks, during weekdays, and during winter. Prices are typically lower late at night, during weekends, and during summer. As the wholesale price of electricity changes per half hour and the traditional tariff does not, there is a misalignment between the market and the tariff. This means that the user pays one price regardless of actual supply / demand movements and carbon intensity in the wholesale market, leading to no incentive to shift demand away from peak times – which will become increasingly important as more demand electrifies – and times of high carbon-intensity, as well as potentially higher overall bills for the end user.

Smart tariffs offered in the UK residential power market can contain or rely on any of several key components, which incentivise users to shift their demand profiles towards off-peak and greener periods of supply, reward users for this shift, or automate this shift via smart appliances and software. Because the gas market settles daily instead of half-hourly, smart tariffs are not offered for gas.

There is no one consistent definition of a smart tariff – definitions in the market include: "any tariff that is not a flat rate, a tariff that requires a smart meter, a tariff that works well with LCTs and other devices to reduce bills and cut carbon" (Smarter Tariffs – Smarter Comparisons, 2023). A range of smart tariff types and definitions are outlined opposite.

Tariff types outlined in red are included in Arup's WP4 modelling.

SMARTER

1. **REBATE:** User behaviour rewards, like rebates, allow suppliers to encourage load shifting behaviour outside of the tariff bounds. Users are rewarded by specific behavioural changes with credit to their accounts, but no formalised lower rate exists for off-peak times, or vice versa.
2. **TRADITIONAL TIME OF USE TARIFF:** A time of use tariff encourages load shifting behaviour with at least two rates for different periods of the day – typically, a day-time peak rate and a night-time off-peak rate. Traditionally, rate prices are fixed in advance, and do not necessarily reflect market signals. The tariff is enabled by a smart meter that records consumption in each period of the day, feeding information back to the supplier, but also allowing the user to monitor their own consumption levels. Load shift is determined by user behaviour and is not supplemented with software elements or automation.
3. **GENERATION-SPECIFIC TOU TARIFF:** Time of use tariffs can be generation specific, tailoring rates to the home generation technology installed at the target user's home, as in the case of Cosy Octopus, where there are two off-peak periods, designed to allow the user to heat their home with an installed heat pump, and one peak period with higher costs. Another example is Octopus Flux, where there are peak and off-peak import and export rates, allowing users with solar and batteries installed at their home to benefit from ToU in both directions.
3. **DYNAMIC TOU TARIFF:** Time of use tariffs can be dynamic instead of fixed in advance by employing real-time pricing in response to market signals. This optimises the effectiveness of load shifting away from actual peak demand or carbon-intensive periods. Dynamic pricing is typically a half-hourly rate and can include negative pricing. Dynamic ToU tariffs can be software enabled, with an app to notify users of prices, but current market offerings are not automated.
4. **SOFTWARE AUTOMATED TARIFF:** In contrast to tariffs that incentivise users to shift their own demand behaviour, these tariffs leverage smart software and corresponding smart appliances to automate load shifting in response to market signals. Current market offerings are EV-specific, using smart EVs and chargepoints to refuel at the cheapest and greenest times, but this tariff could be used for other applications, contingent upon the installation of smart home appliances. This can be an import-only tariff, or have an export component, allowing automated export to the grid and for the home to become part of the supplier's virtual power plant.

Smart Tariff Types

Source: Arup
Note: See Appendix 1 for a summary of Arup's UK residential market smart tariffs desktop study.

ARUP

2. Introduction

Arup's WP4 modelling considers a traditional tariff with no Time of Use element; two Time of Use smart tariffs – one with one peak period and one off-peak period and one with two peak periods and two off-peak periods; and a dynamic smart tariff that varies with each half-hour period.

2.5 Tariff Structures [2/2]: Tariffs Selected for Analysis

Arup undertook a desktop study to inform the tariff structures modelled in this phase.

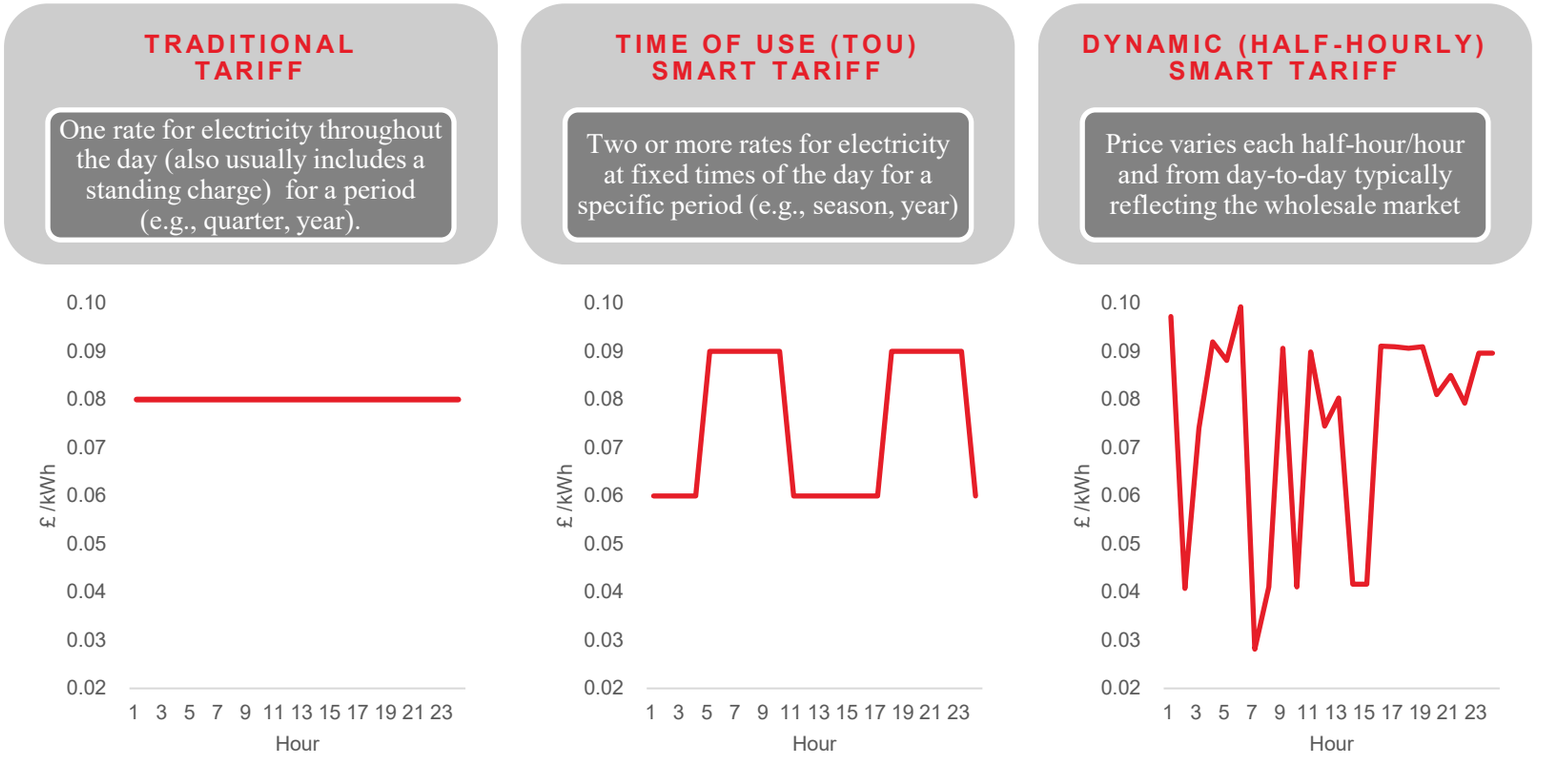
For smart tariffs, Arup considered tariff type, target market, prerequisites, price caps, and export benefits. In the UK retail energy residential market, most smart tariffs are Time of Use (ToU), designed for EV charging and/or residential consumption. Octopus Energy do, however, have more dynamic tariffs, which track the half-hourly wholesale prices.

Arup considered traditional, ToU, and dynamic tariff types in the WP4 modelling to reflect the common products available.

The **traditional gas and electricity tariffs** in Arup's modelling are based on historical Ofgem price cap information and a projection thereof driven by Arup PLEXOS wholesale electricity and gas price curves (using half-hourly pricing for electricity and daily pricing for gas – see an annual summary in Appendix 4).

The **smart electricity tariffs** in Arup's modelling are based on Arup PLEXOS wholesale electricity and gas price curves and Ofgem/DESNZ/ESO data on proportion of energy bills made up by wholesale costs. Arup models three smart tariffs:

- A periodic ToU tariff with 1 peak period and 1 off-peak,
- A periodic ToU tariff with 2 peak periods and 2 off-peak (example shown in second chart opposite), and
- A per-half-hour dynamic smart tariff pinned to the movements of the wholesale electricity market (capped at 100p /kWh, in line with the cap observed for current Octopus tariffs).



Tariff Types Diagram

Source: Arup

ARUP

Section 3

Methodology

3. Methodology

Arup's WP4 analysis determines the change in energy use between a reference and three intervention package cases for three archetypes of houses in Chapel Allerton, as well as associated capex and payback period. Change in household energy bills is calculated based for three smart tariff types.

3.1 Methodology Overview

Arup's analysis is driven by an Excel-based model, developed to model smart tariff linked packages for each archetype under different scenarios of demand.

The model uses a variety of input assumptions to reflect energy consumption within the dwelling and associated costs, pre- and post-implementation of intervention packages, and pre-and post-implementation of smart tariff types.

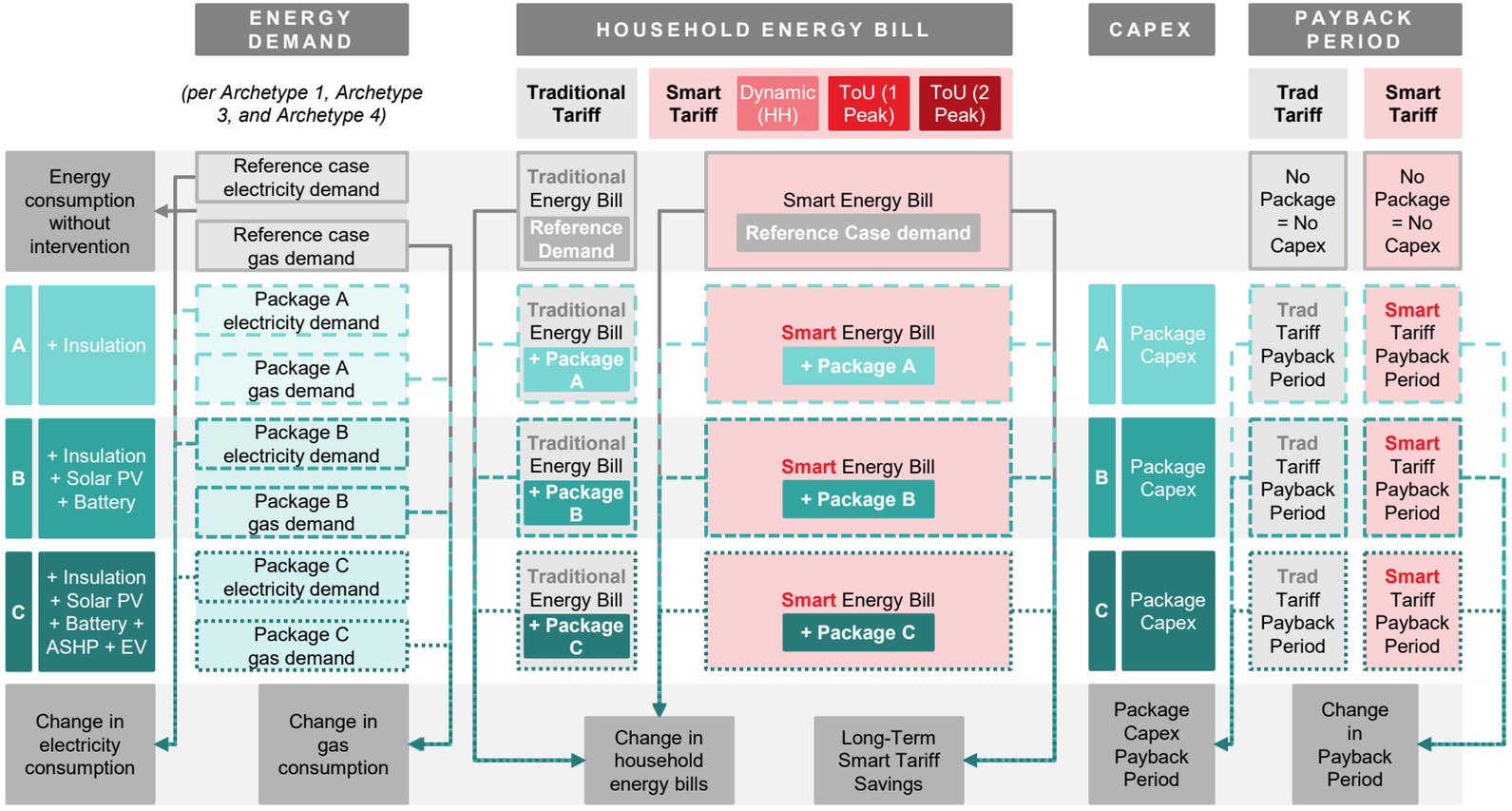
Three other models are utilised to generate input assumptions for the Excel model:

1. PLEXOS Energy Market Simulation Software, which projects electricity prices,
2. Octopus Faraday, which provides real Octopus customer electricity demand profiles, and
3. an Arup heat profiling tool, which is used to profile gas (domestic heat) demand.

For the energy demand change calculations, Arup's Excel model follows Green Book guidance for valuation of energy use for appraisal. Phase 1 data is a key source of input assumptions for archetype characteristics, capital costs of intervention measures, and annual demand.

Energy demand methodology is further detailed in Appendix 2.

QA was undertaken by Arup and adjustments were made where deemed necessary. Select elements of the QA exercise are included in Appendix 3.



Arup WP4 Methodology Overview Diagram

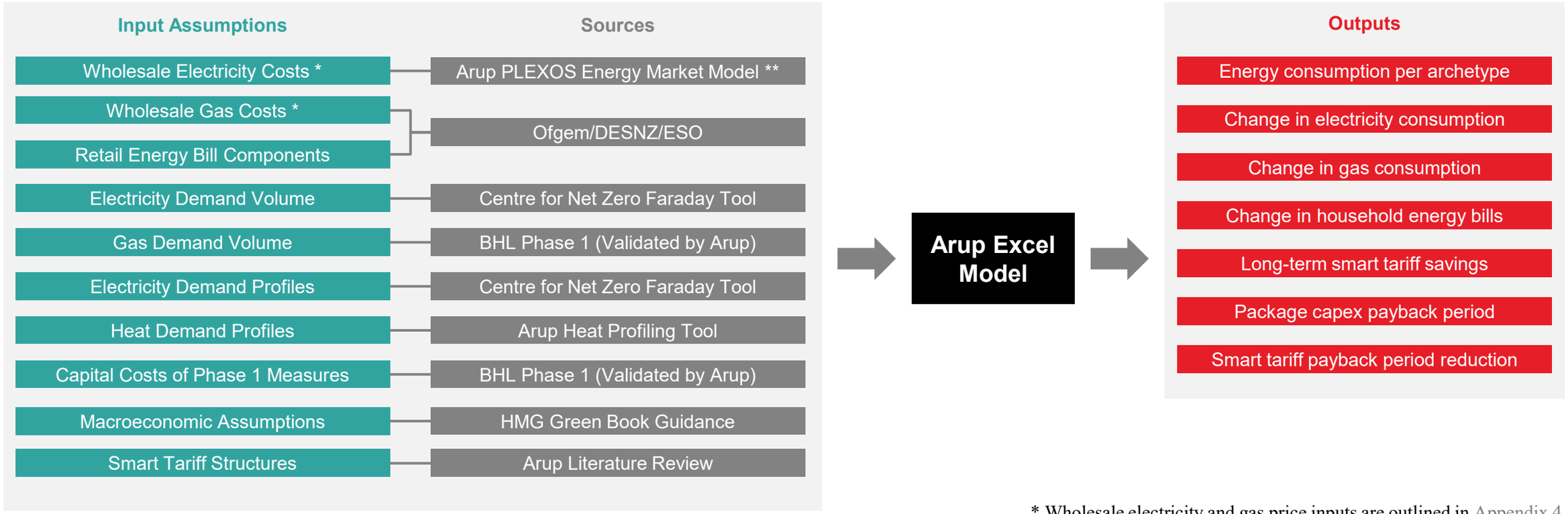
Source: Arup

ARUP

3. Methodology

Arup's WP4 analysis is driven by energy demand data from Faraday and Arup's heat profiling tool; energy cost data from PLEXOS; energy bill components from Ofgem, DEZNZ, and ESO; smart tariff structures from an Arup literature review; and intervention capex from phase 1 of BHL.

3.2 Inputs, Sources, and Outputs



* Wholesale electricity and gas price inputs are outlined in Appendix 4.

** Wholesale price assumptions in Arup's PLEXOS modelling are underpinned by National Grid ESO Future Energy Scenarios 2022, System Transformation scenario.

3. Methodology

There were a number of simplifying assumptions and limitations associated with the modelling. The reasons for these simplifying assumptions and limitations was a combination of data availability and the tools/models utilised.

3.3 Assumptions and Limitations

Energy Demand Over Modelling Horizon

- The demand level and profile per archetype and package remains the same in each year of the modelling horizon (2024-2050). In reality, the absolute demand level and shape would vary annually, however, Arup has not attempted to project what this variation would look like. Instead, the Faraday-generated demand data for a single year, which is based on real data is utilised in each year.

Non-Energy Cost Component of Energy Bills

- Arup has not projected how the non-energy cost component (i.e. network, policy and supplier costs) might evolve over time. Instead, we have analysed the historical contribution of this component to the overall energy bill using price cap data from Ofgem to determine a historical average percentage share. This share has been applied and assumed to remain constant over the modelling period.

Replacement/Refurbishment of Package Interventions

- The Phase 1 assumptions assumed no replacement or refurbishment of intervention measures, and therefore no associated costs. The same assumption is used in this modelling. For most intervention measures, this is likely a fair assumption given the lifetime of measures exceeds the modelling horizon, however, for certain measures (e.g. battery storage), in reality there would be additional capex associated with refurbishment and/or replacement as their expected lifetime is shorter than the modelling period.

Payment for Self-generation of Electricity

- Self-generation via solar PV and BESS export for applicable packages is inherently captured in the demand data generated by the Faraday tool, however, it is not possible to extract the level of electricity demand offset by self-generation and therefore the possible payments to the homeowner for any surplus generation exported to the grid, for example, through the Smart Export Guarantee (SEG) scheme.

Faraday Tool User-defined Inputs

- Translation of archetype characteristics and technologies into Faraday via user defined inputs is imperfect (e.g., only capture limited detail for some characteristics and there is no visibility of technology parameters). This means the inputs utilised for Archetype 1 and Archetype 4 result in the same electricity demand profiles due to grouping of EPC ratings with the user-defined inputs.

Smart Tariffs

- Arup utilises real electricity demand data from Octopus Energy customers with and without smart tariffs and low carbon technologies. However, the data does not distinguish between smart tariff type (e.g., dynamic, ToU). Modelling of different smart tariffs is therefore based only on different price structures (the standing and unit charge per unit of electricity consumed) and does not capture how consumer behaviour and thus the demand profiles would vary in response to different structures. Furthermore, each smart tariff modelled is based on the same underlying wholesale power price projections and this limits differences across smart tariffs explored.

ARUP

Section 4

Energy Demand

4. Energy Demand

There are important seasonal differences in daily energy demand profiles, particularly when they include energy being consumed for space heating. With the increase in energy consumption in the winter for space heating, there is also less solar PV generation and greater general domestic electricity use.

4.1 Demand Profiles [1/5]

The following section provides an overview of the gas and electricity demand profiles of each archetype under the reference case and resulting from Packages A, B, and C.

Gas Demand Profiles

Space heating accounts for the largest proportion of domestic energy use. The demand for heating varies throughout the year, with peak demand occurring in the winter months when temperatures drop. This is clearly shown on the gas demand profiles for each of the archetypes on the following slides. The gas demand profiles also vary daily due to outdoor temperature fluctuations.

In Packages A and B, improvements in building fabric reduce overall heating demand relative to the Reference Case. For Package C there is no gas demand due to an assumed disconnection from the gas grid when an ASHP is installed.

Electricity Demand Profiles

The electricity profiles for both the Reference Case and Package A are the same in this study. This is because there is no change in electricity consumption when improving the fabric of dwellings while not having electrical heating or installing LCT.

Relative to the Reference Case, both half-hourly and annual electricity consumption for the packages that include LCTs (Packages B and C) changes substantially.

For Package B (PV + BESS), there is a reduction in daytime demand relative to the Reference Case, which is likely due to self-consumption of solar PV. The evening peak demand (the time at which electricity is typically most expensive) is also reduced for Package B relative to Reference Case. While we should expect the battery to charge in the daytime at times when there is excess electricity being generated by the solar PV, the battery also charges overnight due to a price event. This is because there are lower prices overnight, as typically the case with tariffs such as Agile. Overall, there is a reduction in annual demand for package B relative to the Reference Case.

For package C (Fabric + PV + BESS + ASHP + EV), overnight consumption greatly increases relative to the other profiles. This is expected because EVs can be programmed to charge at certain times of the day to capitalise on lower electricity prices, as discussed already. Relative to package B, there is also an increase in in demand for Package C. However, this increase is not significantly more when compared to that for the Reference Case. The increase in consumption due to the ASHP and EV is therefore slightly mitigated by solar PV and BESS.

In Packages B and C, seasonal effects on electricity demand are more pronounced. This is because Solar PV systems generate less electricity during the winter months, especially in the evening when both general domestic electricity use, and heat demand is at its highest. In Package C, the adoption of an ASHP for heat provision results in an overall increase in household electricity consumption, especially during the winter. However, the increase in electricity consumption due to the ASHP servicing heating demand is relatively small when considering the gas that was being consumed for the same purpose (for Reference Case and Packages A and B). This is because heat pumps are a more efficient method of heat provision than traditional gas boilers.

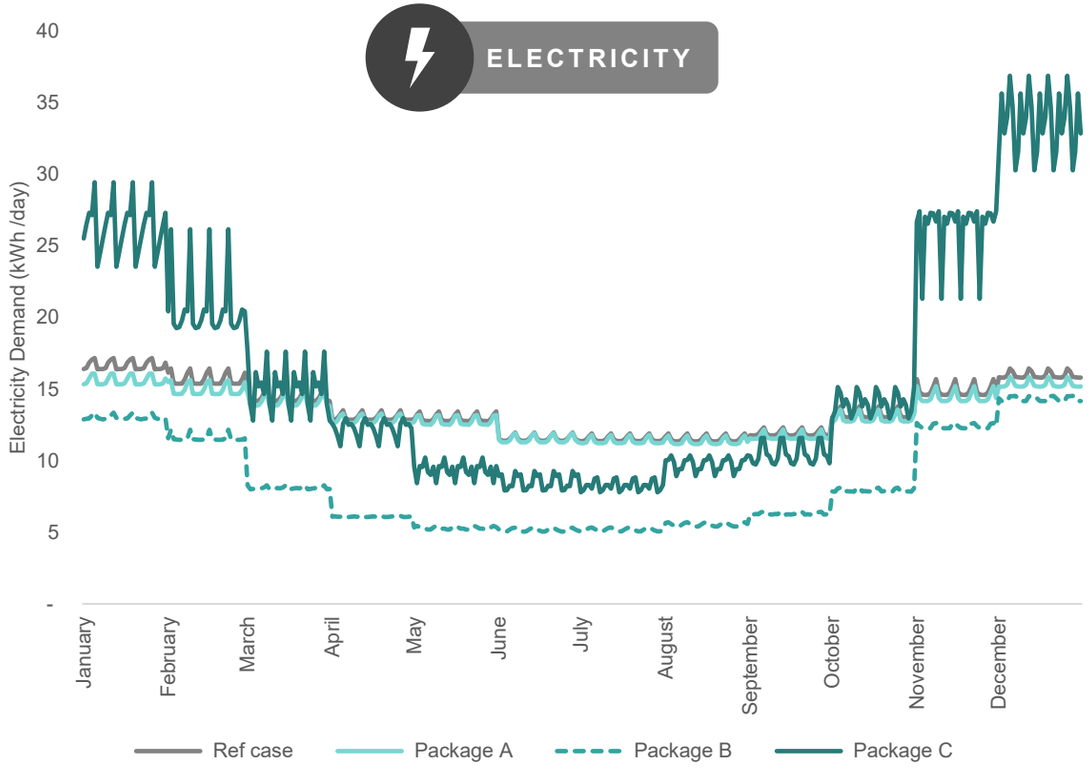
Tariffs such as Agile which base pricing on grid demand, will also be influenced by these seasonal spikes in demand. Despite reduced solar PV generation in winter, there is an opportunity, when combined with BESS, to utilise the electricity generated during the day to offset some household grid electricity consumption during peak periods when electricity prices are at their highest. As mentioned, the battery also charges overnight due to price events.

ARUP

4. Energy Demand

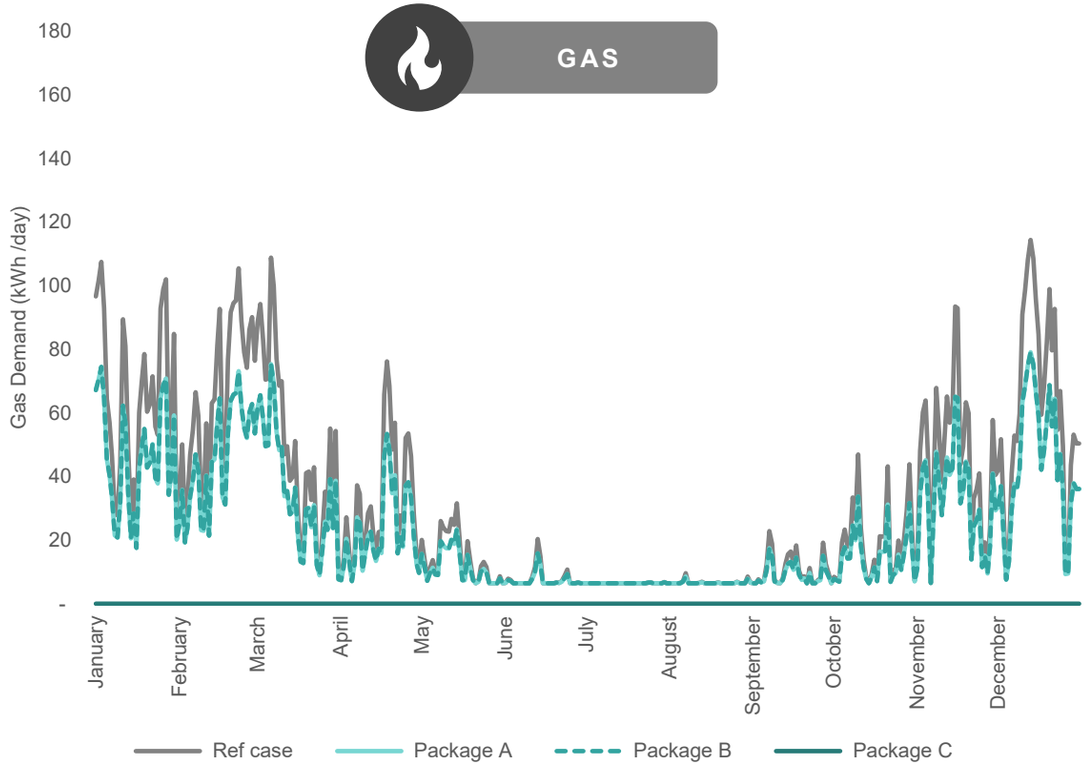
Package A, limited to insulation interventions only, has a limited impact on gas demand profile for all Archetypes. In Package C, the archetypes are fully electrified and disconnected from the gas network, leading to no gas demand and an increase in electricity demand in the winter.

4.1 Demand Profiles [2/5]: Archetype 1



Archetype 1 Daily Electricity Demand (Annual Profile)

Source: Octopus Faraday Tool and Arup Analysis



Archetype 1 Daily Gas Demand (Annual Profile)

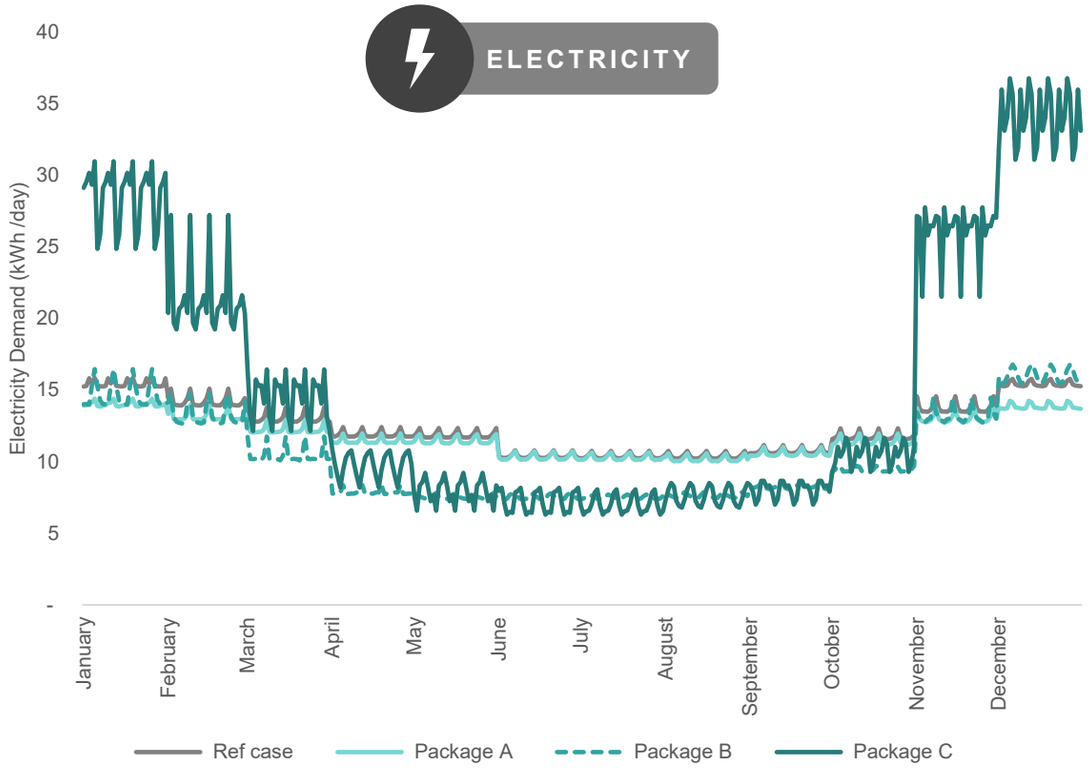
Source: Arup Gas Demand Profiling Tool

ARUP

4. Energy Demand

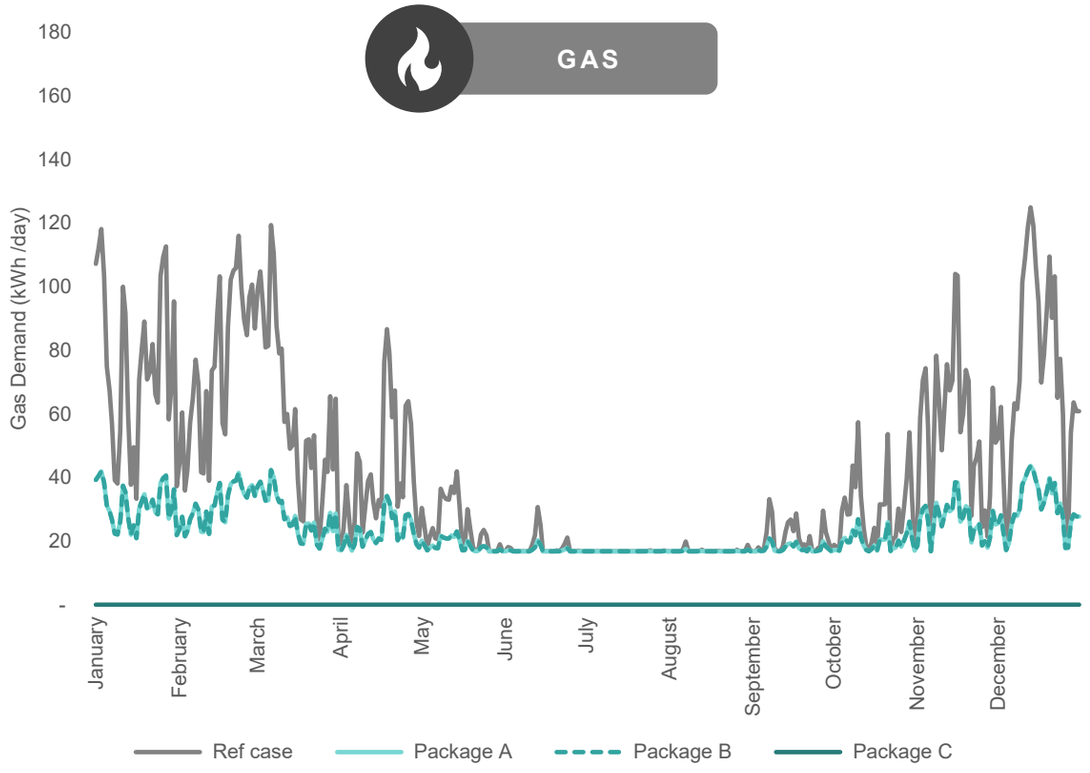
Across the archetypes, Package C sees higher electricity demand in the winter owing to ASHP electricity consumption.

4.1 Demand Profiles [3/5]: Archetype 3



Archetype 3 Daily Electricity Demand (Annual Profile)

Source: Octopus Faraday Tool and Arup Analysis



Archetype 3 Daily Gas Demand (Annual Profile)

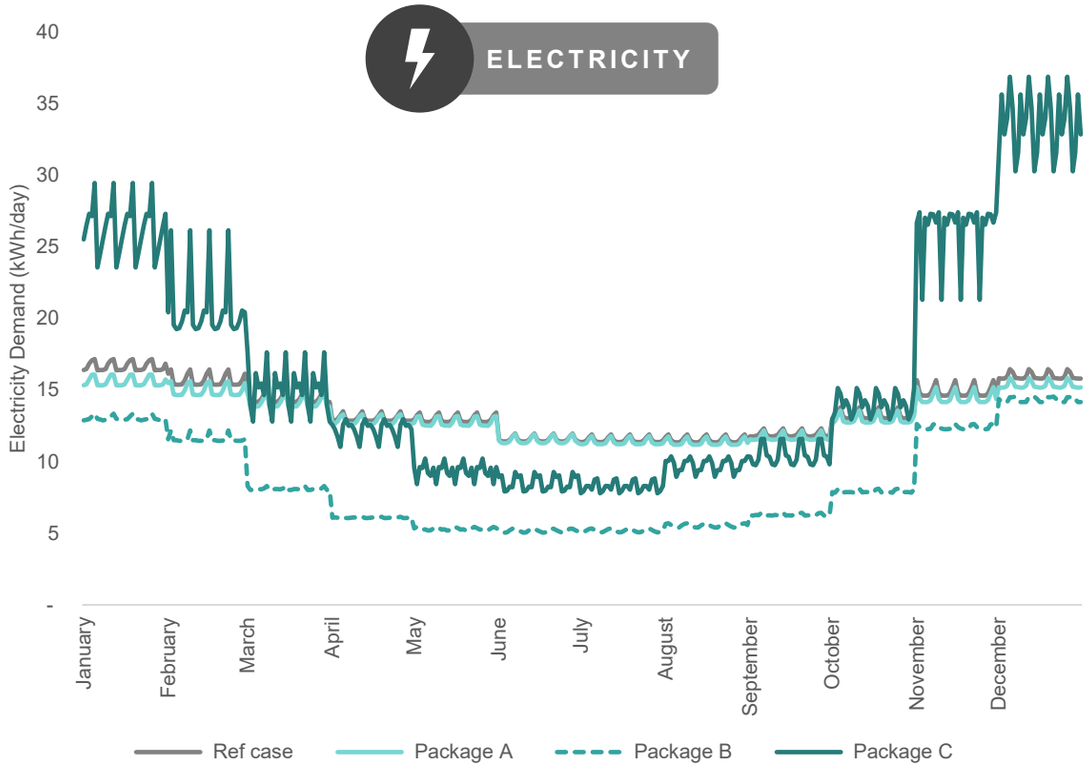
Source: Arup Gas Demand Profiling Tool

ARUP

4. Energy Demand

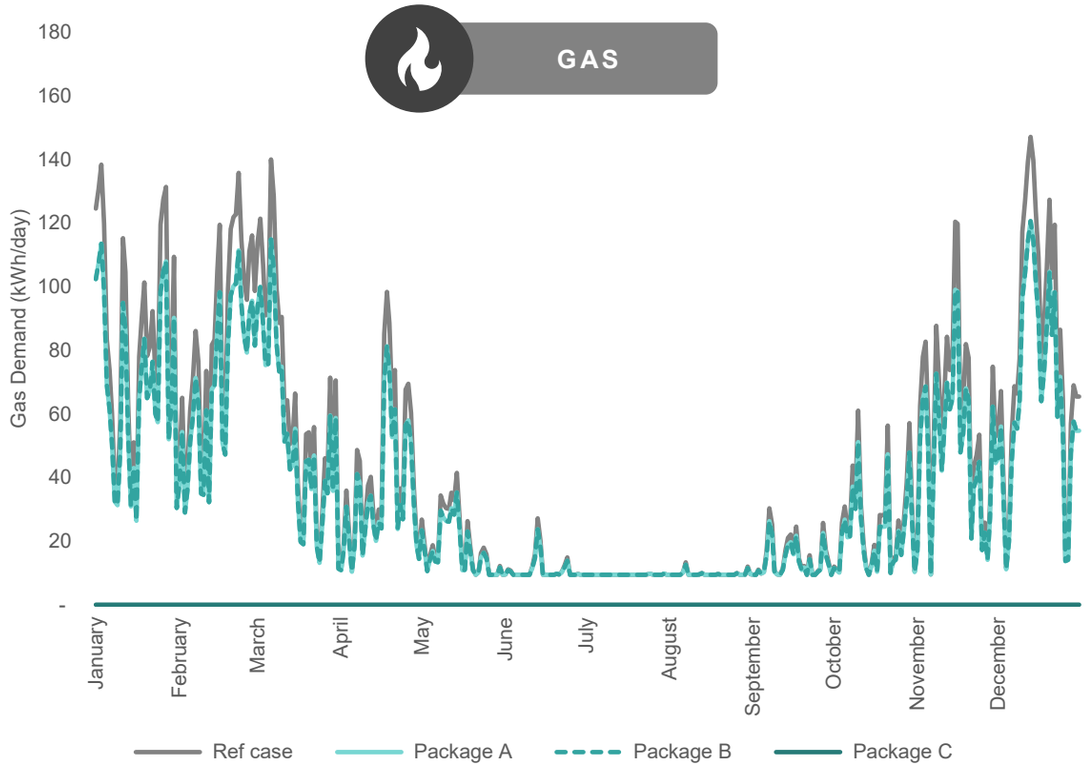
Across scenarios, Arup assumes gas demand does not change between Packages A and B.

4.1 Demand Profiles [4/5]: Archetype 4



Archetype 4 Daily Electricity Demand (Annual Profile)

Source: Octopus Faraday Tool and Arup Analysis



Archetype 4 Daily Gas Demand (Annual Profile)

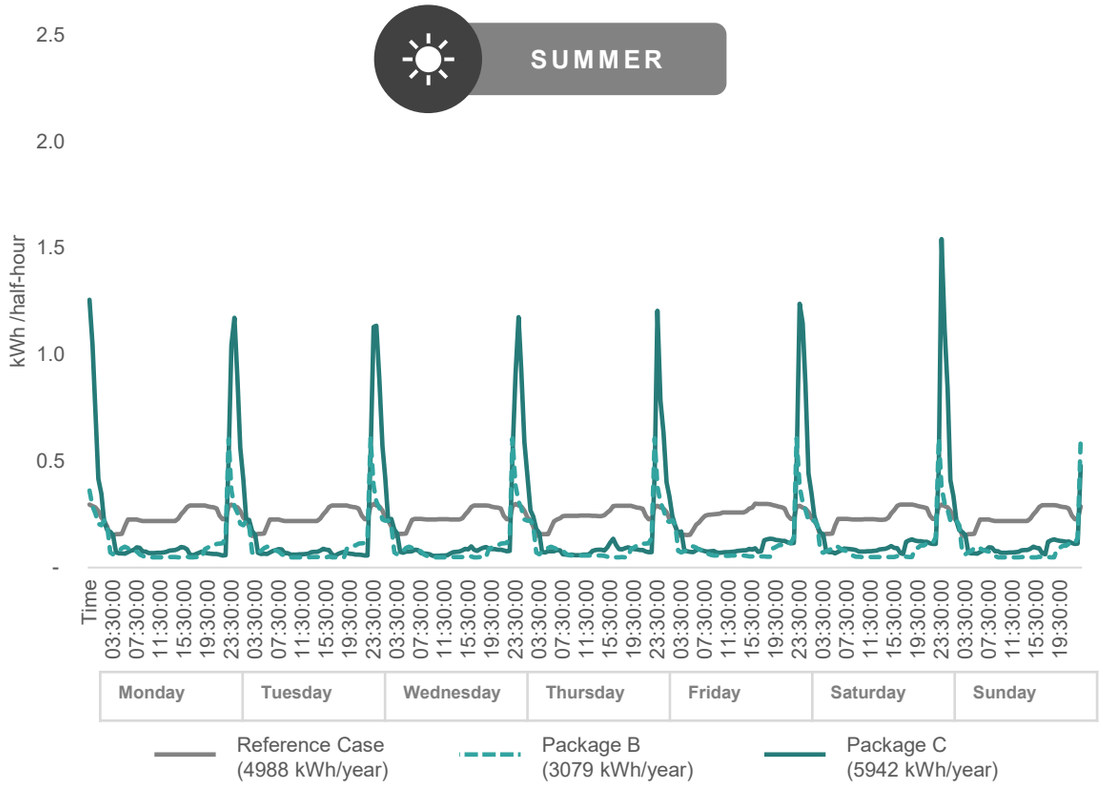
Source: Arup Gas Demand Profiling Tool

ARUP

4. Energy Demand

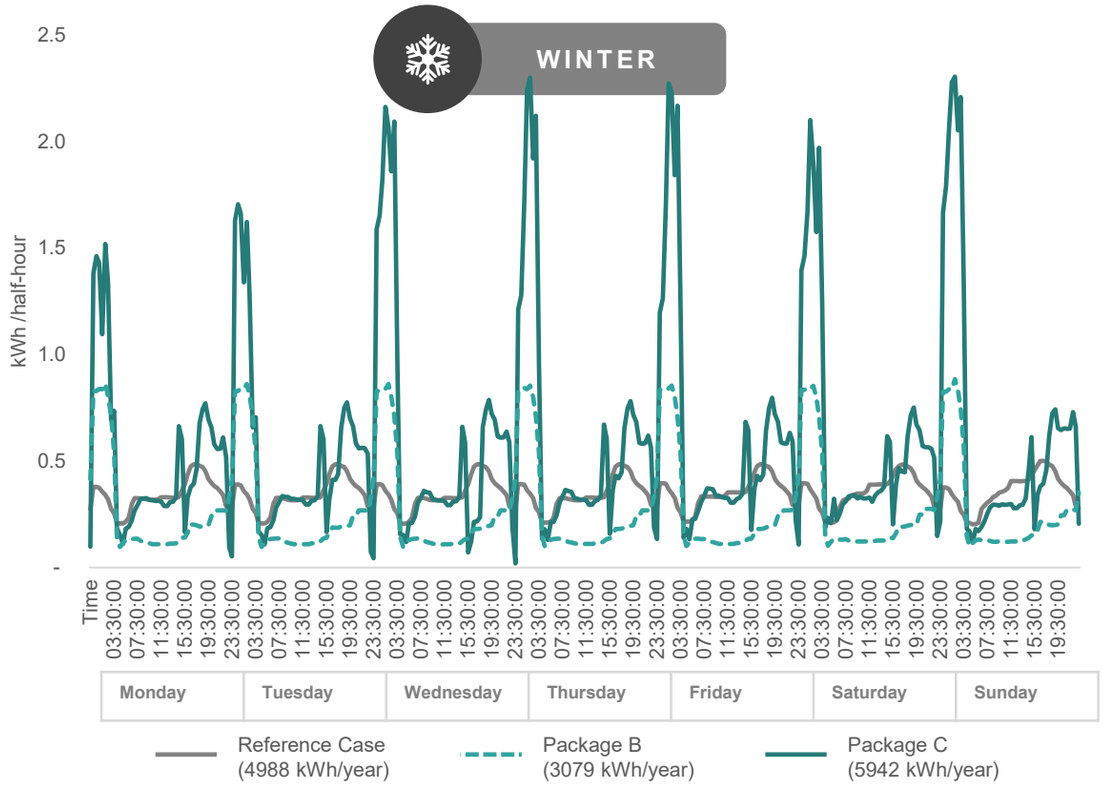
Seasonal increase in peak demand is most obviously observed for electricity profiles with ASHP. A reduction in summer daytime demand for profiles with PV + BESS relevant to Reference Case. For package B, daytime demand is also reduced in the winter, including in the evening due to the battery.

4.1 Demand Profiles [5/5]: Seasonality deep-dive (Archetype 1)



Archetype 1 Half-Hourly Electricity Demand (Weekly Profile in Summer)

Source: Centre for Net Zero's Faraday Tool (based on Octopus Energy smart meter data) and Arup Analysis



Archetype 1 Half-Hourly Electricity Demand (Weekly Profile in Winter)

Source: Centre for Net Zero's Faraday Tool (based on Octopus Energy smart meter data) and Arup Analysis

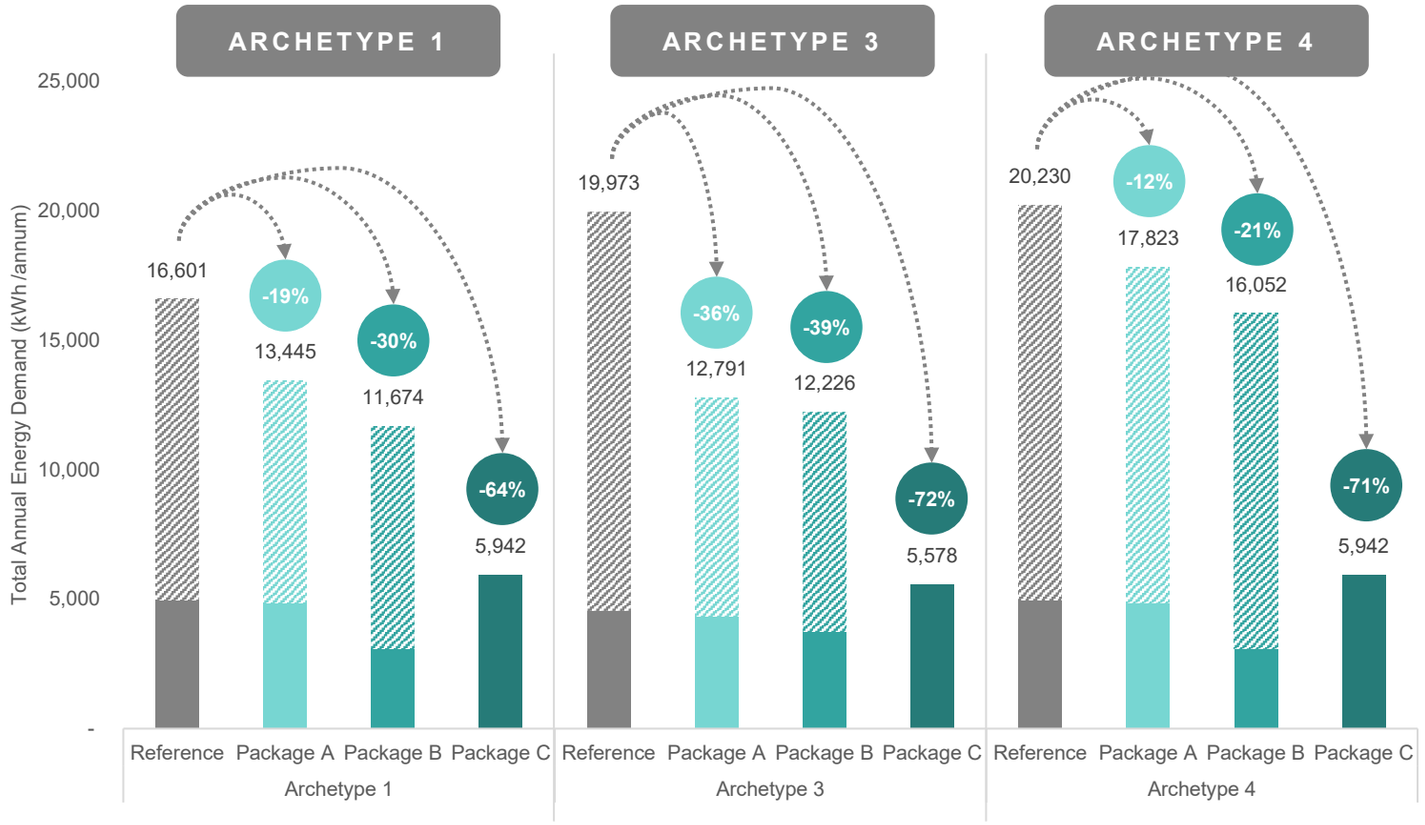
4. Energy Demand

Package A, with only insulation interventions, sees the smallest energy demand change. Package C sees the greatest change, with gas usage eliminated through ASHP implementation. Change in energy demand ranges from -12% to -72%. The greatest reductions across packages are seen for Archetype 3.

4.2 Change in Energy Demand

As set out in more detail in the Methodology section, gas profiles for the archetypes are largely based on actual annual gas demands for the target postcodes. For the package cases, the reference case gas demand values are scaled using the estimated gas demand reduction potentials generated by Parity Projects' building-level modelling, which is based on the RdSAP methodology. Therefore, the main driver for Archetype 3 having the greatest demand reductions, especially for packages A and B, is due to the exact fabric measures considered for the specific dwelling types and the reference case gas demand values.

As for the Faraday tool used to generate the electricity demand profiles, the main limitations are linked to there being limited detail on dwelling characteristics and no detail on occupant characteristics to capture differences in heating demand. This is highlighted by Archetype 1 and 3 having the same electricity demands, particularly for package C that includes electrical heating. Refer to the Methodology section for more details on this.



Annual Energy Demand by Archetype and Package: Electricity vs Gas (not including demand met by home generation)

Sources: Octopus Faraday Tool, Arup Gas Demand Profiling Tool, and Arup Analysis

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Section 5

Energy Bill

5. Energy Bill

Arup assesses household energy bills against (1) three household archetypes, (2) demand stemming from one reference case and three package of interventions, and (3) prices stemming from one traditional tariff and three smart tariffs.

5.1 Energy Bill and Savings [1/3]

For each of the three selected Archetypes, Arup has assessed the impact on 2024 total household energy bills of four demand scenarios and four tariff types. The results of this analysis can be seen in the following slides. Energy bills are affected by the household's demand (the amount of energy they need to purchase), demand profile (the periods in which energy is consumed) and the household's energy tariff (the price at which they purchase energy).

Demand scenario

Demand is driven by archetype and package case:

1. Reference case: current demand without intervention
2. Package A: fabric (insulation) measures
3. Package B: A + home generation from solar and battery
4. Package C: B + heat pump and EV

Package Case Interventions

Tariff type

The amount users pay per unit of demand is driven by tariff type:

1. Traditional tariff
2. Dynamic (Half-Hourly) Smart Tariff
3. Time-of-Use (1 peak, 1 off-peak) Smart Tariff
4. Time-of-Use (2 peak, 2 off-peak) Smart Tariff

Smart Tariffs

Fuel type

Arup also provides a breakdown of electricity vs gas bills, reflecting the changes in electricity and gas demand (driven by the different package measures) that are outlined in Section 4.3 Change in Energy Demand. Note that there is no gas costs in Package C because there is no gas demand as the archetype is assumed to have fully electrified.

Savings Type

Arup separates household bill savings into two types:

1. **Package savings:**
   - Savings from change in demand driven by implementing package interventions.
   - Package interventions tend to decrease overall energy demand and can affect the proportion of demand that is met by electricity or gas.
   - The amount of savings depends on the selected package and the archetype.
2. **Smart tariff savings:**
   - Savings from switching from a traditional to a smart tariff.
   - Smart tariffs can improve alignment to market signals, allowing users to benefit during lower cost, off-peak periods.
   - The amount of savings depends on the amount of demand and the type of smart tariff.

Long-Term Savings

Arup further assesses the **long-term impact of smart tariffs** on 2025-2050 household energy bills. These results are outlined in Section 5.2 Smart Tariff Savings (2025-2050) and are presented as the household energy bill **smart tariff savings** per package and year, averaged across archetypes and smart tariffs types. As outlined in Section 5.2, smart tariff-related savings reduce over time for each package as wholesale electricity prices decline and market volatility reduces.

5. Energy Bill

2024 total bills range from £1.2k (Archetype 3 Package C, dynamic half-hourly smart tariff) to £2.9k (Archetype 4 reference case demand, traditional tariff). A similar level of savings is observed between smart tariff types.

5.1 Energy Bill and Savings [2/3]: Total Energy Bill (2024)

The lowest energy bills are observed under Package C demand with a dynamic (half-hourly) smart tariff, and the highest under reference case demand with a traditional tariff.

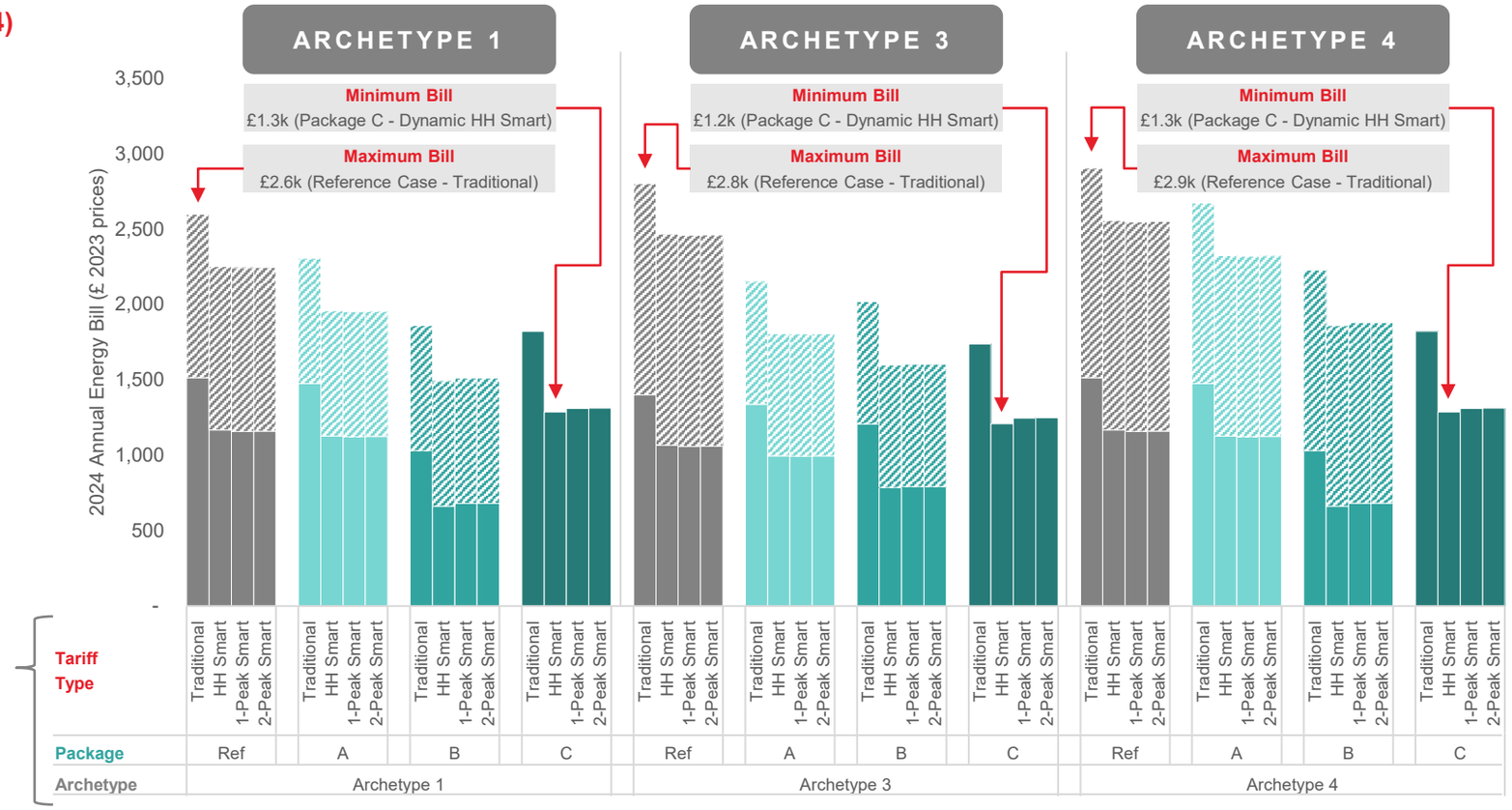
Implementing **Package C** interventions and switching to a dynamic, half-hourly smart tariff would represent a **54% reduction** (average across archetypes) in 2024 household energy bills when compared to the reference case demand with a traditional tariff. Implementing just Package C interventions without switching from a traditional tariff would save 35%.

Package B interventions plus a dynamic, half-hourly smart tariff would save, on average, **40%**, while paining Package B with a traditional tariff would save 27%.

Package A interventions paired with a dynamic, half-hourly smart tariff would save, on average, **27%**, while pairing a traditional tariff with Package A would save 14%.

See Appendix 5 for total energy bill results for 2024 to 2050.

Tariff Type – affects the cost per unit of energy demanded
Package – affects the amount of demand and type of fuel
Archetype – affects the household profile and energy demand



2024 Total Energy Bill Scenarios: Archetypes 1, 3, and 4

Sources: Arup Plexos Modelling, Octopus Faraday Tool, Arup Gas Demand Profiling Tool, and Arup Analysis

Package
- Reference case (no package)
- Package A
- Package B
- Package C

Fuel
- Solid fill – electricity bill
- Pattern fill – gas bill

5. Energy Bill

Smart tariff savings average approximately 40% of overall savings across packages and archetypes. Smart tariff savings range from £300 under Package A to £500 under Package C. Greater reductions in demand lead to increased total smart tariff savings.

5.1 Energy Bill and Savings [3/3]: Energy Bill Savings (2024)

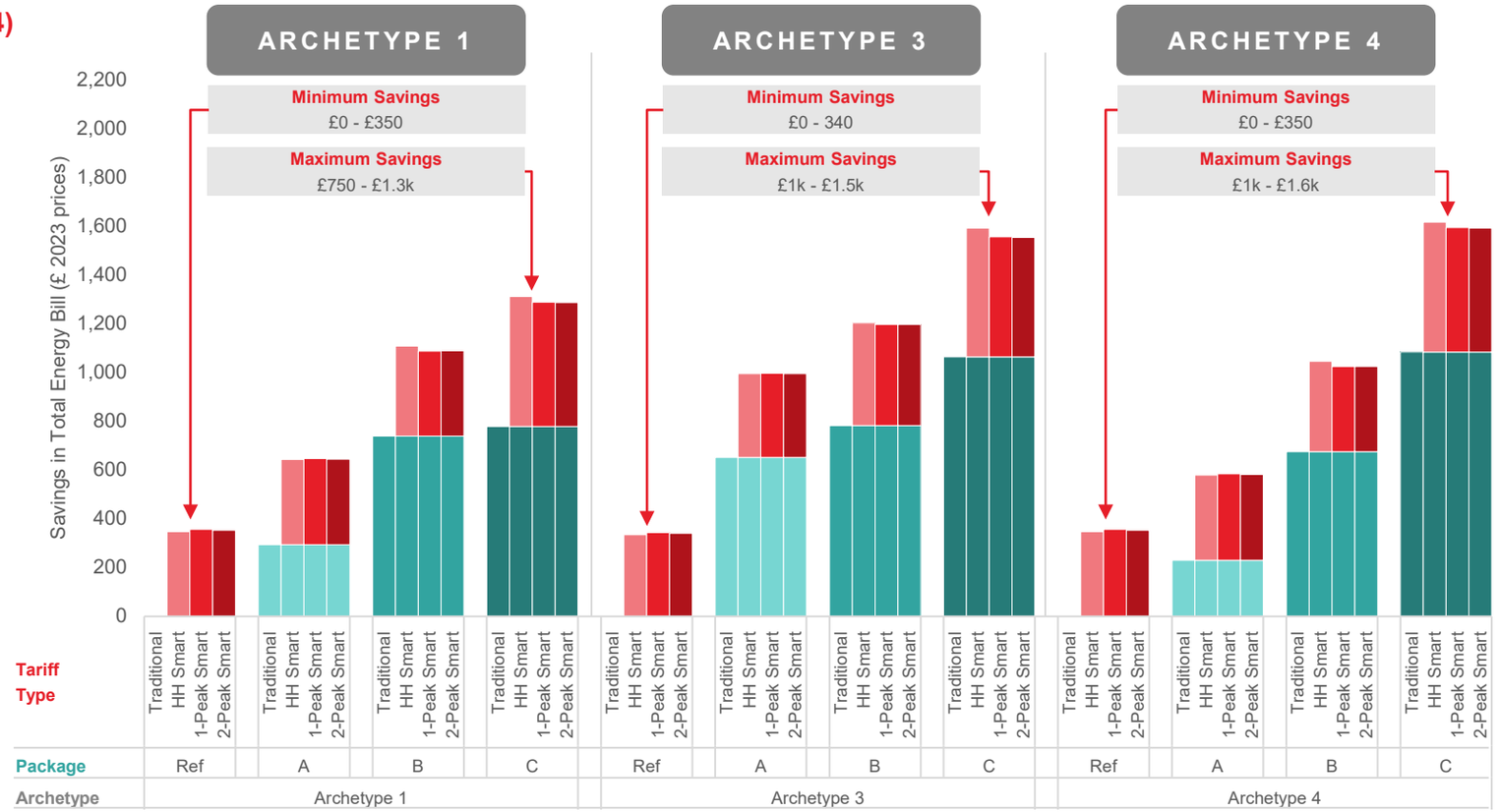
Total savings range from £300 to £1.6k.

Package savings stem from the **reduction in demand** resulting from implementing the interventions included in packages A, B, and C. **Smart tariff savings** stem from switching from a traditional to a smart tariff and the **improved alignment of smart tariffs to real energy market signals** of supply and demand.

Package savings under Package A represent an average 50% of overall savings across archetypes, with those under packages B and C representing 66% and 65%, respectively.

Smart tariff savings represent 100% of reference case savings across archetypes, as no package intervention is taking place. Across the package cases, smart tariff savings represent 39% of total savings (average across archetypes). Smart tariff savings represent the highest proportion of total savings for Package A and the lowest for Package B. On an absolute basis, smart tariff savings increase with greater changes in demand, with the highest smart tariff savings under Package C.

A tabular outline of Arup's 2024 household energy bill and savings results is provided in Appendix 5, alongside graphed results for each year from 2024 to 2050.



Savings in 2024 Total Energy Bill Scenarios (Compared to Reference Case Demand, Traditional Tariff): Archetypes 1, 3, and 4

Sources: Arup Plexos Modelling, Octopus Faraday Tool, Arup Gas Demand Profiling Tool, and Arup Analysis

5. Energy Bill

Smart tariff-related savings reduce over time for each package as wholesale volatility reduces. Smart tariff savings reduce from £300-400 in 2025 to £50-£100 in 2040s, driven by more stable wholesale prices.

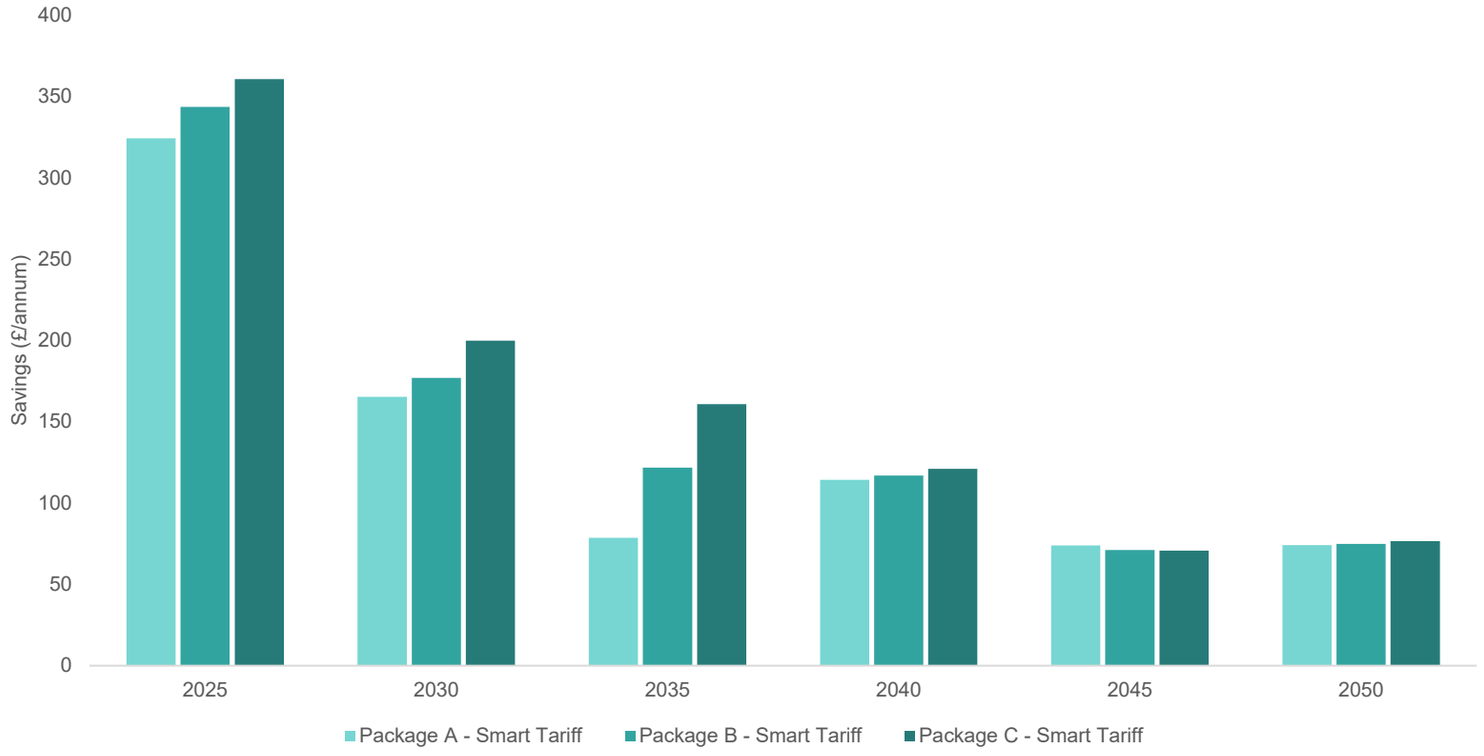
5.2 Long-Term Smart Tariff Savings (2025-2050)

The chart opposite shows smart tariff savings in 2025, 2030, 2035, 2040, 2045 and 2050. The savings are averaged across both the smart tariff structures considered and the archetypes studied.

The modelling indicates that the smart tariff related savings reduce over time. In 2025, the average smart tariff related savings are c £325-360/year. These savings fall to c.£79-161/year in 2035 and then to c. £75/year in 2050.

This reduction in savings can be attributed to the following:

- Falling wholesale electricity prices as shown in Appendix 4. The wholesale electricity prices used in this modelling fall from over £100/MWh in the early 2020s to around £40-50/MWh from 2035 onwards. Wholesale prices fall as more zero/low marginal cost generation (e.g. renewables, nuclear) come online.
- Similarly, wholesale electricity market volatility reduces over time from the current high levels observed with the recent energy crisis.
- Furthermore, the contribution of the wholesale element of the overall electricity bill falls back to historical levels compared to current price cap levels, reducing the level of savings achievable versus a traditional tariff.



Average smart tariff related savings across tariff structure and archetype 2025-2050

Source: Arup

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5. Energy Bill

Arup's smart tariff savings results are comparable with data in the public domain. Arup's results range from £300 to £500 in 2024, reducing to £50 to £100 per annum by 2040, while the third-party results outlined below range from £90 to £450 per annum.

5.3 Comparison to Other Studies

Agile Octopus
Octopus Energy

"Average agile customer would save £188 per year compared to legacy standard variable tariffs"

Source: Agile Octopus Report (https://octoenergy-production-media.s3.amazonaws.com/documents/agile-report.pdf)

Intelligent Octopus Flux
Octopus Energy

"Cuts bills by more than £450 while unlocking full potential of clean energy tech"

Source: Intelligent Octopus Flux Press Release (https://octopus.energy/press/smarter-cleaner-cheaper-octopus-launches-new-smart-tariff-to-unlock-solar-and-storage/)

Smart Meter Benefits (2019)
Smart Energy GB

"Recent trial tariffs have shown that engaged households can save around £90 per year from shifting energy use away from peak times, and this increases to £130 for households who have an electric car"

Source: Smart Meter Benefits Report https://www.smartenergygb.org/smart-meter-benefits/benefits-for-you/time-of-use-tariffs-the-benefits

SmartCharge
British Gas

"In our trials, EV customers have saved around 20% from their electricity bills, whilst helping to balance demand on the grid"

Source: Centrica Press Release https://www.centrica.com/media-centre/news/2023/british-gas-launches-new-services-to-supercharge-uks-net-zero-ambition/

Charge Anytime
Ovo Energy

"Charge Anytime" tariff offers savings of up to £350 a year for OVO's EV customers"

Source: OVO Energy Press Release (https://company.ovo.com/ovo-launches-best-value-innovative-electric-vehicle-charging-plan/)

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Section 6

Capital Investment

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6. Capital Investment

Package capex ranges between packages and archetypes based on the interventions involved and house type. Package A total capex ranges from £3,500 to £25,500, Package B ranges from £24,000 to £50,500, and Package C from £7,500 to £30,000.

6.1 Package Capex

Package capex is the upfront cost associated with implementing the interventions within Package A, B, and C. This includes supply and installation costs.

Name	Package	Total Capex £ 2023 prices	Cavity Wall Insulation £ 2023 prices	Loft Insulation £ 2023 prices	External Wall Insulation £ 2023 prices	Suspended Floor Insulation £ 2023 prices	Insulated Doors £ 2023 prices	Glazing £ 2023 prices	Solar PV £ 2023 prices	BESS £ 2023 prices	ASHP £ 2023 prices	EV £ 2023 prices
Archetype 1	Reference	-	-	-	-	-	-	-	-	-	-	Arup has excluded EV capex from the analysis. There are many variables that would significantly impact the range of this category, including whether the household already has an EV, the type of EV being purchased, and the provider of home charging infrastructure.
	Package A	3,500	1,500	500	-	-	1,500	-	-	-	-	
	Package B	13,500	1,500	500	-	-	1,500	-	3,000	7,000	-	
	Package C	25,500	1,500	500	-	-	1,500	-	3,000	7,000	12,000	
Archetype 3	Reference	-	-	-	-	-	-	-	-	-	-	
	Package A	24,000	-	-	21,500	2,500	-	-	-	-	-	
	Package B	38,500	-	-	21,500	2,500	-	-	7,500	7,000	-	
	Package C	50,500	-	-	21,500	2,500	-	-	7,500	7,000	12,000	
Archetype 4	Reference	-	-	-	-	-	-	-	-	-	-	
	Package A	7,500	-	-	-	1,500	1,500	4,500	-	-	-	
	Package B	18,000	-	-	-	1,500	1,500	4,500	3,500	7,000	-	
	Package C	30,000	-	-	-	1,500	1,500	4,500	3,500	7,000	12,000	

Supply and Installation Costs of Package Measures – initial capex figures (£ 2023 prices)

Sources: Parity Projects Phase 1 Modelling, and Arup Desktop Research and Benchmarks
Note: Figures are rounded to the nearest £0.5k – rows may not add up to displayed total.

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6. Capital Investment

Capex payback time without a smart tariff ranges from 21 to 59 years for Package A, 34 to 87 years for Package B, and 43 to 71 years for Package C. Switching to a smart tariff reduces payback time by 12 to 29 years for Package A, by 10 to 24 years for Package B, and by 5 to 6 years for Package C.

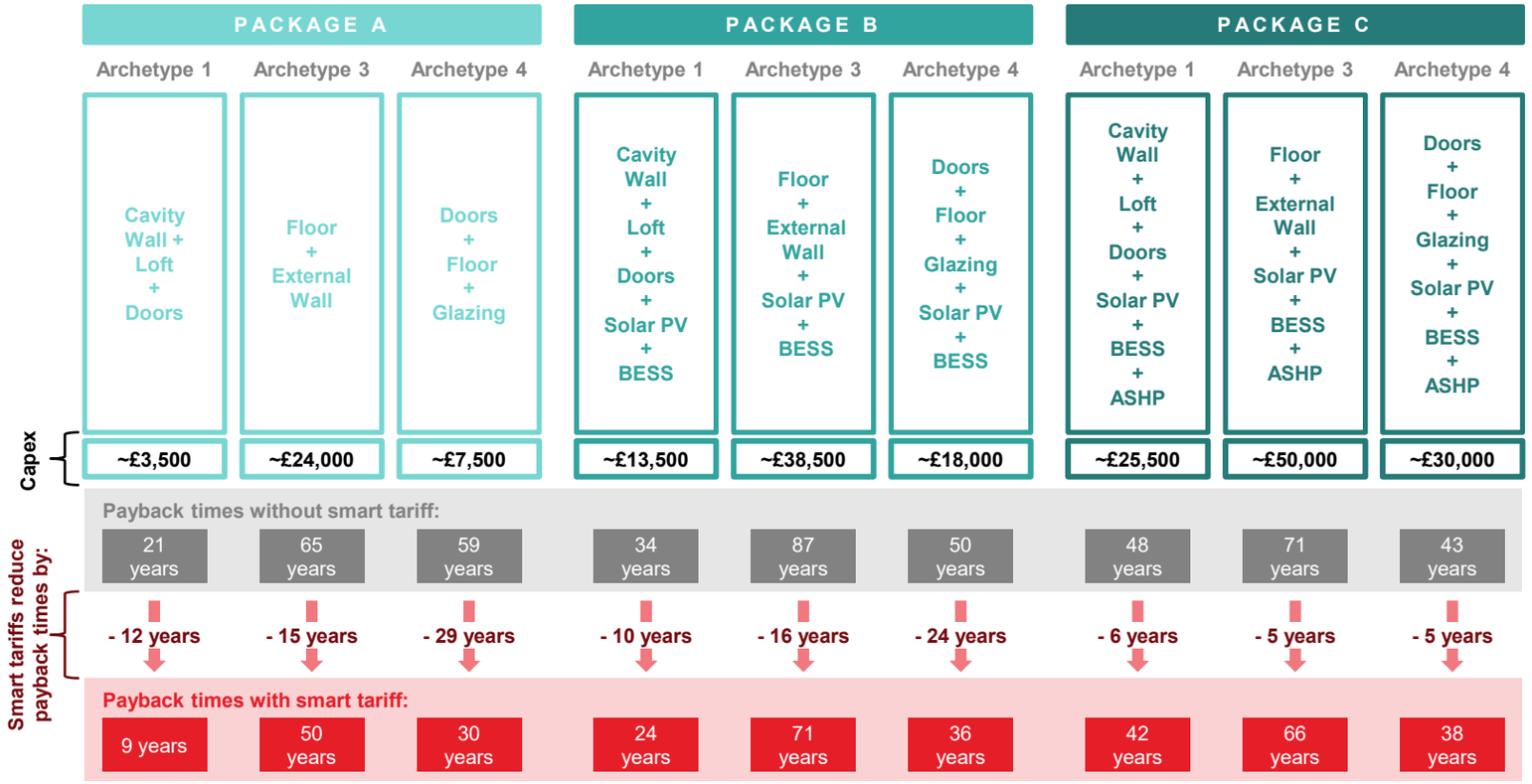
6.2 Package Payback Times [1/2]

The packages of intervention measures considered range from £3,500 for Package A for Archetype 1 to £50,000 for Package C for Archetype 3. Most of the packages considered have significant capex costs and whilst they yield energy costs the simple payback times calculated remain substantial. These payback times range from 21 to 87 years.

External wall insulation is a key driver of the long payback times for Archetype 3 given its capital cost of £21,500. Of the packages considered, Package C is on average the most expensive and therefore has the longest payback times. This is driven by the suite of measures considered, which include various insulation measures, solar PV, BESS and ASHP.

Arup has also calculated simple payback times with the smart tariffs linked to the packages to understand the benefits they could bring. The smart tariffs help reduce payback times by 5-29 years across the packages and archetypes studied. This sees the payback time range reduce to 9 to 71 years. The greatest reductions in payback times are observed for Package A due to the lower capital costs associated with the measures implemented.

The capital costs considered are largely taken from Parity Projects Phase 1 modelling. On the next page we consider a sensitivity on capital costs informed by our benchmarking of capital cos ranges of each intervention measure. The purpose of this is to understand how payback times are impacted.



Capex and Payback Time (with and without Smart Tariff): Package A, B, and C

Sources: Parity Projects Phase 1 Modelling, Arup Desktop Research and Benchmarks, Arup Plexos Modelling, Octopus Faraday Tool, Arup Gas Demand Profiling Tool, and Arup Analysis

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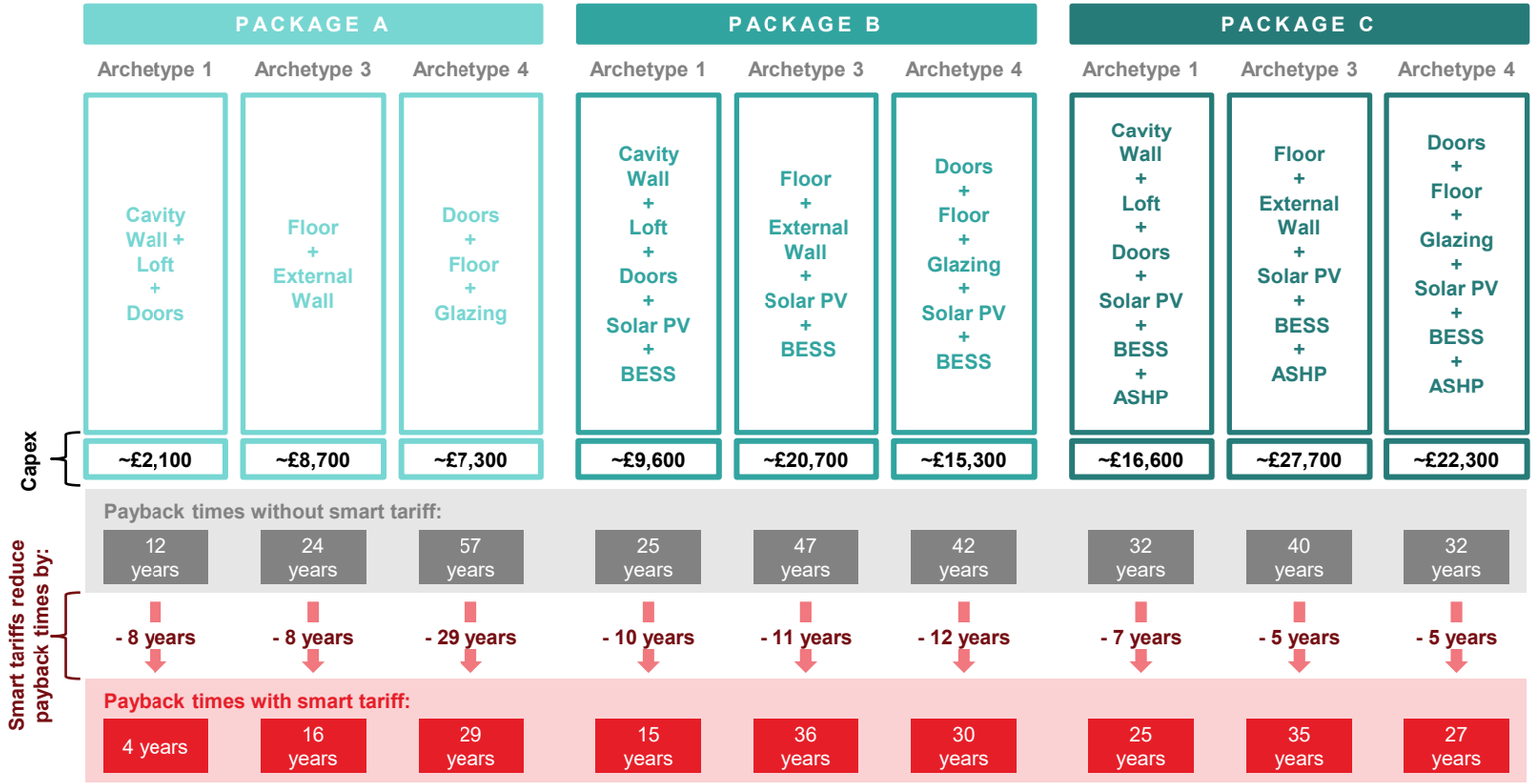
6. Capital Investment

Assuming the lower end of the range of capital cost estimates reviewed as part of benchmarking sees payback times without the smart tariff range from 12-57 years and 4-36 years with the smart tariff.

6.3 Package Payback Times [2/2]



Capex and Payback Time (with and without Smart Tariff): Package A, B, and C

Sources: Parity Projects Phase 1 Modelling, Arup Desktop Research and Benchmarks, Arup Plexos Modelling, Octopus Faraday Tool, Arup Gas Demand Profiling Tool, and Arup Analysis

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Section 7

Conclusions and Policy Inferences

7. Conclusions and Policy Inferences

The modelling indicates that when smart tariffs are linked to packages of energy saving and/or energy generation intervention measures, additional energy and cost savings can be achieved.

7.1 Key Conclusions

The modelling suggests that when smart tariffs are employed alongside packages of intervention measures (e.g., solar PV, battery storage and heat pumps), additional energy and cost savings can be achieved.

Overall savings associated from the smart tariff linked packages range from c. £650 to £1,600. this represents overall savings of 30-55%. The greatest savings are observed for Package C, where the interventions plus smart tariff enable the greatest reduction in energy consumption. Of the overall savings achieved for the various packages, the smart tariff component of the savings is around 40% with the remaining savings facilitated by the intervention measures.

The savings associated with the smart tariff alone range from ~£350 to £550 depending on the archetype considered, smart tariff structure, and package interventions deployed. This represents around 10-20% additional savings on top of the savings achieved by deploying the packages of measures (depending smart tariff structure, package and archetype). It is important to note that these savings do reduce over time as wholesale electricity prices and volatility decline.

Arup has compared the smart tariff savings observed from the modelling with publicly available studies and estimates where possible. The level of smart tariff-related savings observed is largely in line with savings estimated for various smart tariff products available to the market. Comparator data is, however, limited in the public domain and where available the detail on methodology and assumptions is also limited.

Whilst the modelling shows that smart tariffs can help improve payback times, for the packages of interventions considered they remain very long given the associated capital costs, which could put off consumers.

Modelling smart tariffs is challenging. Whilst, Arup has been able to utilise real-life data on how smart tariffs impact consumer behaviours, there were still a number of simplifying assumptions used for the modelling. For example, data availability on different smart tariff structures and how they impact on consumption patterns. Each smart tariff is also based on the same underlying wholesale power price data and therefore the savings across each are very similar Support and input from a supplier would help further improve the modelling.

7.2 Policy Inferences

There are a number of policy inferences arising from this research. Arup's modelling suggests there is real potential for smart tariffs to facilitate savings, but this will be dependent on:

- **Supplier motivation**: It is unclear what the benefits of smart tariffs are for suppliers. Smart tariffs could help with the balancing costs suppliers face on the wholesale market and suppliers could also seek to retain some of the smart tariff benefits realised (i.e., share the benefits with the consumer). However, without clear incentives for the supplier, the product offering to consumers could be limited. The current results currently assume all benefits are passed through to the consumer – how likely is this/what is the incentive for the supplier to do this?
- **Regulation/Licence conditions**: Rules would need to be implemented to ensure any sharing of benefits between supplier and consumer are reasonable to ensure both the consumer sees genuine savings and the supplier is incentivised to offer smart tariff products. Furthermore, smart tariffs, especially those with a dynamic price structure can see prices move both up and down in line with the wholesale market. This can expose customers to prices much higher than they would face under a traditional tariff structure. An important consideration should be whether a price cap is an essential component of smart tariffs to protect consumers.
- **Electrification**: The cost of carbon is currently reflected in electricity prices but not in gas price. If UK is serious about electrification, carbon costs need to be captured in the gas prices faced by consumers in order to make electrification of heating more appealing economically.
- **Smart Meters:** The rollout of smart meters, and in particular, SMETS2 meters and half-hourly metering, will obviously be essential for smart tariffs and the progression to greater automation, which will both improve the benefits of smart meters and support changes to consumer behaviours. Acceleration of the governments smart meter rollout will therefore be key.

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Section 8

Appendices

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Appendix 1

UK Domestic Tariffs Desktop Study

Appendix 1: UK Domestic Tariffs Desktop Study

Arup's performed a desktop review of "smart" tariffs available to residential users in the UK market. Information on "smart" tariff type, effects, pricing structure, and any prerequisites was collected from the majority of suppliers by market share.

A1.1 Approach to review

Arup collected available information on the following tariff elements:

- Description / overview of the tariff including how it likely impacts energy consumption and profile and the target consumer group
  - Type (time of use, automated, etc.)
  - Market (residential / EV)
  - Direction (import / export)
  - Impact
  - Target customer
- Pricing structure
- Prerequisites (smart meter, specific technologies, property type, etc.)
- The review did not include business or I&C tariffs.
- Some tariffs are not yet available (in beta, testing, available soon, etc.) and some have been temporarily or permanently removed from the market because of price volatility in the energy market or other factors.

Arup's desktop review covers the following suppliers (listed alphabetically):

- British Gas
- E.ON Next
- Ecotricity
- EDF
- Good Energy
- Green Energy UK
- Octopus Energy
- Ovo
- ScottishPower
- Shell

This review covers the majority of the residential market by supplier market share.

The outputs of Arup's desktop review are detailed over the following slides, including:

- Summary of import and combined import / export tariffs
- Summary of export tariffs
- Elements of "smart" tariffs
- Observations and conclusions
- Key questions for further investigation

Arup's investigation of the market offering is still in development. Arup intends to use this information to help design its own bespoke tariffs for BHL.

ARUP

Key
Available tariff
In pilot / testing stage
Unavailable tariff

Appendix 1: UK Domestic Tariffs Desktop Study

A review of tariffs being offered in the UK residential market has found that most branded as "smart" by suppliers are Time of Use (ToU), without an automated software component. Those with this component tend to cater towards EV users, relying on smart EV chargepoints [1/3].

A1.2 Summary of review: import and combined import / export tariffs [1/3]

Supplier	Tariff Name	Type	Market	Direction	Pricing	Software / Remote or Automated Demand Side Response (DSR)	Required Assets
Octopus Energy	Agile Octopus	Dynamic	Residential / EV	Import	Variable rate tariff pinned to wholesale prices, with daily standing charge and "plunge pricing" payment during negative price periods. Half-hourly tariff pricing published day ahead. Price cap of 100p /kWh.	N//A	Smart meter (SMETS2 and some SMETS1)
Octopus Energy	Octopus Go	ToU	EV	Import	Daily standing charge plus two variable rates: peak and off-peak (00:30-04:30).	N//A	Smart meter (SMETS2 and some SMETS1)
Octopus Energy	Octopus Go Green	ToU	EV	Import	Daily standing charge plus two variable rates: peak and off-peak (00:30-04:30). 100% renewable energy.	N//A	Smart meter (SMETS2 and some SMETS1) Exclusively available to Volkswagen, Audi, Skoda, SEAT, and Cupra electric vehicle drivers
Octopus Energy	Intelligent Octopus	ToU + Remote DSR	Residential / EV	Import	Daily standing charge plus two variable rates: peak and off-peak (23:30-05:30).	Software automatically chooses the cheapest and greenest time to charge to suit user-set schedule. If software determines this is outside of the off-peak period, user will still pay off-peak rate for EV charging and underlying household demand. If user overrides software to charge, user will pay according to the ToU rate. Limited to six hours of managed charging per 24 hours.	Smart meter (SMETS2 and some SMETS1) Intelligent Octopus app Continuous Wi-Fi connection Limited to Tesla, Jaguar, Land Rover, Ford, Audi, BWM, Mini, Skoda and Volkswagen (excluding ID models), OR any car that uses an Ohme charger
Octopus Energy	Octopus ZERO (in pilot phase)	Fixed rate	Residential	Import / Export	No standing charge and 10 MWh of import over 12-month fixed term at no charge. Guaranteed for up to five years. Import above 10 MWh charged at a rate set at fixed term start. EV demand not included in 10 MWh and charged at rate set at fixed term start.	Continuous Wi-Fi connection (PV inverter and home battery settings must be remotely programmed by Octopus). Import / export appears to be remotely managed by Octopus.	Smart meter for import and export Octopus ZERO-approved home (in pilot phase, these are new builds selected with Octopus in collaboration with developers) Octopus ZERO-approved heat pump, solar PV (likely min. 3 kWp), and battery systems (likely min. 5 kWp)
Octopus Energy	Tesla Tariff (no longer available in the UK)	Symmetrical import /export rate ('net metering')	Residential / EV	Import / Export	Combined 24/7 symmetrical /kWh import and export rate; feed in tariff (FiT) payments for exported energy will be stopped and be replaced by export payments on the Tesla tariff.	Managed by Tesla (Tesla UK Virtual Power Plant)	Min. 1 Powerwall 2 battery MCS-certified Solar Panel (up to 9 kWp per Powerwall installed Compatible smart meter

ARUP

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In pilot / testing stage
Unavailable tariff

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A1.2 Summary of review: import and combined import / export tariffs [2/3]

Supplier	Tariff Name	Type	Market	Direction	Pricing	Software / Remote or Automated Demand Side Response (DSR)	Required Assets
Octopus Energy	Cosy Octopus	ToU	Residential	Import	Daily standing charge (quoted day rate per kWh) plus two lower price per kWh "boost periods" (from 04:00 - 07:00 and 13:00 - 16:00; 40% cheaper than the Flexible Octopus rate in region), and a "peak period" rate per kWh (from 16:00 - 19:00; 60% above the Octopus flexible rate in region).	N/A	Smart meter (SMETS2 and some SMETS1) Air-source heat pump
Octopus Energy	Octopus Flux	ToU	Residential	Import / Export	Daily standing charge (quoted day rate per kWh) plus a lower price per kWh "flux period" (from 02:00 to 05:00), and a "peak period" rate per kWh (from 16:00 to 19:00) - for both import and export. Feed in tariff (FiT) payments for exported energy will be stopped and replaced by export payments on the Octopus Flux tariff.	N/A	Smart meter for both import and export Solar PV system Battery system
Ovo	Charge Anytime	ToU + Remote DSR	EV	Import	Add-on for existing Ovo customers offering reduced smart charging rate of 10p /kWh – charged as credit paid for smart charging energy demand compared to original rate.	Software manages charging to coincide with cheapest and greenest time, within user-controlled window.	Smart meter Existing Ovo domestic supply contract Compatible EV (various) or charger (Ohme or Indra; if user wants to incorporate solar system, this must be an Indra Smart Pro charger)
Ovo	Ovo Power Move (not yet launched)	Add-on reward			Ovo sets Power Move "challenges" to use energy at "greener times of day". Users will get money off energy bills. First "challenge": move non-essential electricity to a different time of day, and only use 12.5% or less of electricity during peak hours of 4pm-7pm, in exchange for flat payment of £10.	N/A	Smart meter sending half-hourly readings Ovo pay monthly tariff
British Gas	EV Energy Tariff	ToU	EV	Import	Lower price for charging at night (12am - 5am): 9.4p /kWh; daytime rate is slightly higher than normal British Gas rate.	N/A	Smart meter Existing British Gas domestic electricity supply contract (not compatible with Economy 7) Home EV charger

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Key
Available tariff
In pilot / testing stage
Unavailable tariff

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A review of tariffs being offered in the UK residential market has found that most branded as "smart" by suppliers are Time of Use (ToU), without an automated software component. Those with this component tend to cater towards EV users, relying on smart EV chargepoints [1/3].

A1.2 Summary of review: import and combined import / export tariffs [3/3]

Supplier	Tariff Name	Type	Market	Direction	Pricing	Software / Remote or Automated Demand Side Response (DSR)	Required Assets
British Gas	PeakSave Winter (trial)	Add-on reward	Residential	Import	British Gas trial "rewarding customers for making small changes to their regular routines". Credit paid for shifting demand off-peak.	N/A	Smart meter British Gas supply contract Limited trial
British Gas	PeakSave Sunday (trial)	ToU	Residential	Import	Half price electricity in a one-off session between 11am and 4pm.	N/A	Smart meter British Gas supply contract Limited, one-off, invite-only trial
Green Energy UK	TIDE (temporarily unavailable)	ToU	Residential / EV	Import	Weekday: four variable ToU rate bands; Weekend: two variable ToU rate bands.	N/A	Smart meter (SMETS2)
EDF	GoElectric 35	ToU	Residential / EV	Import	Standing charge plus variable off-peak and peak rates. Off-peak rate: 4.5p /kWh (12am-5am daily - winter, 1am-6am - summer); peak rate varies by region.	N/A	Smart meter Home chargepoint
EDF	GoElectric 98	ToU	Residential / EV	Import	Standing charge plus variable off-peak and peak rates. Off-peak rate: 18.85p /kWh (9pm - 7am weekdays, plus all day on the weekends); peak rate varies by region.	N/A	Smart meter Home chargepoint
ScottishPower	Smart (Time of Use) tariffs (beta product)	ToU	Residential / EV – varies by plan	Import	Various plans (Weekend, Evening, Day and Overnight) with Peak and Off Peak rates, with different periods for winter and summer.	N/A	SMETS2 smart meter or a ScottishPower SMETS1 meter
Good Energy	Green Driver (closed to new applications)	ToU	EV / Residential	Import	Fixed day and night unit rate plus standing charge for 12 months. Night (Off Peak) rate is fixed at 25p/kWh for 7 hours (00:00-07:00). Customer can use this power for EV charging and home consumption.	N/A	SMETS2 meter
E.ON Next	Next Drive (launching soon)	ToU	EV	Import	Not yet launched, however customers will benefit from lower priced electricity when charging between 00:00 and 07:00am. Price paid during other hours will be standard electricity rates.		SMETS2 meter To schedule EV to charge at cheapest times of day, must have E.ON Home app and E.ON installed Vestel charger

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Key
Available tariff
In pilot / testing stage
Unavailable tariff

Appendix 1: UK Domestic Tariffs Desktop Study

Arup has also included some export tariffs in the desktop review – these are not all "smart" in the ToU or software automation sense, but incentivise home generation, reducing consumption from the grid and increasing gris supply capability.

A1.3 Summary of review: export tariffs

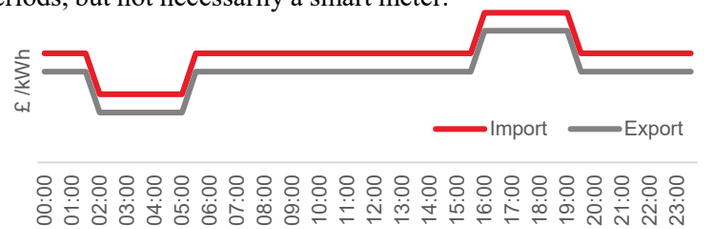
Supplier	Tariff Name	Type	Market	Direction	Pricing	Software / Remote or Automated Demand Side Response (DSR)	Required Assets
Offered by many suppliers	Smart Export Guarantee Tariff	Fixed rate	Residential	Export	Fixed rate payment for any excess renewable electricity exported to the grid from sources such as: Solar PV panels, Wind turbines, Hydro electric systems, Micro-combined heat and power (Micro CHP), Anaerobic digestion (AD)	N/A	Some home generation: Solar PV panels, Wind turbines, Hydro electric systems, Micro-combined heat and power (Micro CHP), Anaerobic digestion (AD)
ScottishPower	SmartGen	To be further explored	Residential	Export	12p/kWh (includes a variable element that requires further research)	N/A	Smart meter and installation of one of following < 5MW: solar PV, wind turbine, hydro, anaerobic digestion or micro-CHP
ScottishPower	SmartGen+	To be further explored	Residential	Export	15p/kWh (preferential rate for customers who installed solar PV or BESS through ScottishPower	N/A	Smart meter and installation of one of following < 5MW: solar PV, wind turbine, hydro, anaerobic digestion or micro-CHP (installed through ScottishPower)
Ecotricity	Smart Export Tariff (launching soon)	To be further explored	Residential	Export	Pricing information not yet available	Information not yet available	Smart meter and own generation asset

Appendix 1: UK Domestic Tariffs Desktop Study

"Smart tariffs" offered in the UK residential power market can contain or rely on any of several key components, which incentivise users to shift their demand profiles towards off-peak and greener periods of supply, reward users for this shift, or automate this shift via smart appliances and software.

A1.4 Elements of "smart" tariffs

Time of Use (ToU) tariffs incentivise users to shift demand away from high-demand periods with different price bands for peak and off-peak times of the day and week. Many ToU tariffs are enabled by smart meters, but can also include Economy 7 and 10 tariffs, which require a meter capable of recording usage in two periods, but not necessarily a smart meter.



Example of a ToU tariff with non-symmetrical import / export (Octopus Flux)

Dynamic pricing offers tariff rates that track the movements of the wholesale market, which can be affected by supply and demand forces, as well as the generation type mix (i.e., the amount of renewable generation).

Smart software enables the optimisation of residential demand, generation, and storage, by automating scheduling of:

1. demand from smart appliances and electric vehicles (to take place at times where power is cheapest and / or greenest), and
2. supply from home generation and storage (to be exported to the grid during peak times or reserved).

Smart software might be used by suppliers to manage user demand as part of import tariffs and to create Virtual Power Plants (VPPs) as part of export tariffs. Tariffs employing smart software include Intelligent Octopus and Ovo Charge Anytime.

Smart appliances can be connected to, controlled, or monitored remotely. Smart appliances can be set to manual schedules to take advantage of off-peak prices, can automate response to market signals when coupled with smart software, and can facilitate smart tariffs. Smart appliances can include:

- Smart meters
- Load control switches
- Smart HVAC
- Smart lighting
- Smart electric vehicle chargepoints

Electric vehicles (EVs) that are mostly charged at home are a key market for smart tariffs. Smart EV chargepoints allow automation of EV demand with smart software and tariffs. Smart EV chargepoints can also enable vehicle to grid technology to be incorporated into suppliers' VPPs.

Home renewable generation can be harnessed to meet demand both at the home and on the grid via export tariffs. The export of distributed home generation can be automated via smart software and appliances in tandem with ToU export tariffs. Modes include:

- Solar PV panels
- Wind turbines
- Hydro electric systems
- Micro-combined heat and power (Micro CHP)
- Anaerobic digestion (AD)

Home battery storage enables home generated renewable power to be stored to reduce the effects of intermittency, allowing energy to be used at non-productive times of day or exported to the grid during peak times via export tariffs.

Export tariffs incentivise users to export home generated energy to the grid at high-demand periods. Export tariffs can be symmetrical, where the import and export rates are identical (e.g., the now unavailable Octopus Tesla tariff), or non-symmetrical, where the user pays more for import than they are rewarded for export (e.g., Octopus Flux). In net metering import / export tariffs, imported energy is counted against exported energy for net billing. Export tariffs can be provided independently to, or bundled together with, import tariffs.

User behaviour rewards incentivise users to change their behaviour patterns to shift demand away from peak periods in exchange for rewards including credit or discounts (e.g., British Gas PeakSave, which is still in trial).

Insulation could be a prerequisite for certain tariffs, including Octopus ZERO, which is still in pilot phase. Financing implications and the possibility of framing suppliers as service providers, installing insulation and renewable generation should be explored further.

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Smart Tariffs Desktop Research

Arup's desktop review has identified a lack of clarity surrounding the definition of "smart" in terms of available or planned tariffs. Next steps include drafting an internal definition of "smart" for the tariffs designed for BHL and investigating the key questions set out on this slide.

A1.5 Observations and conclusions

- Very limited truly smart tariffs from a handful of suppliers on offer to consumers (e.g., involving automation of consumption and/or export in response to a price signal).
- Most tariffs are ToU tariffs designed for EV charging and/or residential consumption.
- A number of tariffs are naturally in beta testing/pilot phase with limited or no availability to customers.
- Octopus Energy are the major player in the smart tariff market in terms of both number of "smart" tariffs available and innovation in relation to tariff structure.
- Several tariffs have been withdrawn based on the market conditions (e.g. volatility) experienced over the past 2 years.
- Most tariffs are purely import tariffs, however, several enable the consumer to export any surplus power they generate themselves (or allow them to enter into a separate export tariff alongside their import tariff).
- Mechanism for rewarding consumer shifting energy usage to outside of peak demand periods varies from a lower rates to financial reward (e.g. credit on their bill).
- Emerging requirement for a SMETS2 smart meter.
- Signal to reduce/shift demand is price for all tariffs (noting this likely also sees a shift to lower carbon intensity periods).

A1.6 Key questions for further investigation

- What makes a tariff "smart"? How do we want to define this for our own tariffs?
- What elements need to be included in a smart tariff to maximise the benefits of each package of measures?
- Should automation be an essential requirement?
- How granular / dynamic should pricing be?
- How should consumers be rewarded for shifting or reducing consumption and exporting surplus generation?
- Should the signal to shift / reduce / export be drive by price alone or include a carbon signal as well?
- Should prices be capped where there is a direct link to wholesale power prices?
- How will generation assets and insulation improvements be financed? Is there ae role for the DNO or Supplier in financing or service provision here?
- What smart tariffs are available in markets outside of the UK?

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Appendix 2

Energy Demand Methodology

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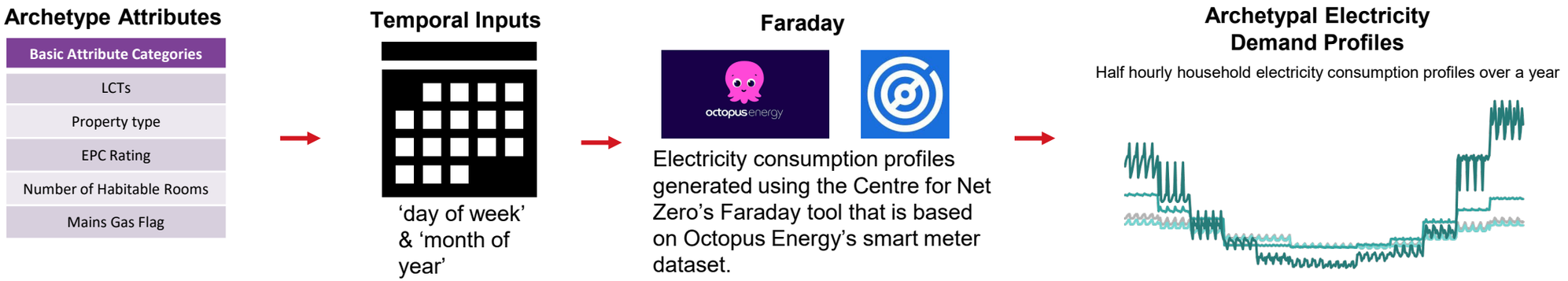
Appendix 2: Energy Demand Methodology

ELECTRICITY

A2.1 Methods: Faraday (Alpha Version 2) Electricity Demand Profiles - High-Level Workflow



Overview of Approach

Faraday (Alpha Version 2), as developed by the Centre for Net Zero, is based on Octopus Energy's extensive smart meter data. Many of Octopus Energy's customers have low carbon technologies (LCT), such as electric vehicles (EV), heat pumps (HP), solar photovoltaics (PV) and home batteries, and some of these customers have a combination of these. Understanding how these customers currently behave can provide important insights for those interested in the energy system of the future. Faraday is able to generate anonymised half-hourly electricity load profiles for user-defined archetypes, thus strictly protecting customer data and privacy (e.g., GDPR). An 'XGBoost' model, that is stacked with a linear regression model to account for macro economic factors, is trained and evaluated using Octopus Energy's smart meter data from 2021 and 2022 respectively. On a daily-settlement level, the model reportedly achieved a Mean Absolute Percentage Error (MAPE) of ~12%. Daily profiles are generated for the BHL project by selecting certain archetypal attributes for a specified day of the week and month of the year. Annual profiles are then constructed over the course of a given calendar year by running scripts to combine all appropriate daily profiles.

Key Limitations

Outputs are deterministic given user defined inputs. There may be limited training data for certain combinations of archetype attributes, thus potentially decreasing the accuracy or representativeness of some profiles. There is no way of knowing the exact type and capacity of technologies that customers have, and there is the potential for physically inaccurate outputs for a single customer. The archetype attributes do not currently consider dwelling floor area or occupant information, and they also only capture limited detail for some attributes. It is not possible to know the exact tariff customers are singed up to for a given user-defined archetype; it is likely to be a mixture but with dominant tariff-driving features. Customers within training dataset are likely to be biased towards affluent early adopters, thus not being nationally representative.

Key Working Assumptions (for BHL Project)

The Faraday profiles inherently capture rational consumer behaviour in line with affluent early adopters. Customers are mostly assumed to be on an Octopus Energy "smart tariff" (e.g., 'Agile'). Customers are also assumed to have appropriately sized demand, storage and/or generation technologies where Faraday attributes such as property type, EPC rating and number of habitable rooms are considered as a reasonable proxy for this as well as for dwelling size and occupancy more generally. However, as a result of QA actives, we generate Faraday electricity profiles here by not changing the 'EPC rating' for BHL archetype + package cases that do not include electrical heating. We also model a disconnection from mains gas for homes heated by an ASHP, which we do by selecting the 'no mains gas' Faraday input option.

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Appendix 2: Energy Demand Methodology

A2.2 Methods: Mapping BHL Archetypes + Packages with Faraday (Alpha Version 2) Archetypal Attributes

Faraday archetype attributes selected do not entirely align with those for the BHL Project. This is either due to there being limited Faraday attribute options available or due to it being deemed necessary to ensure consistency and soundness of work based on quality assurance activities.

Faraday (Alpha Version 2) Archetype Attributes

Attribute	User Defined Inputs
LCT	“Home Battery”, “Heat Pump”, “PV”, “EV”
EV Numbers	“None”, "No Electric Vehicles", "Has 1 Electric Vehicle", "Has 2 or more Electric Vehicles"
Property type	"House", "Flat"
Property Type (houses)	"Bungalow", "Detached", "Semi-Detached“ , "Terraced"
EPC Rating	"A/B/C", "D/E", “F/G"
Number of Habitable Rooms	"1 Habitable Room", "2 Habitable Rooms", "3 or more habitable rooms"
Mains Gas	"Is Mains Gas", "No Mains Gas"

Faraday Archetype Attributes Selected (Aligned as Best as Reasonably Possible with BHL Archetypes + Packages)

Archetype 1 — Cavity semis/detached with gas boilers — 20 Miles Hill Terrace

	Reference Case	+ Fabric	+ Fabric + PV + BESS	+ Fabric + PV + BESS + ASHP + EV
LCT			“Home Battery”, “PV”	“Home Battery”, “Heat Pump”, “PV”, “EV”
EV Numbers				"Has 1 Electric Vehicle”
Property type	"House"	"House"	"House"	"House"
Property Type (houses)	"Semi-Detached“	"Semi-Detached“	"Semi-Detached“	"Semi-Detached“
EPC Rating	"D/E"	"D/E"	"D/E"	"A/B/C"
Number of Habitable Rooms	"3 or more habitable rooms"	"3 or more habitable rooms"	"3 or more habitable rooms"	"3 or more habitable rooms"
Mains Gas	"Is Mains Gas"	"Is Mains Gas"	"Is Mains Gas"	"No Mains Gas"

Archetype 3 — Solid brick terraces with gas boilers not in a conservation area — 20 Hamilton Avenue

Reference Case	+ Fabric	+ Fabric + PV + BESS	+ Fabric + PV + BESS + ASHP + EV
		“Home Battery”, “PV”	“Home Battery”, “Heat Pump”, “PV”, “EV”
			"Has 1 Electric Vehicle”
"House"	"House"	"House"	"House"
"Terraced“	“Terraced“	"Terraced“	"Terraced“
"D/E"	"D/E"	"D/E"	"A/B/C"
"3 or more habitable rooms"	"3 or more habitable rooms"	"3 or more habitable rooms"	"3 or more habitable rooms"
"Is Mains Gas"	"Is Mains Gas"	"Is Mains Gas"	"No Mains Gas"

Archetype 4 — Turn of the century houses with a gas boiler — 9 Meadow Walk

Reference Case	+ Fabric	+ Fabric + PV + BESS	+ Fabric + PV + BESS + ASHP + EV
		“Home Battery”, “PV”	“Home Battery”, “Heat Pump”, “PV”, “EV”
			"Has 1 Electric Vehicle”
"House"	"House"	"House"	"House"
"Semi-Detached“	"Semi-Detached“	"Semi-Detached“	"Semi-Detached“
"D/E"	"D/E"	"D/E"	"A/B/C"
"3 or more habitable rooms"	"3 or more habitable rooms"	"3 or more habitable rooms"	"3 or more habitable rooms"
"Is Mains Gas"	"Is Mains Gas"	"Is Mains Gas"	"No Mains Gas"

Appendix 2: Energy Demand Methodology

GAS

A2.3 Methods: Gas Demand Profiles - High-Level Workflow

Parity Projects Building-Level Modelling

Domestic building level modelling based primarily on the RdSAP methodology

Annual gas demand reduction values (%) for archetypes + packages relevant to reference cases

DESNZ Gas Consumption Statistics

Department for Energy Security & Net Zero

Average domestic meter annual gas demand at postcode level used to scale normalised demand profiles

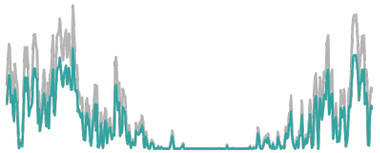
Annual gas consumption values (kWh) for archetypes + packages

Arup Gas Profile Tool

Normalised daily gas consumption over a year based on CIBSE Test Reference Year temperature data for Leeds.

Scaled gas demand profiles (hh) for each archetype + package combination (kWh)

Archetypal Gas Demand Profiles



Half hourly (grid) consumption profiles over a calendar year

Overview

Parity Projects utilized RdSAP-aligned building modelling to generate estimates for annual baseline gas consumption and post-retrofit intervention demand across different building types. Gas demand reduction percentages were derived for each building archetype and corresponding retrofit package.

It was decided to use annal gas demand from Postcode-level metered gas consumption data (sourced from DESNZ) in place of Parity Projects' estimations. This alteration was prompted by RdSAP's propensity to exaggerate heating demands, particularly in buildings with lower Energy Performance Certificates (EPCs). The assumption was that Postcode-level building characteristics exhibited sufficient homogeneity to apportion mean annual gas demand to specific building archetypes.

The percentage reductions were then applied to the Postcode-level data to project gas consumption post retrofit interventions for each package. Factoring in an 80% gas boiler efficiency, an aggregate heat demand figure was established for each archetype and retrofit option.

Once the total heat demand for each package had been established, gas demand profiles were produced. The heat demand was split via percentages between space heating (SH) and domestic hot water (DHW) demand, with the number of residents in each archetype assumed based on the number of habitable rooms (from Parity Projects). Then, based on standard DHW Arup profiles and SH profiles produced from **projected dry bulb temperature profiles (from the CIBSE Test Reference Year for Leeds),** the percentage split of the total heat load was used to calculate hourly SH and DHW demands. Finally, the hourly demands were converted to gas consumption and aggregated to produce a daily profile of demand.

Key Limitations and Working assumptions

- Gas consumption data is based on average metered data – without actual metered energy use for the dwelling this will never be an accurate representation of actual energy use in the building.
- Due to the observed phenomenon of the RdSAP methodology overestimating heating demand, there is a risk that the % demand reduction is greater than the true potential reduction.
- While standard profiles aim to account for varying occupancy behaviours between seasons, days of the week and the time of week, they do not capture individual behavioural patterns so will never completely accurately reflect the daily variations in gas consumption.

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Appendix 3

Quality Assurance

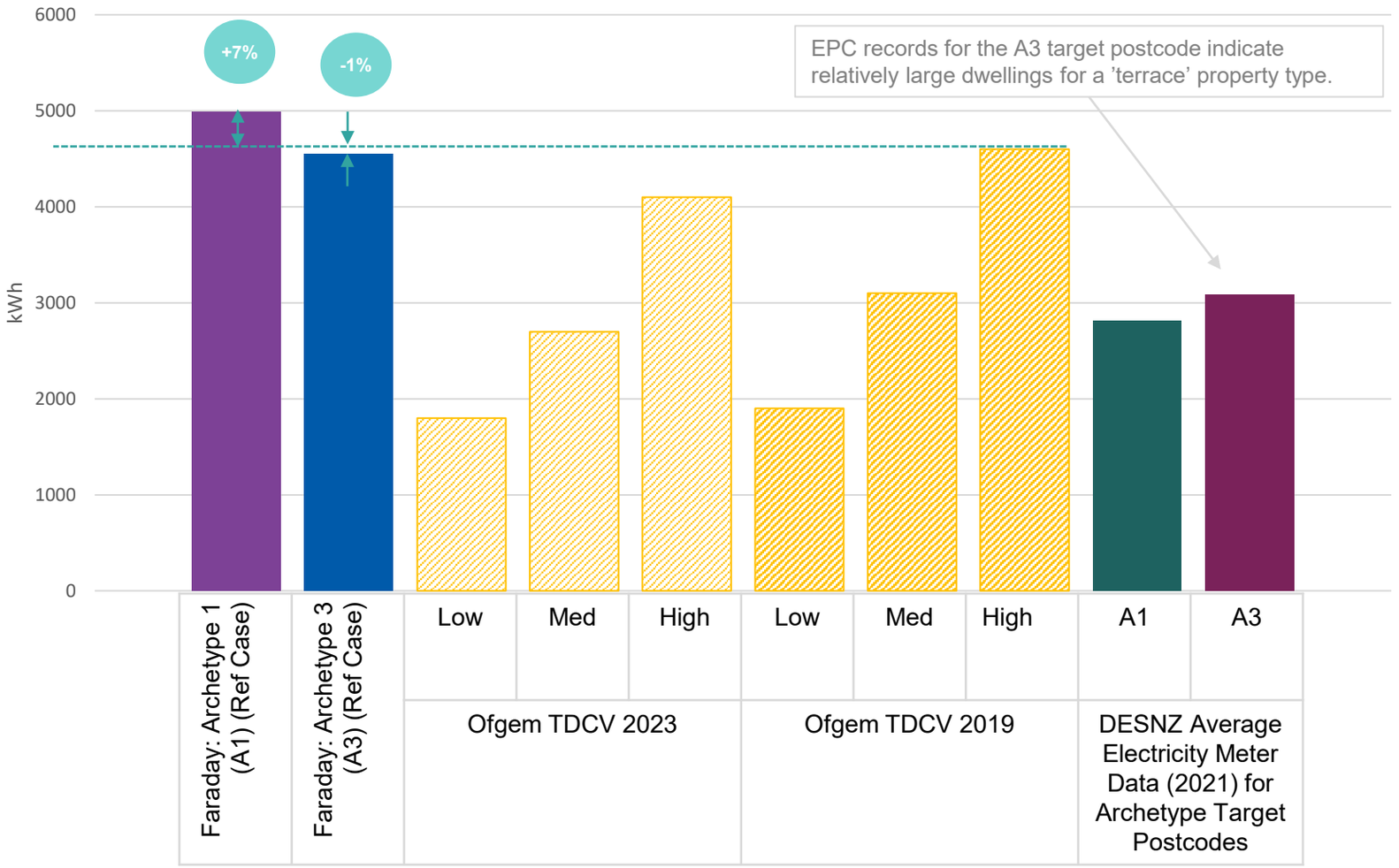
Appendix 3: Quality Assurance

A3.1 Faraday vs Other Data Sources (Reference Cases, General Domestic Annual Consumption Values)

Faraday vs Ofgem TDCV vs DESNZ Postcode Meter Data: The Faraday annual electricity consumption values for the Reference cases are mostly higher than both Ofgem's TDCVs and the average electricity meter consumption values for the target postcodes.

The Faraday annual consumption values for the reference cases are higher than both Ofgem's Typical Domestic Consumption values (TDCV) (for the years 2019 and 2023) and DESNZ's electricity meter consumption data for the target postcodes (for the year 2021). Note that Ofgem paused its release of TDCVs during the COVID-19 pandemic period due to the impact that travel and work restrictions had on household electricity use.

As detailed in the methods section, the Faraday profiles are derived using an 'XGBoost' model that is trained using data for the year 2021. There were still some COVID-19 travel and work restrictions in place in 2021, which is possibly one of the reasons why the Faraday annual consumption values for the reference cases are higher than Ofgem's TDCV. That being said, the Faraday values are still much higher than the DESNZ postcode meter data for the same year. Therefore, another reason for this is possibly a result of the Faraday profiles being inherently biased towards affluent early adopters (i.e., that typically consume greater amounts of electricity and work in professions which typically allow for home working). Its also worth noting again that the Faraday profiles are 'model representations' of typical days of the week for a given month of the year that are combined to give an annual profile. This means that Faraday may not entirely capture the impact of very low or no occupancy days (for which there would likely be many throughout the year, e.g., holidays). In conclusion, the Faraday values are within reasonable and explainable limits.



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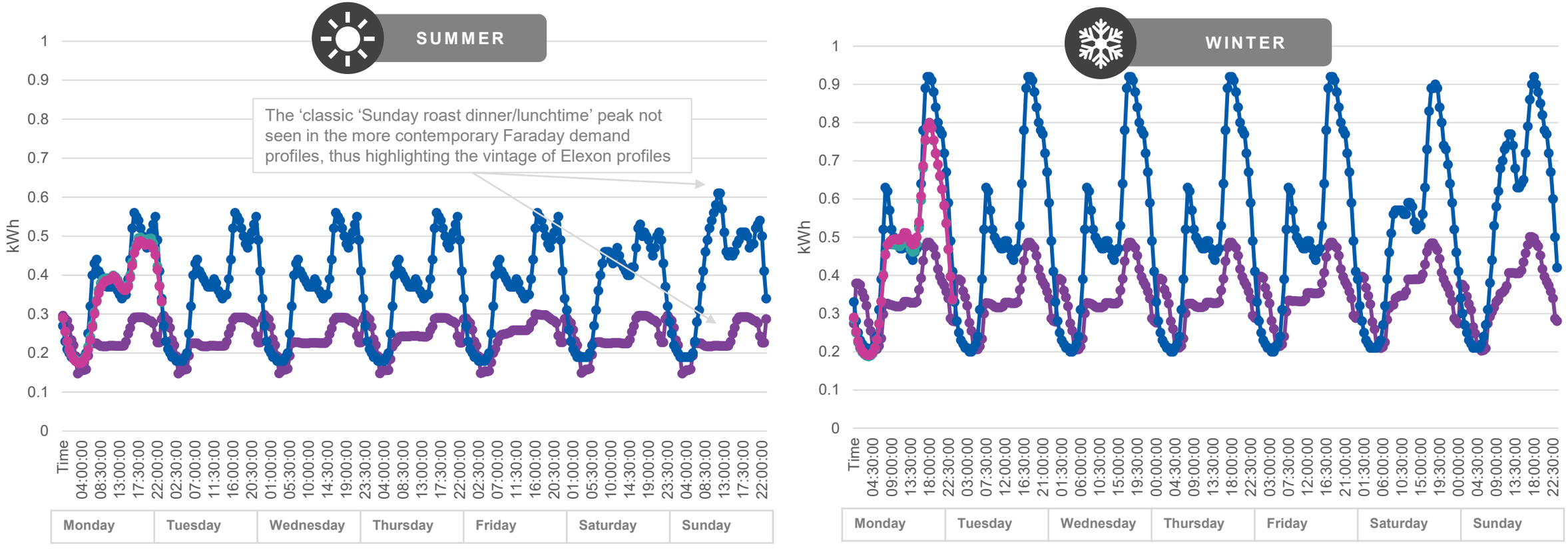
Appendix 3: Quality Assurance

A3.2 Faraday vs Other Data Sources (Archetype 1, General Domestic Profiles) (Summer & Winter)

Faraday vs Elexon (Profile Class 1) vs CLNR (TC1a): Faraday profiles have consistently lower demand values over summer & winter daytimes. This is expected given the reductions in both peak and annual use of electricity over the years owing to increasing efficiency & diversity of demands.



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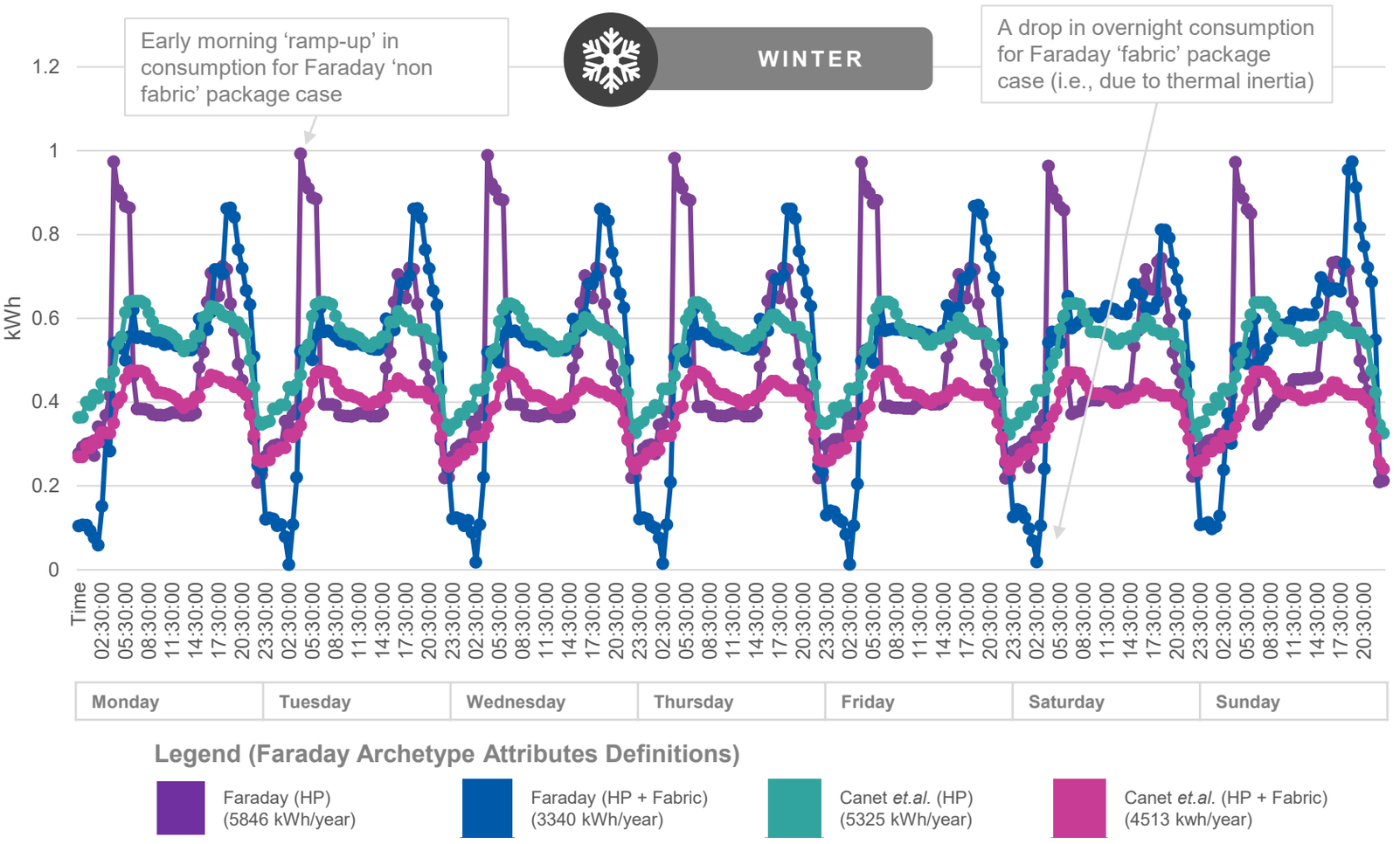
Appendix 3: Quality Assurance

A3.3 Faraday vs Other Data Sources (Archetype 1, Heat Pump Profiles) (Winter)

Faraday vs Canet *et.al.*: Reasonable alignment between datasets given performance improvements in HP installations since RHPP trial in 2012/13.

The Canet *et.al.* profiles are also generated using an 'XGboost' machine learning model. However, the Canet *et.al.* model is trained on monitored ASHP data from between 2012 and 2013 as part of the RHPP scheme. We scale the Canet *et.al.* normalised ASHP profiles here using the gas demands for Archetype 1 target postcode both before and after fabric measures. When considering annual values, it is found that, for Archetype 1, there is around 1200 kWh and 500 kWh difference between the Faraday and Canet *et.al.* methods for cases with and without 'fabric' respectively. Note that the Canet *et.al.* profiles do not include general domestic electricity consumption as they only account for electricity consumption for the ASHP. These differences are found to be in the 'low' category of Ofgem's TDCVs. It is also worth considering these differences within the context of recent evidence from DESNZ's Electrification of Heat Demonstration project which reveals an improvement in SPF by around 0.3 to 0.4 (30-40%) since the RHPP scheme. Overall, this analysis suggests that there is reasonable alignment of the datasets and therefore that the Faraday profiles capture realistic heat pump consumption.

HP Fabric Case	Faraday *(includes general domestic)* (kWh / year)	Canet *et.al.* *(does not include general domestic)* (kWh / year)
No Fabric	5846	5325
Fabric	3340	4513



Appendix 3: Quality Assurance

A3.4 Parity Projects' Capital Costs (Benchmarking)

Reasonable alignment of capital cost values.

[**Bold**: capital cost values used in BHL Financial Modelling]

BHL Archetype	Cost Sources	Cavity Wall Insulation	External Wall Insulation	Loft Insulation	Glazing	Insulated Doors	Suspended Floor Insulation	Solar PV	ASHP	BESS
Archetype 1	Parity Projects [£2022]	**1,294**		**579**		**1,560**		**3,232**	**12,000**	
	Benchmark	480 to 660 [1] 416 to 773 [2]	7,000 to 9,000 [1] 5,670 to 10,530 [2]	180 to 610 [1] 291 to 540 [2]	4,800 to 7,000 [1] 4165 to 7735 [2]	1,000 to 2,000 [2]	750 [1] 1,694 to 3,146 [2]		7,320 to 12,240 [6] 13,143 [7]	**5,000** [5]
Archetype 3	Parity Projects [£2022]		**21,532**				**2,691**	**7,555**	**12,000**	
	Benchmark	338 to 627 [3]	£5005 to £9295 [3]	270 to 501 [3]	3115 to 5785 [3]	1000 to 2000 [2]	£1534 to £2849 [3]		7,320 to 12,240 [6] 13,143 [7]	**5,000** [5]
Archetype 4	Parity Projects [£2022]				**4,383**	**1,560**	**1,431**	**3,712**	**12,000**	
	Benchmark	480 to 660 [1] 416 to 773 [2]	7,000 to 9,000 [1] 5,670 to 10,530 [2]	180 to 610 [1] 291 to 540 [2]	4,800 to 7,000 [1] 4165 to 7735 [2]	1000 to 2000 [2]	750 [1] 1694 to 3146 [2]		7,320 to 12,240 [6] 13,143 [7]	**5,000** [5]

Sources for Benchmarking	Descriptions (including limitations and assumptions)
[1] BEIS, 2017 (Prepared by Cambridge Architectural Research) (link)	Most cost ranges shown are for a small semi-detached home
[2] CCC, 2020 (Prepared by UCL) (Link)	Assuming easy to treat cavity walls, Costs are for 2015/16 and are shown for a dwelling that ranges from a small to large semi-detached, assuming easy to install loft installation. Easy to install double glazing (e.g., not in a conservation area). External insulation includes scaffolding and other costs.
[3] CCC, 2020 (Prepared by UCL) (Link)	Assuming easy to treat cavity walls. Costs are for 2015/16 and are shown for small to large Terraces. Easy to install double glazing (e.g., not conservation area). External insulation measure includes scaffolding and other costs.
[4] CCC, 2019 (Prepared by Currie & Brown and AECOM) (Link)	Not used here but provided for further reading.
[5] Energy Saving Trust (Link)	We take the lower limit of £5000.
[6] DESNZ, 2023, RHI Statistics (Link)	Taking the lower and upper quartile costs for accredited systems between 6 to 10 kW capacity, which account for the highest number of installations.
[7] DESNZ, 2023, Boiler Upgrade Scheme Statistics (Link)	Average value used.

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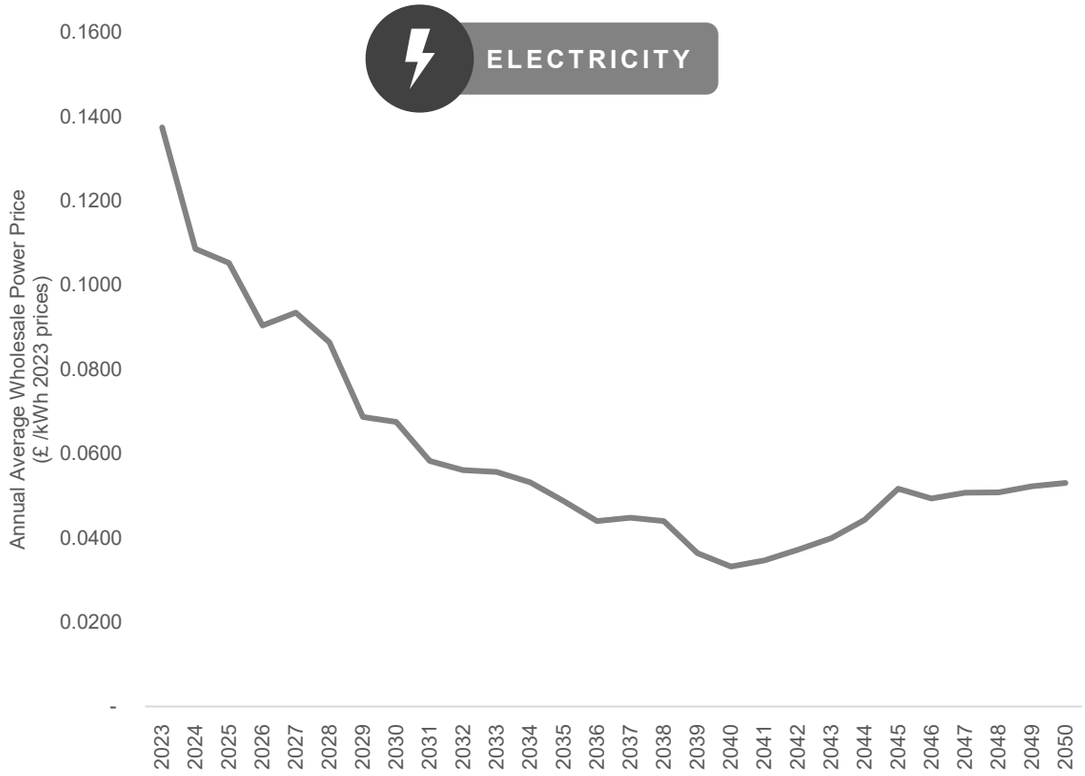
Appendix 4

Energy Prices

Appendix 4: Energy Prices

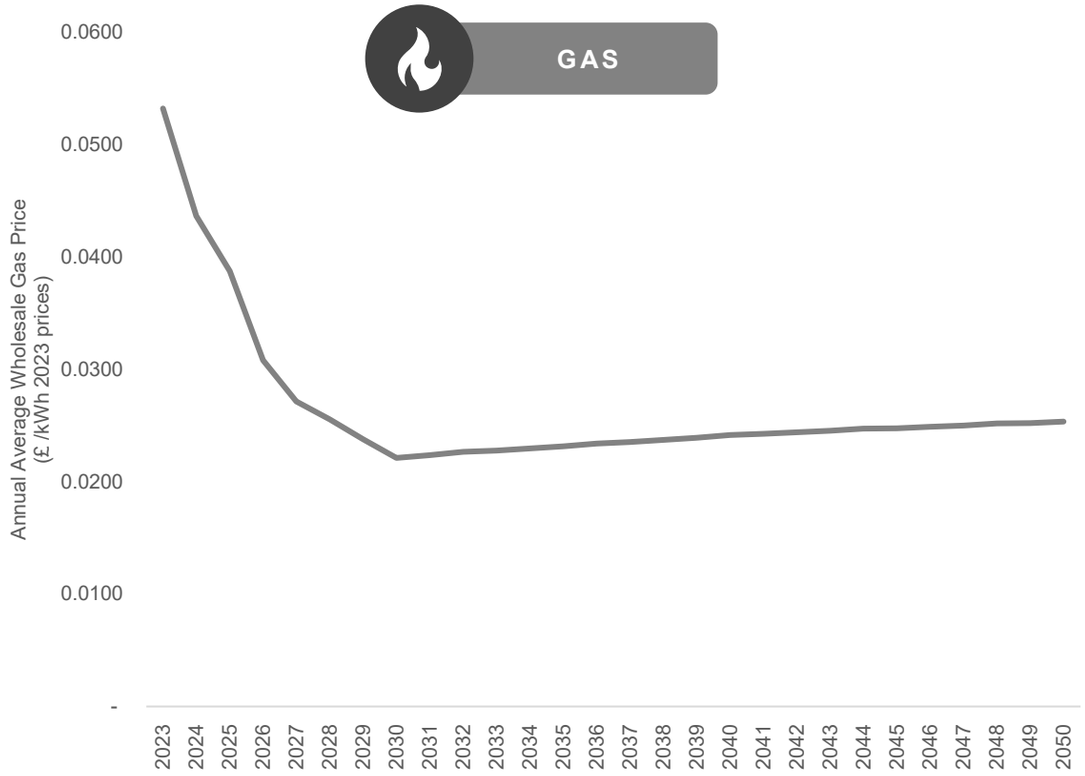
The tariffs in Arup's analysis are driven by projections of wholesale electricity and gas prices. Arup's analysis is carried out per half-hour for electricity prices and per day for gas prices. An annual average of each price profile is outlined below.

A4.1 Energy Prices: Annual Average



Annual Average Wholesale Electricity Price (£/ kWh 2023 prices)

Sources: Arup PLEXOS Energy Market Model and National Grid ESO Future Energy Scenarios 2022, System Transformation scenario



Annual Average Wholesale Gas Price (£/ kWh 2023 prices)

Sources: National Grid ESO Future Energy Scenarios 2022, System Transformation scenario

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Appendix 5

Energy Bill Modelled Results

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Appendix 5: Energy Bill Modelled Results

Total bills range from £1.2k to £2.9k. Total savings range from £300 to £1.6k. Smart tariff savings average approximately 40% of overall savings across packages and archetypes, with the remaining savings coming from reductions in demand driven by package interventions.

A5.1 Energy Bill Savings Table: 2024 Household Energy Bills and Savings

Archetype		Archetype 1				Archetype 3				Archetype 4			
Package		Ref	A	B	C	Ref	A	B	C	Ref	A	B	C
Traditional energy bill	*£ 2023 /annum*	2,601	2,307	1,861	1,822	2,803	2,151	2,020	1,739	2,906	2,675	2,230	1,822
Smart HH energy bill	*£ 2023 /annum*	2,254	1,957	1,492	1,288	2,468	1,808	1,599	1,211	2,559	2,326	1,860	1,288
Smart 1 peak energy bill	*£ 2023 /annum*	2,244	1,953	1,512	1,311	2,460	1,806	1,606	1,246	2,550	2,322	1,881	1,311
Smart 2 peak energy bill	*£ 2023 /annum*	2,247	1,955	1,512	1,314	2,463	1,808	1,605	1,248	2,552	2,324	1,881	1,314
Package case savings	*£ 2023 /annum*	-	294	739	778	-	652	783	1,065	-	231	676	1,084
+ smart tariff savings: HH	*£ 2023 /annum*	347	349	370	534	335	343	421	528	347	349	370	534
+ smart tariff savings: 1 peak	*£ 2023 /annum*	356	354	349	511	343	345	414	492	356	354	349	511
+ smart tariff savings: 2 peak	***£ 2023 /annum***	354	351	349	508	340	343	415	490	354	351	349	508
Total savings: traditional tariff	*£ 2023 /annum*	-	294	739	778	-	652	783	1,065	-	231	676	1,084
Total savings: HH smart tariff	*£ 2023 /annum*	347	643	1,109	1,312	335	995	1,204	1,592	347	580	1,046	1,618
Total savings: 1 peak smart tariff	*£ 2023 /annum*	356	648	1,088	1,289	343	997	1,197	1,557	356	584	1,025	1,595
Total savings: 2 peak smart tariff	***£ 2023 /annum***	354	645	1,089	1,287	340	995	1,198	1,555	354	582	1,025	1,592

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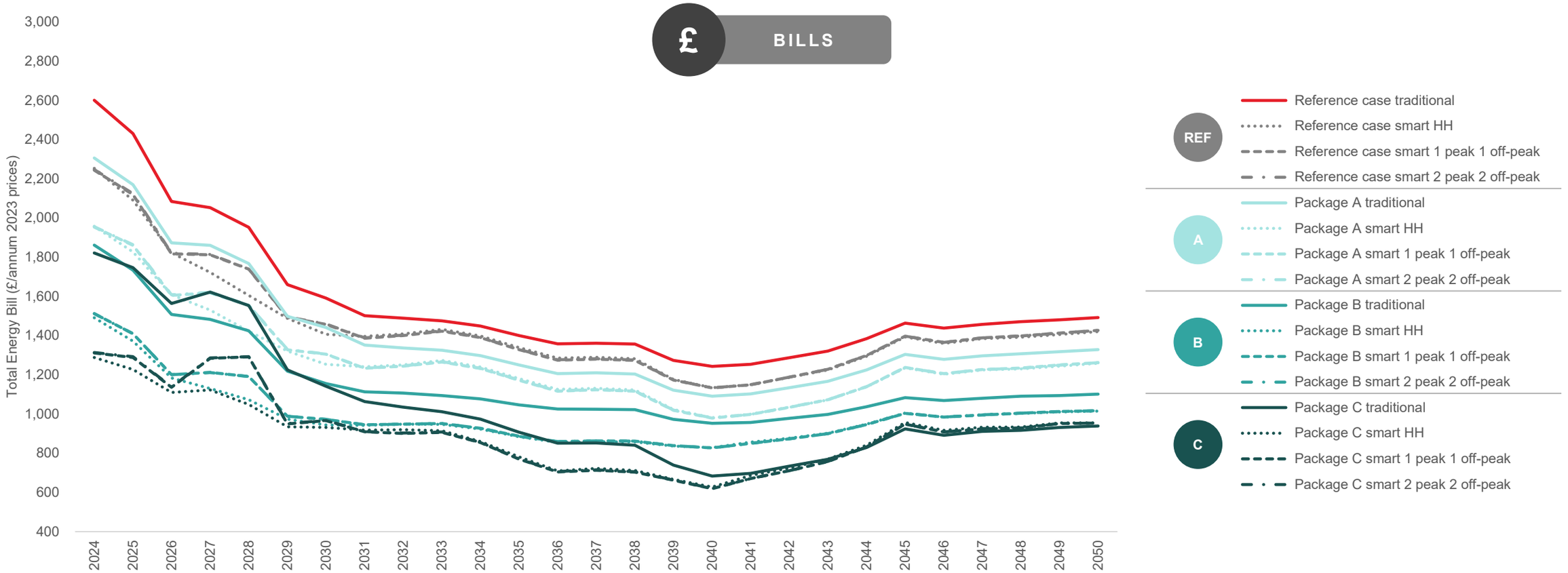
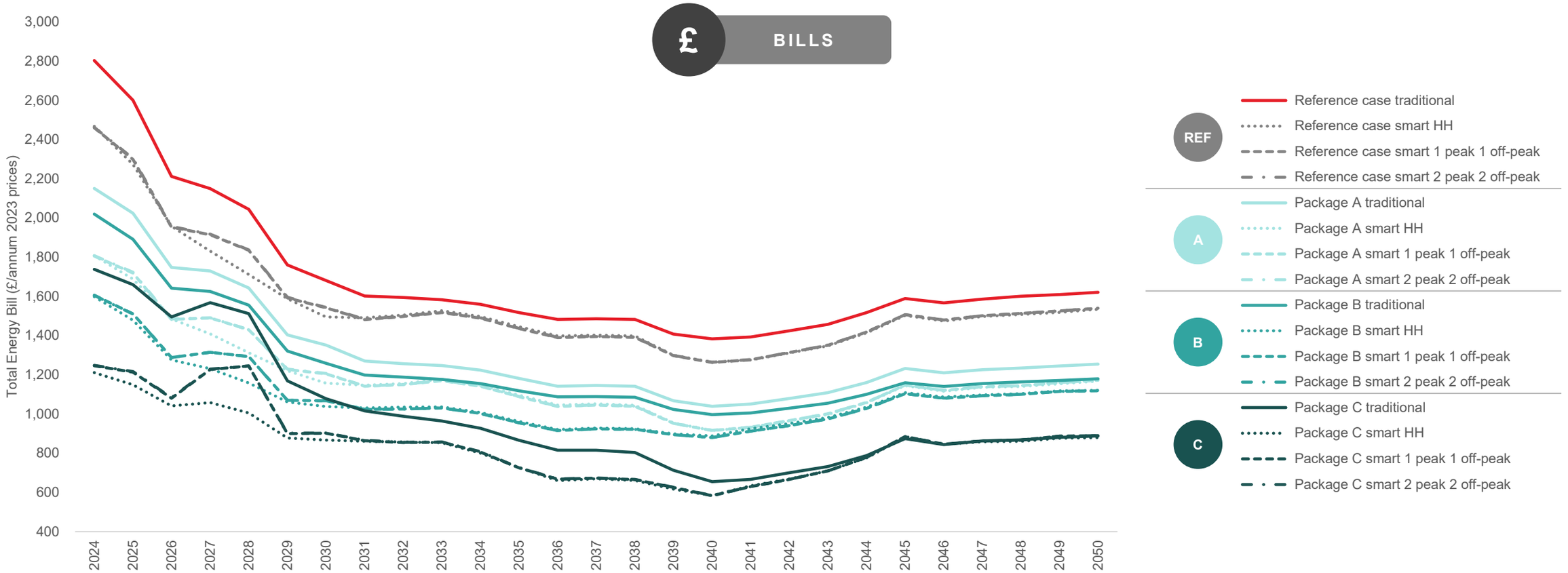
Appendix 5: Energy Bill Modelled Results

A5.2 Total Household Energy Bills [1/3]: Archetype 1 (2024-2050)



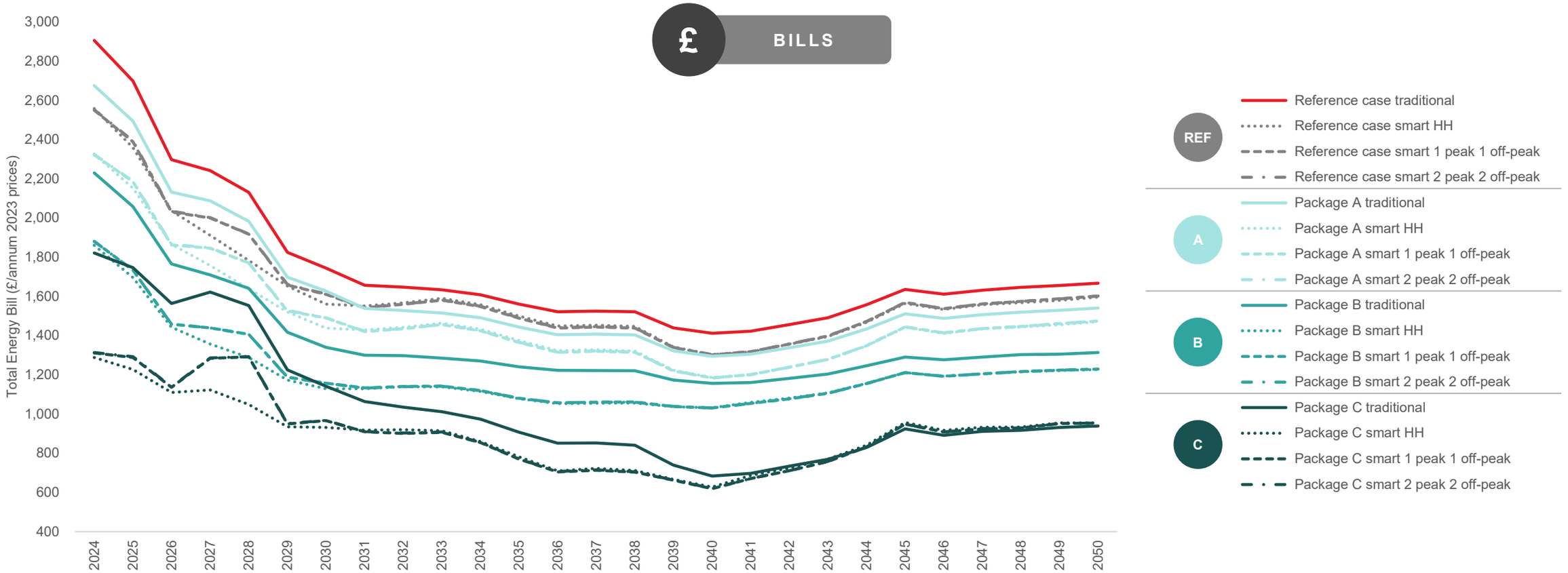
Appendix 5: Energy Bill Modelled Results

A5.2 Total Household Energy Bills [2/3]: Archetype 3 (2024-2050)



Appendix 5: Energy Bill Modelled Results

A5.2 Total Household Energy Bills [3/3]: Archetype 4 (2024-2050)



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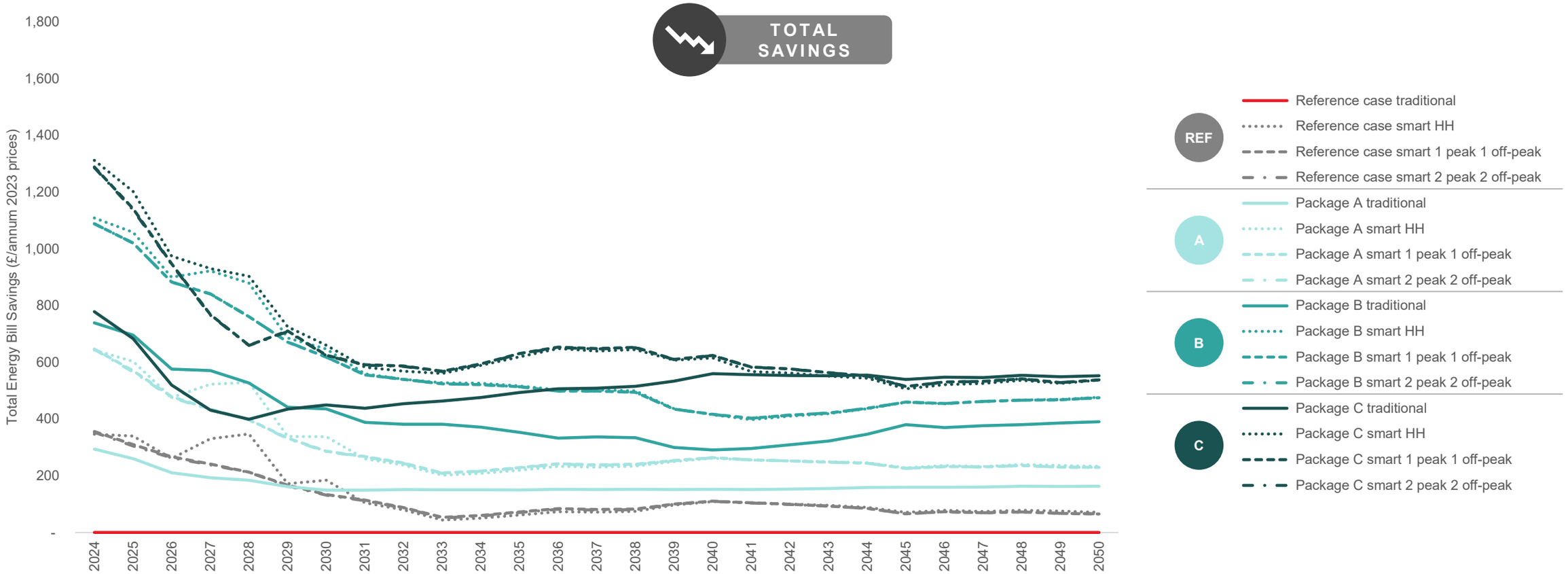
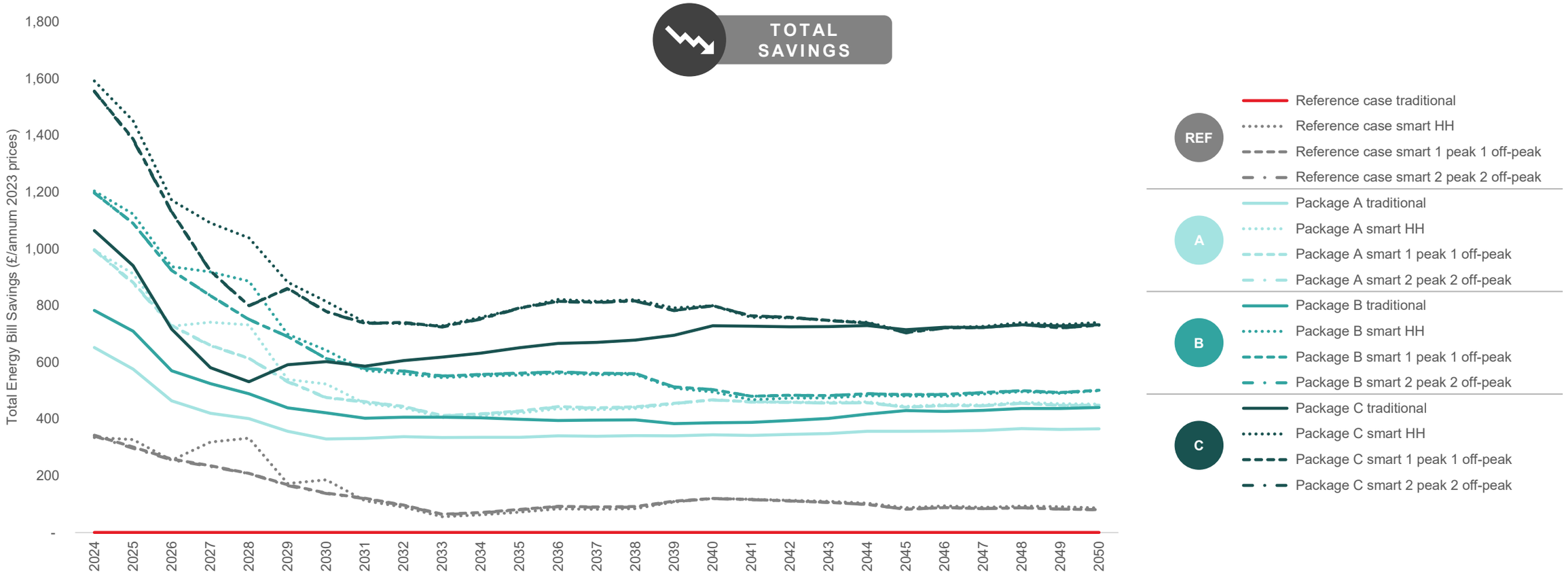
Appendix 5: Energy Bill Modelled Results

A5.3 Total Household Energy Bill Savings (compared to Reference Case Traditional Tariff) [1/3]: Archetype 1 (2024-2050)



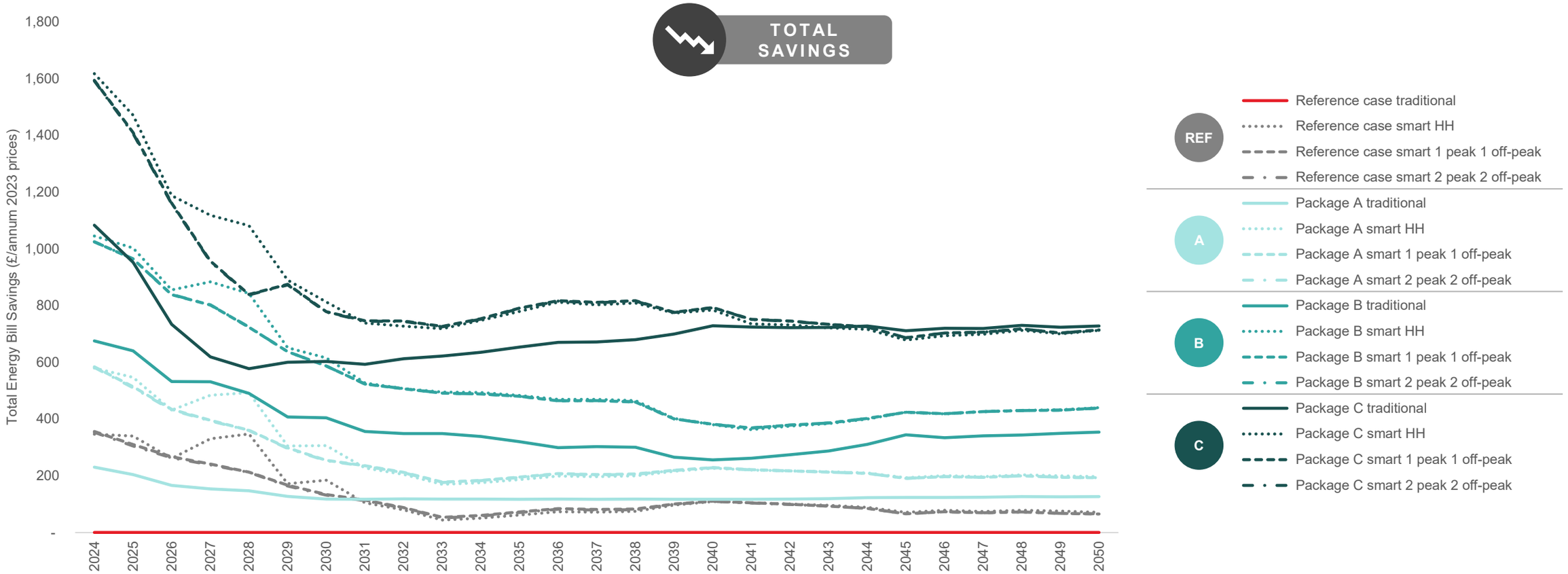
Appendix 5: Energy Bill Modelled Results

A5.3 Total Household Energy Bill Savings (compared to Reference Case Traditional Tariff) [2/3]: Archetype 3 (2024-2050)



Appendix 5: Energy Bill Modelled Results

A5.3 Total Household Energy Bill Savings (compared to Reference Case Traditional Tariff) [3/3]: Archetype 4 (2024-2050)



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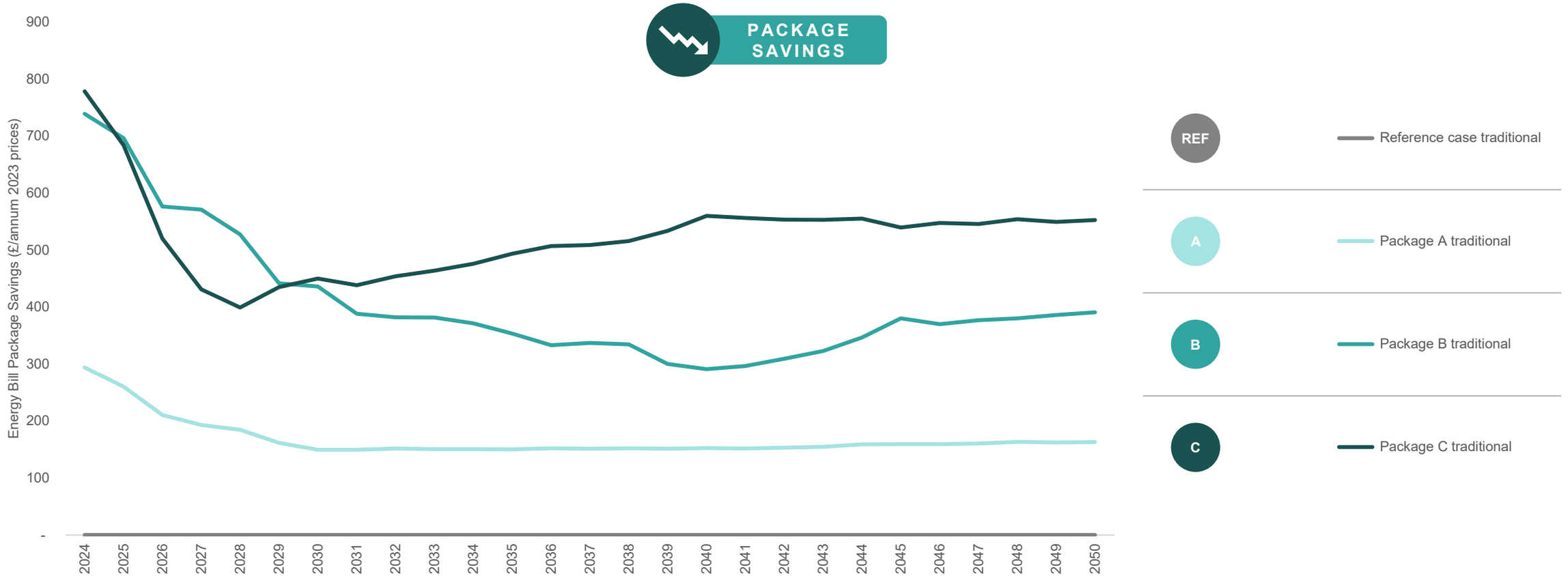
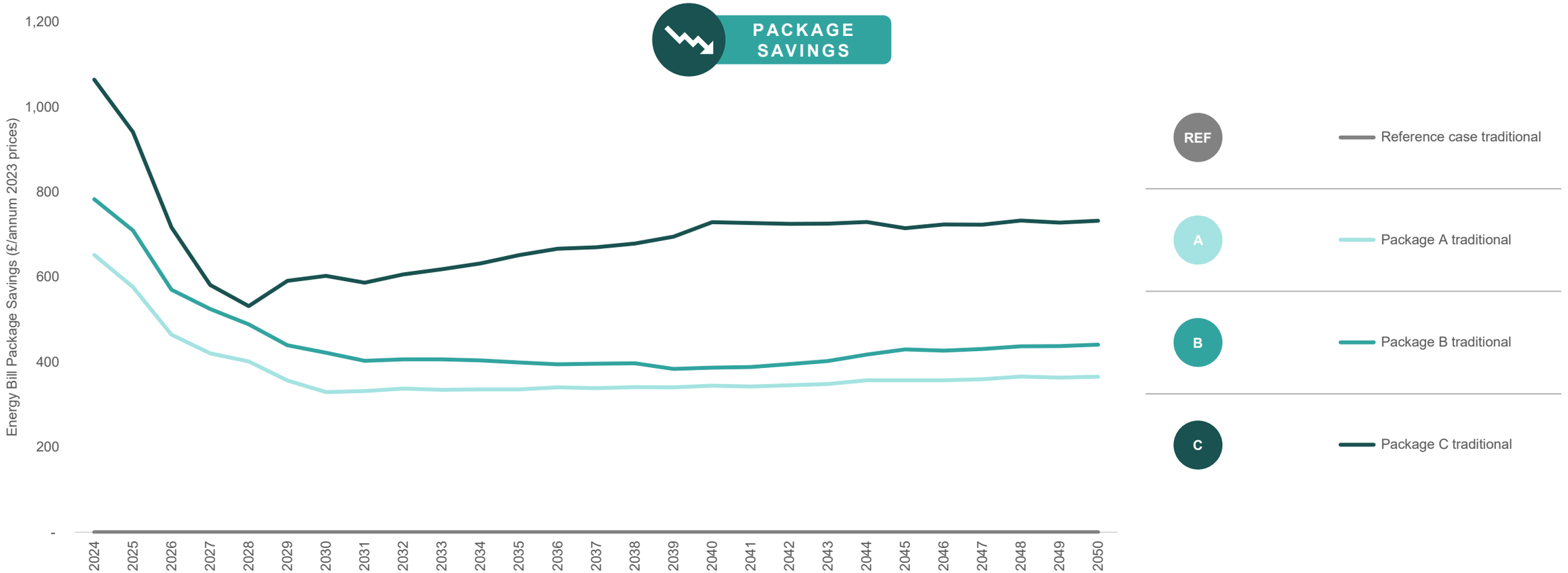
Appendix 5: Energy Bill Modelled Results

A5.4 Household Energy Bill Package Savings (compared to Reference Case Traditional Tariff) [1/3]: Archetype 1 (2024-2050)



Appendix 5: Energy Bill Modelled Results

A5.4 Household Energy Bill Package Savings (compared to Reference Case Traditional Tariff) [2/3]: Archetype 3 (2024-2050)



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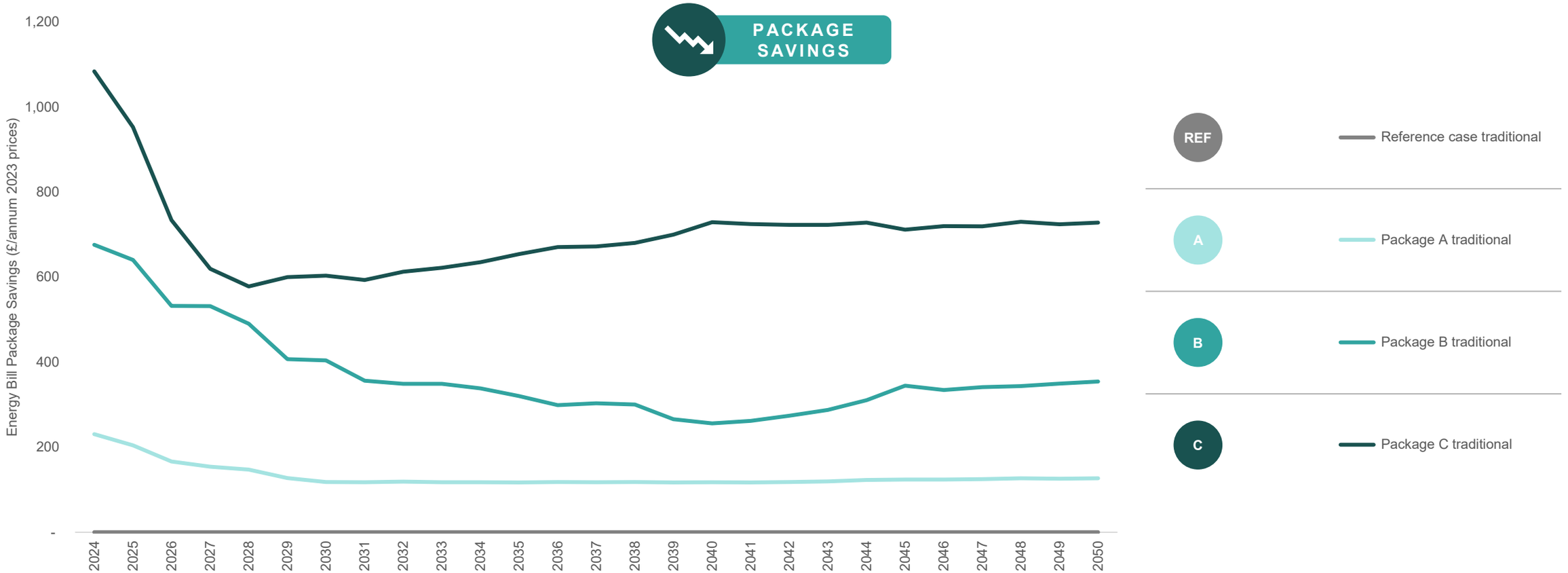
Appendix 5: Energy Bill Modelled Results

A5.4 Household Energy Bill Package Savings (compared to Reference Case Traditional Tariff) [3/3]: Archetype 4 (2024-2050)



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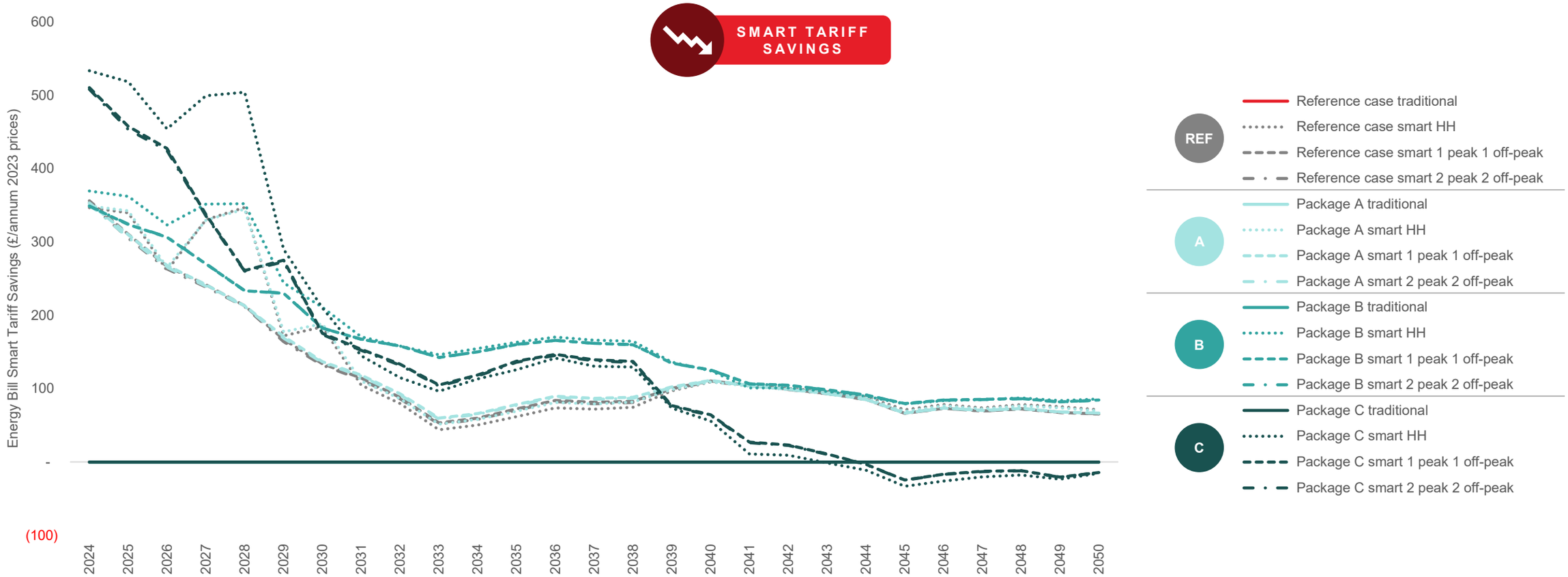
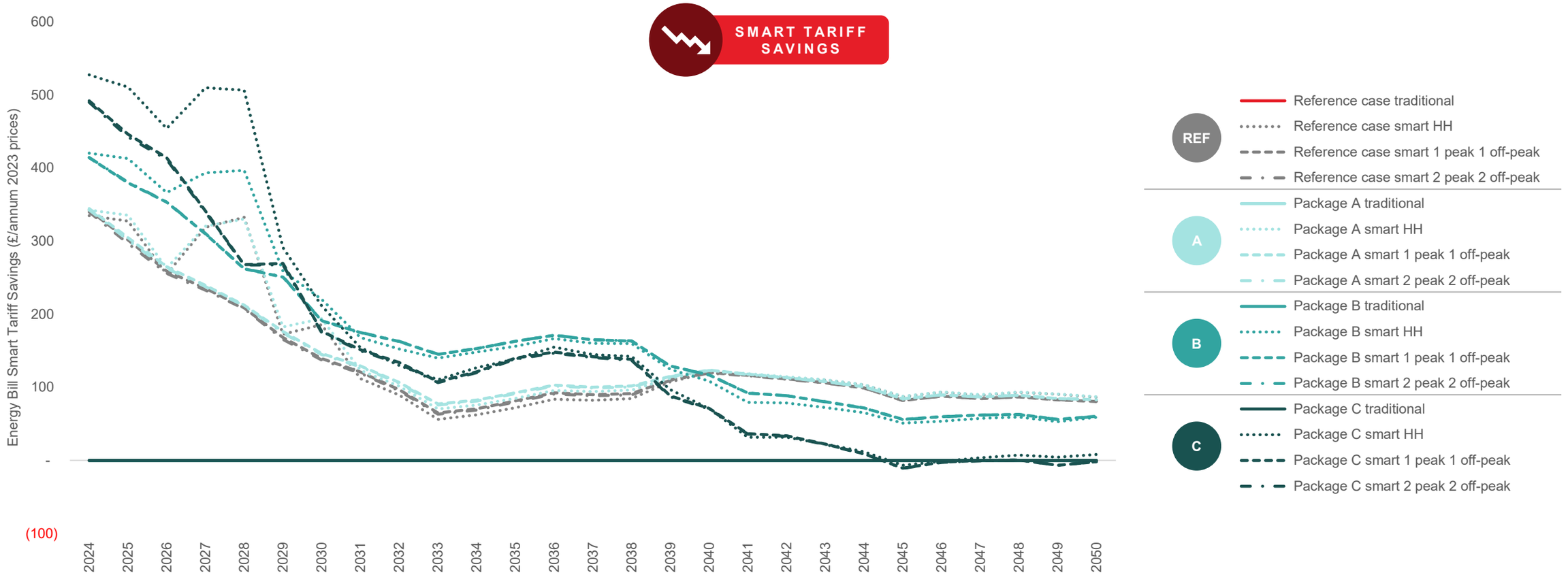
Appendix 5: Energy Bill Modelled Results

A5.5 Household Energy Bill Package Savings (compared to Reference Case Traditional Tariff) [1/3]: Archetype 1 (2024-2050)



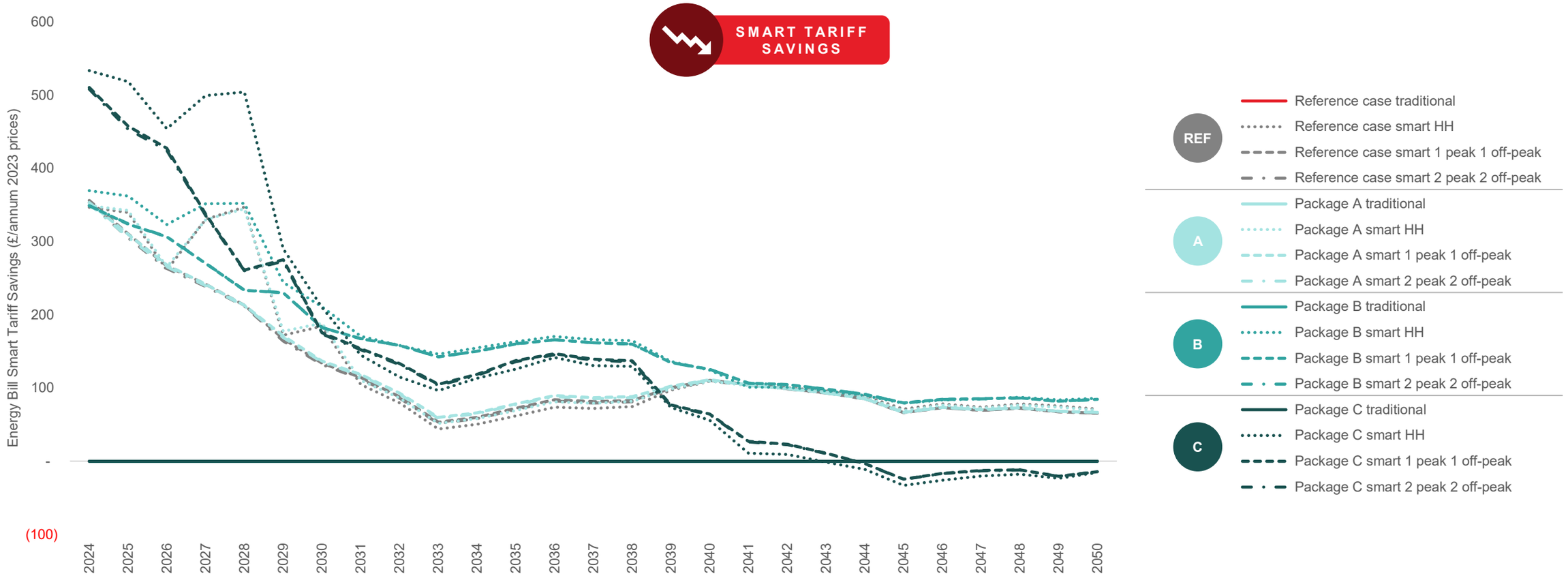
Appendix 5: Energy Bill Modelled Results

A5.5 Household Energy Bill Package Savings (compared to Reference Case Traditional Tariff) [2/3]: Archetype 3 (2024-2050)



Appendix 5: Energy Bill Modelled Results

A5.5 Household Energy Bill Package Savings (compared to Reference Case Traditional Tariff) [3/3]: Archetype 4 (2024-2050)



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Appendix 4: LLCA Focus Group and Community Engagement Findings

Social

Social
Integrated Agency

FINAL REPORT

Leeds Retrofit Accelerator focus groups and community engagement

October 2023

Energy-saving, green home upgrades – findings from 19 July 2023 focus groups and wider community engagement

1. Purpose

This report sets out key findings from a series of focus groups held with homeowners in the Chapel Allerton ward of Leeds. Its purpose is to provide insights from Chapel Allerton residents to inform the continued design, development and operationalisation of a new service aimed at helping local people make energy-saving and green improvements to their homes. This service is part of Leeds City Council (LCC) and the West Yorkshire Combined Authority's (WYCA) work to make Leeds and West Yorkshire net zero carbon.

NB: The focus groups took place prior to the Government's announcement of an extension to the deadline for scrapping new gas-fired boilers in homes. It is unknown the extent to which this announcement may have influenced homeowners' attitudes and motivations about energy-saving home improvements.

2. Introduction

In recent years there has been a government push to encourage people to install more energy efficient, environmentally friendly upgrades in their homes. This drive comes at a time when energy bills have rocketed and is not without challenges. The UK's housing stock, for example, is the oldest and least energy efficient in Europe.

On 19 July Social and Snook hosted a workshop in Chapel Allerton, Leeds to gather views from local people on the customer journey of making their homes more energy efficient and environmentally friendly. This work is part of a major partnership with Leeds City Council, Otley Energy, Lloyds Banking Group, Octopus Energy and other key stakeholders to address barriers that prevent households from accessing energy-saving green home upgrades.

The following report reflects on an agreed need to develop a better, more responsive service for green home improvements and it is informed by a range of views from key stakeholders across the pilot area of Chapel Allerton.

3. Focus group methodology

Focus groups are an established qualitative approach to collecting data through group interaction in order to gain a deeper understanding of social issues. Our group was designed to bring together a **mixture of different people, ages, social backgrounds and genders** from Chapel Allerton to understand:

- Local perceptions and attitudes in relation to energy saving, green home upgrades
- Motivations and barriers to undertaking green home improvements
- What language, messaging and communications work best to support people on the customer journey
- Initial responses to the proposed high-level customer journey

The focus group was booked to take place at **Seven Arts Centre in Chapel Allerton** – an attractive and accessible venue at the heart of the target community – at 6pm. Both the venue and timing were chosen to encourage the broadest representation among local

residents, particularly working people or those with childcare responsibilities who typically prefer early evening events.

Attendees were recruited by promoting the event through a range of channels following extensive stakeholder mapping and engagement with the Council's communications team. These included direct mailers sent to all households in the Chapel Allerton ward boundary; emails to key stakeholders such as ward councillors, estate agents and community groups; advocacy through local businesses and the ward locality officer; and promotion of the event using local community and Council social media channels. Anecdotal feedback on the evening suggested that the direct mailer was the most effective recruitment tool.

In total **26 attendees** joined the focus groups, made up of a mixture of local residents. We had a broadly balanced gender split between male and female, with one person identifying as non-binary. Most identified as White British (English and Scottish), with one identifying as White Irish, one identifying as White British and Irish, and one identifying as White and Asian. One person identified as disabled and attendees came from a broad age spectrum. The oldest attendee was 81 and the youngest 29.

Initially we had planned to provide a walkthrough of the proposed Leeds Retrofit Accelerator service however, with different workstreams within the programme progressing at different rates, this proved impractical within a focus group approach. We therefore adapted our methodology to focus on attitudinal factors relating to green home improvements and a high-level view of the customer journey to understand particular opportunities and/ or barriers.

Group discussions covered topics such as people's understanding of the language of retrofitting; how they would want to receive information about retrofitting; levels of trust in information sources and referrers; perceptions of different interventions; motivations and barriers; and service-specific elements such as finance. There was a mix of questions, from quickfire "scores on the door" questions to obtain quantitative data, to deep-dive qualitative discussions to capture views and sentiment on specific issues or technologies. Please refer to **Appendix 1** for the full focus group agenda and questions.

To provide as meaningful feedback as possible, we sought to segment participants into persona types based on the working persona typologies developed by Snook. The intention was both to test the validity of these persona typologies and identify the extent to which lifestyle and overall attitudes to home improvement, technology and green issues influence individuals' perceptions of retrofitting their home.

At the outset of the session, attendees were asked to identify which of the six persona categories they identified with most. By far the largest group was the **Committed Greens,** followed by **Busy and Unsure** and **Home Improvers**. There were smaller numbers of **Smart Life Enthusiasts** and **Property Improvers**, so participants identifying with those persona types were grouped together. No-one identified as a **Home Buyer**, which may be indicative of the current state of the housing market.

Workshop event on July 17th at Seven Arts Centre, Leeds

4. Key insights and themes

This was a highly interactive session and attendees were engaged and keen to share views. Discussions were lively, frequently passionate and marked not just by an interest in embracing technological interventions, but also by committing to behavioural change to mitigate the climate crisis. Although this varied from group to group, there was a strong willingness among all groups to make the shift from their current lifestyle to a more environmentally friendly one.

As this report highlights, though, every participant's lifestyle and circumstances are different and supporting them on a customer journey to reduce energy and install green energy upgrades to their home will require carefully managed communications and a trusted, personalised service. But while each participant had unique circumstances and needs, there were some common themes that could be drawn from our discussions, expressed by all of the persona types to some extent:

- ◊ **Trust**

  A notable finding was that consumer confidence is holding people back from investing in energy saving, green home upgrades. This is linked to a trust deficit in that attendees had reservations about retrofit suppliers and were confused by existing messaging and communications in the marketplace. This was complicated to unpack, as the lack of trust extended to inconsistent government messaging, concerns around local supplier availability and competence and, in some instances, the technology itself. Issues

highlighted included negative feedback from friends or acquaintances that had adopted certain technologies (particularly heat pumps) and not seen any benefits (either in terms of a warmer, more comfortable home or return on investment); experiences, either direct or second-hand, of "cowboy" suppliers; and a proliferation of advertisements, particularly on social media, making it difficult to identify trusted providers.

"The school I used to work at had a heat pump installed and we had some problems with it that we weren't able to fix because our supplier went bust. We couldn't find anyone else who was able to fix it and the whole process was just too complicated. The technology is still new and the market needs to mature first before I can trust it."

Focus group participant

◊ **Personalisation**

What quickly became apparent in the course of our discussions was that everyone had unique needs and wanted a bespoke service. There was considerable pushback on anything that looked like a uniform service and didn't recognise their personal needs. This included strong resistance to marketing messages along the lines of "people like you" but support for the concept of a one-stop shop, helping homeowners find the right solutions for their home and circumstances and navigate what is perceived as a complex range of options.

"Everyone's house is different and we're all at different stages on this journey. Not everyone is ready for a heat pump and there are lots of other quick wins we want to explore first. It has to be personalised, not a one size fits all service."

Focus group participant

◊ **Local delivery and marketing**

Closely linked to the issue of trust was a desire among attendees to be able to access trusted, qualified local providers. Concerns were raised at a lack of information available on who could provide the services that attendees wanted and some also expressed frustrations at local plumbers not having the right skills to fix heat pump problems. A consensus formed around the need for trusted local experts who could support people along their customer journey to make their house more energy efficient and environmentally friendly. The view was expressed that a service promoted or supported by the Council would garner greater trust.

"I want to insulate my floor in a terraced house because it's freezing in winter – but I've had a lot of conflicting advice from local providers and no one seems to be able to help me. I just can't find a trusted provider who can do it and have even ended up looking at YouTube videos and thinking of trying to do it myself. The only thing that's stopped me is I know if it goes wrong I could end up with dry rot."

Focus group participant

◊ **Wait and See**

Just as lots of people have concerns about going electric on their next vehicle because of issues like charging infrastructure, range and battery capacity, there are similar doubts holding people back from making some energy-saving green home upgrades. There was a strong sense among all persona groups, but particularly the Busy and Unsure who most likely represent a mainstream consumer view, that improvements in financial incentives – particularly grants – could be on the horizon, particularly if there is a change in Government next year, or that advances in technology could provide better options in a few years' time. This is leading to a "wait and see" attitude, with homeowners unwilling to invest money or face disruption at this point in time.

"Technology is evolving so rapidly we're worried about investing in a heat pump and then something better coming along and superseding it. Years ago we were told that buying diesel cars was a good thing for the environment. Then when we got one we were told we were poisoning people and it was bad for the environment. It's hard to know what's the right thing to do because there are so many different views and unreliable sources of information."

Focus group participant

◊ **Finance**

Attendees felt there was a lack of information on what finance models were available to fund green home upgrades. Many wanted to see the same level of flexibility around financing that you would typically have in purchasing a car, for example. The more attendees learned about potential models, the more interested they were in potentially investing in upgrades, particularly though property-linked finance options. There were good levels of interest in services that allow home owners to access equity in their property through a specialist lifetime mortgage, freeing up cash to improve the energy efficiency of their homes.

Following the high-level presentation of the customer journey, there was little enthusiasm displayed among attendees to pay £350 for a house audit to discuss what upgrades could be made to homes. That said, when Andy Boyle from Otley Energy explained the proposed model in greater detail, those participants he spoke to expressed greater acceptance of and openness to this up-front payment. Overall though, attendees expressed a strong preference for government grant funding as this quote illustrates:

"At the end of the day it comes down to cost and if we want to move to net zero then they need to make it easier to invest in interventions to improve your home's energy efficiency."

"I don't think we should have to pay for an audit just to find out what we can do to improve our home's energy efficiency. The world is literally on fire and anyone wanting to reduce their environmental impact should be supported. It should be free."

Focus group participant

5. Motivations for making green home improvements

The top two motivators for individuals looking to make energy-saving, green home improvements were saving money on their energy bills and doing their bit for the environment. In terms of messaging about the LRA service, these should be considered top-level messages. Following closely were making my home cosier/ warmer in winter and cooler in summer, although there was some discussion that the level of priority that individuals attach to this will depend on some degree to their type of home and its insulation. Those with newer, better insulated properties highlighted that this was of a lesser concern to them.

Less important to participants was getting their home ready for future green technologies, adding value to their home and making their home more attractive. Although the Home/ Property Improver group scored these factors higher than others, it was noticeable that even they scored adding value to their home and making their home more attractive much lower than the other motivators discussed. It was notable that the Committed Greens refused to score these three factors, as they either did not understand them or did not consider them to be reasons for retrofitting their homes, although they gave top scoring to all of the other factors.

The middling score for getting ready for future technologies would appear to tally with the "wait and see" attitude expressed by focus group participants in wider discussions. The scores also indicate that property improvements should be considered as secondary messaging for Home and Property Improver and Smart Life Enthusiast persona types only.

MOTIVATOR	GROUP	AVERAGE SCORE	OVERALL AVERAGE
Making my home cosier in winter	**Committed Greens**	10	8.7
	Busy and Unsure	7.4	
	Home/ Property Improver	8.6	
Making my home cooler in summer	**Committed Greens**	10	8.2
	Busy and Unsure	5.7	
	Home/ Property Improver	9	
Saving money on my energy bills	**Committed Greens**	10	9.3
	Busy and Unsure	8.3	
	Home/ Property Improver	9.6	
Getting my home ready for future green technologies	**Committed Greens**	DNA	6.7
	Busy and Unsure	6	
	Home/ Property Improver	7.4	
Adding value to my home	**Committed Greens**	DNA	5
	Busy and Unsure	4.4	
	Home/ Property Improver	5.6	
Making my home more attractive	**Committed Greens**	DNA	4.6
	Busy and Unsure	3.7	
	Home/ Property Improver	5.4	
	Committed Greens	10	

Doing my bit for the environment	**Busy and Unsure**	8.4	9
	Home/ Property Improver	8.6	

Table 2. Group feedback on reasons for wanting to make energy-saving, green home improvements

6. Core benefits of the service

Our discussions extended to a focus on the core benefits of the Leeds Retrofit Accelerator model and specific technologies. The following is a summary of focus group attendees' response to these benefits and associated technologies.

◊ **Reducing Energy Use**

There were mixed views among attendees relating to specific green technologies, but a strong consensus on the need to reduce energy use. Making their home more energy-efficient and reducing carbon was a high priority for all groups.

Below is a brief summary of feedback from group discussions and how each group rated different energy-saving interventions using a 0-10 scoring approach (with 0 being the least attractive and 10 the most).

Feedback on energy efficiency technologies

- **Solar**

There were mixed reactions to solar panels. Some were vocal about how their property was unsuitable for solar and others felt they weren't sufficiently informed and wanted to learn more. That said, there was an active interest among all groups in utilising the technology. Cost was a key factor and some were more ready than others to consider installing panels, while others felt it was less of an immediate priority. There was a sense that the greater visibility of solar panels on homes within the area was helping to normalise this technology and make it more attractive.

- **Electric vehicles**

The home/property improvers were most positive about electric vehicles and they were clearly viewed in an aspirational light, though cost and variations in quality/range were also key considerations. The **Committed Greens** group was the most negative about electric vehicles as they generally felt that car ownership was ultimately bad for the planet. Furthermore, concerns were raised about extracting the rare minerals needed in batteries. Other participants were already on this journey and a number of electric car vehicle owners were part of the discussions.

- **Cheaper tariffs**

In some groups there were strong views around fairness with regards to being able to take advantage of cheaper tariffs. For example, it was pointed out that some people do not have flexibility over when they need energy – such as those needing home dialysis, or those with lifestyles (e.g. parents of young children) that offered limited time or flexibility to take advantage of cheaper tariffs. The view was expressed that this was more about managing grid capacity than helping

homeowners save energy. Interest levels were high in the opportunity to manage energy usage through battery storage, but people needed more detail.

- **Air or ground-source heat pump**

Of all the technologies we discussed, this was arguably the strongest example where people were most hesitant because they did not feel they could access trusted information. There is so much conflicting information in the media around heat pumps – and plenty of scare stories – that they did not know what to believe. The cost was the most prohibitive factor along with concerns around having a reliable supply chain to fix/service equipment and scepticism over the benefits of increased warmth/ company and long-term money-saving.

- **Improving your home's insulation**

  All participants had favourable views around home insulation, although this was tempered with some frustration that some people's homes were not suitable for this because their walls were too thin.

TECHNOLOGY	GROUP	AVERAGE SCORE (0-10)
Quick wins (e.g. LED lightbulbs, draught-proofing	**Committed Greens**	10 (already taken these measures)
	Busy and Unsure	5.8
	Home/ Property Improvers	9.3
Solar panels	**Committed Greens**	8.3 (all 10s except for one 0)
	Busy and Unsure	6.1
	Home/Property Improvers	8
Switching to an electric vehicle and charging point	**Committed Greens**	0
	Busy and Unsure	5.3
	Home/Property Improvers	7.8
Air or ground-source heat pump	**Committed Greens**	1
	Busy and Unsure	2.9
	Home/Property Improvers	7.4
Changing how you use energy in your home – either to use less or take advantage of cheaper tariffs	**Committed Greens**	4.7 (though with significant variation – many already doing this)
	Busy and Unsure	6.4
	Home/Property Improvers	9
Improving your homes insulation	**Committed Greens**	7.2 (though with significant variation)
	Busy and Unsure	Not captured
	Home/Property Improvers	8.6

Table 3. Group feedback on how favourably they viewed different green upgrades. Highlighted text denotes highest scoring persona type for each option.

◊ **Generating and storing energy**

In the course of our discussions there was a clear appetite for generating renewable energy in their homes. However, feedback was limited on this other than participants noting that they liked the idea of using their home as a battery and would like more information on how to do this.

◊ **Using and buying energy at the cheapest times (smart tariffs)**

Similarly, there was a healthy level of interest among participants in smart tariffs and reducing energy bills by avoiding peak time hours. And, while discussion was limited, this interest was matched by an appetite to learn more so they could make more informed decisions.

◊ **Selling energy and storage to the grid**

This was welcomed by some groups but none of the participants had experience of it and would welcome further advice/support to start on this journey.

7. High-level customer journey

The following section summarises focus group feedback on the key elements of the customer journey that were presented at the session. Due to time pressures, not all elements of the customer journey were discussed in detail.

Andy Boyle of Otley Energy provided a high-level walk-through of the customer journey, using illustrative slides to provide visual cues about each stage, prepared by Snook.

- **Hyperlocal** – focus group participants welcomed the emphasis on community-based delivery and on engaging with the community through the development and roll-out of the service. A hyper-local approach to marketing the service was also warmly welcomed, with particular support for use of local advocates to share their experiences of retrofitting their homes, local events and pop-ups and open house events where potential customers could see and learn about specific technologies in-situ.

- **Personal plan** – this was broadly welcomed by focus group participants. There was a strong emphasis on the importance of a personalised service in the wider focus group discussions, with participants commenting that each home and homeowner is different. The personal plan was therefore welcomed as providing a bespoke set of options that would meet the specific circumstances of individuals.

  Reservation was expressed about the **up-front cost** however, with several participants expressing initial resistance to having to pay up-front, without knowing if they would be eligible for more involved support such as installation of solar panels, heat pumps, or insulation.

  When the rationale for this upfront cost was explained in more detail, participants

were more understanding and accepting of the need for this to cover the cost of undertaking the home assessment. As the service develops further, consideration should be given to:

  - the level of up-front cost and its acceptability to residents in terms of their perception of costs and benefits
  - providing a clear explanation of the reasons for this cost and what it will cover
  - whether it is possible to refund this cost if homeowners are not eligible for more intensive interventions and will therefore be unable to access further support

- **Finance options** – this element of the customer journey generated the strongest response among focus group participants. All persona types raised questions about the role of Lloyds Bank in the service and concerns about transparency over their role. Participants highlighted a lack of trust in national banks, compared with the Council.

  Those participants who were able to hear further explanation of the role that Lloyds Bank was expected to play – in terms of signposting to a range of finance options across the market, not just Lloyds products – and the rationale for their involvement (i.e. Council resource constraints and the emerging nature of green finance products, requiring specialist expertise), they were more accepting of the approach. It is clear though that the role of Lloyds will require clear and transparent explanation.

  In terms of general attitudes to finance, there was an overall view that government should be providing **grant funding** to enable homeowners to transition to greener energy technologies. There was reluctance expressed across all persona types to take on personal finance. As well as the impact of the rising cost-of-living on attitudes towards personal finance, participants highlighted a reluctance to take on personal debt to fund improvements that they could not take with them if they moved home. Several participants – particularly older participants and those who did not consider themselves as currently living in their "forever home" – expressed concern about investing in energy-saving technologies that they wouldn't see a full return on.

  As such, by far the most popular finance option discussed was **property-linked finance**, whereby the loan/ debt would remain with the property should individuals move on. Participants noted that this option offered the fairest return on investment to all parties.

- **Home assessment** – as noted above, there was strong appetite among participants for bespoke solutions that would help them understand the best options for their home and circumstances. As such, the home assessment was seen as a key selling point within the one-stop-shop offer. Where concern was expressed, it was in relation to the up-front cost associated with the personal plan.

- **Organising and managing works** – there was limited time to discuss this element of the customer journey, due to the volume of discussion around finance options, which was the aspect of the customer journey around which participants expressed the strongest views. There were some positive comments, however, about the

proposal for a personal project manager who could understand homeowners' specific circumstances and guide them through every stage of the customer journey.

It was notable that disruption was not raised as an issue by any of the persona types – the prevailing view appeared to be that participants understood that some level of disruption would be involved in installing more intensive technologies, such as solar panels or heat pumps, but that they were willing to undergo this if the cost and long-term benefits justified it.

Concerns were raised in the wider discussions about trust and confidence in local suppliers, with participants citing examples of poor-quality installation of retrofit measures experienced by friends or neighbours, and/ or the limited availability of suitably qualified local contractors to install and maintain equipment. Although this was not explicitly stated by participants, a further potential benefit of the one-stop-shop could be providing access to trusted/ qualified contractors and managing the works on homeowners' behalf. This would require further testing, however, given the limited discussion in the focus group session.

- **Aftercare** – there was not time to discuss this aspect of the customer journey, however wider comments about a perceived lack of suitably qualified local contractors to maintain as well as install technologies should be taken into account.

8. Additional community interviews

As part of our engagement in Chapel Allerton we approached local businesses and key influencers in the community to gather their views on how the service could be best shaped to support local people to upgrade their homes.

Below is a summary of these discussions.

◊ **The advocate: 'People need a local support network to help them'**

David Cundall

David Cundall is a Chapel Allerton resident living in Gledhow Park Road. He has spent the last 15-years installing energy saving, green upgrades to his home and wants to help others make the same journey.

"The first thing I did about 15-years ago was to install solar water heating and I was fortunate to use a very good local company. I then moved on to insulating our home and got the thickest possible material, although I wasn't able to do the bathroom or toilets.

After this, I invested in solar panels on the roof, again using a local firm. I've been well served by local firms and had no complaints. We subsequently took our gas boiler out and replaced it with an air source heat pump. This was done by Yorkshire Energy Systems and again we had good, reliable service. I've also had double glazing and have an electric car, which I charge off the solar panels.

"I'm a keen environmentalist and am also willing to help others reduce their environmental impact. We've shown some local residents around our house and talked through the energy saving changes we've made. I would gladly to do this with others in Chapel Allerton who are interested in making changes. I know some people want to see how a heat pump and solar panels work first and if it makes them feel more comfortable about making the same changes to their home then I'm happy to have helped.

"For me, the main barrier is often finding a trusted local company that can make the process as painless as possible. I've been fortunate to do that on several occasions now. As a result I have lower bills and our house really is cool in the summer and cosy in the winter."

◊ **Lessons learned: 'There needs to be more support for people making the change'**

Kirsty is the owner of an eco-friendly grocery shop on Harrogate Road in Chapel Allerton called the Re-filling Station. It offers customers a chance to live plastic free with food and liquid re-fills, and was born out of a passion to help others make small changes to their weekly shop.

"I have a 1930s semi with wooden floors and we had underfloor heating controlled by a heat pump installed last year. We used a local architect and fitter, but found the process quite disruptive and space is an issue. We had to get rid of the downstairs loo. The pump wouldn't work at first because the pipe was bent and we found it difficult to get hold of the parts.

We also had to get planning permission because it's tall and we've found that most plumbers don't understand heat pumps. We made a decision to do this because we wanted to future proof our house but it's not easy and it's expensive. If you haven't got proper insulation or the right size radiators it won't work. I would like a one-stop shop that could help me with everything and make the process a lot easier than it's been for me."

◊ **Estate agents: 'There's a crunch on finances at the moment'**

We spoke to estate agents at Fowler and Powell and Stoneacre Properties to try and find out what appetite there is among home buyers and landlords to install energy saving technologies and green upgrades.

"There is an interest but awareness is just too low. People don't fully understand it. We've shown people around houses with green upgrades and they've asked 'can we get a combi boiler instead?' For lots of home buyers it's something that remains on the margins of their understanding. It's not mainstream."

"Landlords are looking at this because of the Energy Performance Certificate (EPC) regulations coming into force in 2025. But because there's a crunch on finances at the moment, they want to know how much it costs. If they re-mortgage the property they're worried about interest rates and a lot of them are asking is it worth it compared to selling it off?

"Home buyers are also asking more about EPCs than they used to. A year ago nobody would care. Now people are asking, 'does it have double glazing?' But it doesn't go much more beyond that."

9. Communications and marketing approach

What has become apparent from the group discussions in our workshop and additional interviews with local businesses and residents is that people want a reliable, local partner to support them on this journey.

This is, in part, due to a lack of trust and confusion over national messaging and resistance to being treated as a single amorphous audience whose individual needs will not be catered for. This trust deficit is a significant barrier that must be conquered to build confidence in the value proposition.

Similarly there was a heavy emphasis on the need to simplify the process. Participants did not want to feel they had to invest many hours of work in researching technology, looking at providers across the country and trawling through complicated finance options. They wanted a simple, local network that could answer their questions and demonstrate a track record of delivery in their community.

Because of the combined concerns around trust, finding reliable local providers and the desire for a personalised customer experience, our strong recommendation is that a streamlined customer journey is supported through a hyper-local marketing strategy.

This would target potential customers in Chapel Allerton with localised messages, promotions, business tie-ins and event-based marketing. It would also be supported by local advocates like David who could help share their experiences of the customer journey, ensure interventions are tailored to a local context and advise on do's and don'ts.

By focussing efforts on a relatively small locality, building a presence in the area and working with early adopters that will share positive experiences, this strategy can begin to narrow the trust deficit and make people more confident about investing in energy-saving home upgrades.

For this to achieve our desired outcomes, it will have to be underpinned by clear, simple and trustworthy explanations of key elements of the service. This will be driven by favourable and easy to understand messaging that we tested in the focus groups.

As shown below, priority messages should be those that emphasise simplicity, personalisation, expertise and a recognition that people are all on different stages of the

customer journey. They should not make generalisations about people's houses, circumstances or make promises or claims that may not sound credible.

This should also be supported by a simple and straightforward tone of voice that provides impartial guidance and explanations. Jargon and any language that has the faintest whiff of marketing speak should be avoided at every turn (terms like retrofit did not resonate at all).

A further key component in building trust is to have a trusted brand – and our discussions suggested the Council's brand was viewed far more favourably than national brands. Indeed, there is considerable research that shows local government consistently remains more trusted than national politicians.

Building a straightforward, friendly brand identity that reinforces trust is key and we would suggest that the Council brand is prominent and takes centre stage. There is less trust in some of the other partners, particularly national banks, and some participants openly questioned the role of them in the project. Their role needs clearly explaining and contextualising.

Combining all these elements – a strong brand, trusted messaging and an emphasis on local support – as part of a wider strategy will require the right blend of hyper-local tactics to make the maximum impact.

This should include a strong emphasis on personal testimonials and open houses along with direct marketing, a dedicated website and further brand building and awareness raising activities including roadshows and extensive social media, video and local media communications.

There are still a number of barriers to overcome to increase the take-up of energy efficient, green home upgrades – not least issues relating to cost and finance, but by working with early adopters and advocates as part of an extensive hyper-local campaign, there is the best possible chance of achieving success.

Key:

MESSAGE	COMMITTED GREENS	BUSY & UNSURE	HOME/PROPERTY IMPROVERS
EASY			
Making it easier to improve your home's energy efficiency and carbon footprint			
Taking the hassle out of improving your home's energy efficiency and carbon footprint			

Helping you make the right energy efficiency improvements for you and your home			
All the help and support you need to make your home warmer and more energy efficient, all in one place			
A team of experts helping you take the right steps to make your home greener and more energy efficiency			
A one stop shop providing all the support you need to make your home greener and more energy efficient – from deciding on the right options for your circumstances to finding qualified contractors and financing the work			
Specialist support to help you make informed decisions to improve your home's energy efficiency, find qualified contractors and finance upgrades to your home			
Helping you navigate different options to make your home greener and more energy efficient and choose the right options for your circumstances			
Support at every stage of the journey to make your home greener and reduce energy bills			
ATTRACTIVE			
Make your home cosier in winter and cooler in summer			
No upfront cost to you			
A one-stop shop, providing you with expert support every step of the way			
Helping you upgrade your home to make long-term savings on your energy bills			
Upgrading your home for the future with low-carbon, energy efficient technologies			
Helping you manage your energy use at home to take advantage of cheaper energy tariffs			
Upgrading your home with technologies that will enable you to produce your own energy and sell any extra back to the Grid			
Helping you do your bit for the climate			
Choose the right blend of energy efficiency improvements for your budget and circumstances			

A service operated by a national energy company, with flexible finance options provided by a national bank			
Signposting to flexible finance options to help you improve your home's energy efficiency and carbon footprint			
SOCIAL			
We're helping people in your area make their home more energy efficient			
People in Chapel Allerton are taking advantage of support to make their homes greener and more energy-efficient			
People like you could save money on their energy bills and stay warmer in winter			
Homes like yours can become greener, more energy efficient and cheaper to heat in winter			
Homes in your area are benefitting from energy efficiency improvements like solar panels, insulation or heat pumps			
Improving homes like yours for a greener, more energy efficient future			
People in Chapel Allerton are eligible for support to help their homes become greener and more energy efficient			
More and more people are investing in ways to make their home greener and more energy efficient			
TIMELY			
Looking to extend or make improvements to your home? We can help you explore green technologies that can make your home warmer and more energy efficient.			
We can help you take the first steps towards a warmer, greener, more energy efficient home			
Make step-by-step improvements to your home's energy efficiency			
You can go at your own pace and make the improvements that best suit your circumstances			
You can start with simple improvements, like LED lightbulbs or changes to how you use energy, and invest in other measures when you feel ready			

Now is the time to upgrade your home for a greener, more energy efficient future			
With rising energy bills and the climate a priority for many people, now is the time to consider how you could make your home greener and more energy efficient			

Table 4. Leeds retrofit accelerator – summary of messaging preferences

10. Conclusions and next steps

The pandemic saw people rapidly shift to digital mediums and it forever changed people's relationship with brands. Most importantly, though, it raised customer service expectations as consumers wanted brands to demonstrate they knew them on a personalised level.

This desire for personalisation – where organisations use data to tailor messages to specific users' preferences – has not slowed down. Research by McKinsey shows that over 70 per cent of consumers now expect companies to deliver personalised interactions and this is extending to a wide range of shopping decisions, including home improvements.

This was borne out of our focus group discussions and if we are going to increase the take-up of energy efficient technologies then customers want a highly personalised service that recognises their individual needs and circumstances. Our feedback showed that people's motivations to improve their home's energy efficiency were closely connected to the type of property they live in and messaging and communications must recognise this.

This is, of course, easier said than done. The starting point for a personalised service, however, is a wider understanding of the different groups and motivations that contribute to this market. These are complex, multi-layered and not without surprises. For example, the 'Committed Greens' have more nuanced views than might have been expected including not wanting to scrap technology that still has a decent shelf life.

Other insights we gained from feedback suggested that the group most likely to be early adopters of larger scale interventions are the home/property improvers. Heat pumps scored particularly poorly among the 'Busy & Unsure' group.

It was also striking that while doing their bit for the environment is a high priority for all groups, the 'Busy & Unsure' group scored it higher in their motivations, ahead of energy cost savings and having a warmer home.

Furthermore, the 'Busy & Unsure' group seemed most interested in lower level interventions, while the 'Committed Greens' were relatively indifferent to these, having already done them.

To conclude, our focus group provided valuable insights into understanding where homeowners in Chapel Allerton are at and their motivations, circumstances and challenges. Armed with this understanding – and particularly the barriers relating to time, complexity, trust and finance – it provides the blueprint to develop smarter pathways that will encourage people onto a customer journey of upgrading their home.

This should be further developed into a hyper-local marketing campaign with personalised designs and simple first steps to match the value proposition with market need.

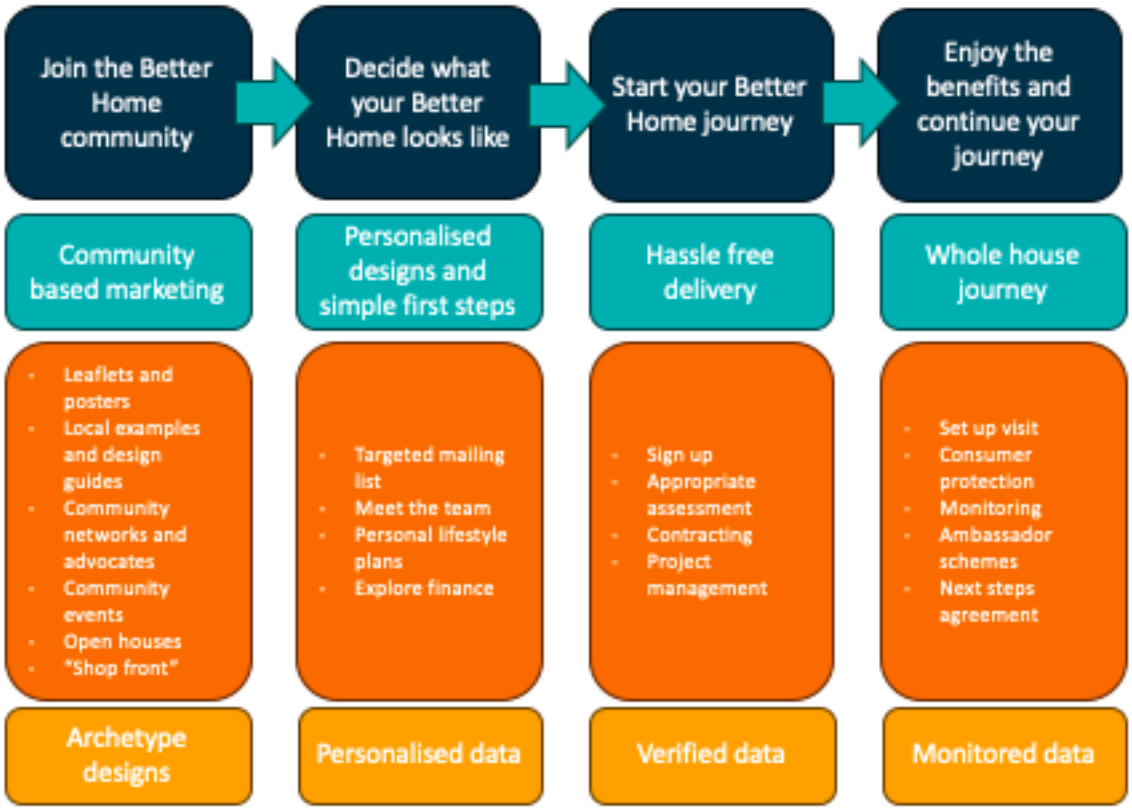


Table 5. How a hyper-local strategy could support a streamlined customer journey

Appendix 5: Marketing Plan

Social

Leeds Retrofit Accelerator

GHFA report – marketing strategy p.1 and p.2 comparison

Summary

- A key assumption of the marketing strategy set out in the initial blueprint report was that a **hyper-local marketing approach** would likely yield the best results, using local networks and advocates to promote the service within the communities where it is to be delivered
- **The findings from the focus groups validate this assumption**. Participants ranked trusted local advocates and local events/ pop-ups where they can find information about options for their home and circumstances and see technologies "in situ" top in terms of the marketing approaches and channels they would be most likely to trust.
- The focus groups also deepened our understanding of the extent to which **trust** is likely to impact customer perceptions of and decision-making around the service. Trust was one of the major themes highlighted through the focus group discussions. As well as using trusted local channels and advocates to promote the service, the approach to branding the service (including leveraging Council endorsement/ support, which was mentioned as marker of trust during the focus group discussions), tone of voice and messages need to also promote a sense of trust – providing clear, accessible and factual information to help customer understand their options and make informed decisions.
- A further aspect of the marketing strategy highlighted by the focus groups is the desire for a **personalised approached**. Although a key feature of the "one stop shop" service, a sense of personalisation should also flow through marketing collateral and messages. Focus group participants expressed distrust in messages or tactics that came across as "salesy" or too generic. Tactics such as letter drops inviting homeowners to local events or pop-ups is one example of an approach focused on building awareness of the service among a wider audience, while signposting customers to personalised information.
- "Mass" marketing efforts to raise awareness of the service, should focus on rebutting myths and misconceptions (which were highlighted by focus group participants as barriers to considering particular technologies/ solutions) using real case studies or advocates from the local community to highlight the benefits of retrofit technologies. Given the trust among local communities, council channels should be leveraged as far as possible, along with community Facebook groups and other local channels. Social media advertising needs careful consideration, given the proliferation of social media adverts promoting various retrofit or boiler upgrades, which again are undermining trust and confidence in both technologies and providers.

Marketing strategy – phase 1 and phase 2 comparison

Phase 1	Phase 2
Benefits messaging: we will create messaging and narratives around the core benefits highlighted – cosy (health and benefit), attractive (future proofing), affordable (efficiency and savings), value add (future resale value) and greener (carbon reductions). This is needed to appeal to the different motivations that will be met by participating in the BHL programme.	The focus groups reinforced the hypothesis that different individuals will have different motivations in accessing the one stop shop, and that messaging must therefore communicate a range of benefits. Different proto persona types responded differently to different benefits messaging. The **"cosy in winter"** messaging played well with all persona types. However, future-proofing and value-add messages were less well-received, with no group professing a like for this message. These latter points should therefore be considered as secondary points in benefits messaging. There was strong support overall for messaging focusing on **"doing your bit for the climate".** All groups other than the Committed Greens, also responded positively to affordability and money-saving messages. The conclusion is that the main driver for Committed Greens is reducing their impact on the environment, whereas other persona types are more interested in energy efficiency and cost saving benefits. Other benefits messaging that was positively received was around the **delivery of the service** itself. All groups responded well to the one-stop-shop concept, with messaging focusing on expert support to help homeowners navigate the right support for them, support at every step of the way, and making it easier to make green energy home improvements, all scoring well among each persona type. Messages reinforcing the personalized nature of the service were also well received. Messages should therefore focus on the ***how*** as well as the *what*.

Community liaison group: we will use these narratives and the corresponding personas that meet the benefits to help identify recruitment for the liaison group. Initially the group will help to identify the correct local channels to use to identify participants by motivation factors. At this initial phase before we have participants who will advocate for the programme, we will also use the group to inform who the influencing local voices will be to launch the programme into Chapel Allerton.	The focus groups reinforced the importance of working closely with the community through the development and launch of the service. This is closely linked to the importance of building trust in the service and the importance of a personalized approached, led by knowledge of local communities and home types. Recommendations for establishing a Community Liaison Group have been put forward as part of end of phase 2 reports and potential members were identified through the focus group process, along with community advocates who have already undertaken retrofit work in their homes. As well as playing a key role in identifying local channels to promote the service within the community, it is recommended that CLG members be engaged in **shaping the design and delivery of the service** to ensure it meets local community needs.
Establish a BHL website: we will review and decide on a potential repurpose of the Leeds section of the current Better Homes Yorkshire website, or create a new site. The purpose of the website is to provide clear information on the programme, its aims, how to participate and provide useful information for users on the wider retrofit/efficiency agenda. We need to recognise that the Leeds title will attract people from outside of Chapel Allerton and we need to capture this interest for wider follow-on work outside of the initial BHL work. To accompany this web presence, we also recommend the introduction of and management of social media channels for the BHL programme to support the ongoing engagement work.	A website will still be a key channel to promote the service within the local community and beyond. However, the focus group work has enhanced understanding of how the structure, content and functionality of such a website could best meet the needs of potential users of the BHL service. The focus groups highlighted the importance of **clear, accessible and informative messages** about potential retrofit options to potential customers. Any messaging that feels like marketing or sales jargon is likely to immediately turn off potential customers. It is recommended that website content provides a **concise and accessible overview** of different options, with the opportunity for users to **delve more deeply** into particular technologies or solutions as required. Use of **real-life case studies and videos/ animations** to bring to life the benefits of interventions and how they could work in situ, should feature prominently across the site. Given the strong appetite for **personalized information and**

	options, there should be **clear calls to action** across the site, encouraging people to make an appointment with an expert to discuss their circumstances and/ or to attend a local event or pop-up to find out more.
Link to wider LCC communications: we propose to work alongside the LCC communications team to identify opportunities to cross promote the work of the BHL programme with their wider climate communications programme. This could include signposting the BHL programme when talking about retrofit, fuel poverty and the carbon footprint of homes. This will include seeking to link to the Leeds by Example website, an online hub and an umbrella brand for individual environmental behaviour change. The aim is to ensure BHL is seen as complementary and a component of LCC activity to make Leeds carbon neutral by 2030.	A key insight from the focus groups was the importance of trust in the service, with participants highlighting the Council as a trusted local brand. It was notable that trust in the Council was significantly higher than in the private sector brands involved in developing the service. Although the proposed operating model has changed since phase 1, the **Council's endorsement of the service should be leveraged** through the branding approach, messaging and channel mix. LCC channels should be utilized, particularly briefings to local ward councillors/ other members, local community groups, and Council social media channels, to enhance trust in the service.
Reach out to Leeds climate organisations: as well as our activity with Chapel Allerton residents we will seek to engage with the Leeds Climate Commission and Climate Action Leeds to seek endorsement for the BHL programme and use their channels to promote the programme.	Through wider community and stakeholder engagement alongside the focus groups, it became clear that there are a number of local organisations engaged in promoting climate action. The BHL service should seek to work in partnership with those organisations – not only to use their channels to promote the programme, but to **learn from best practice and build effective community networks**. This should extend beyond Chapel Allerton to learn from examples of successful work, for example in Otley, where a number of successful initiatives have already been developed and piloted. Beyond the key Leeds climate organisations and action groups, there are also **other community-based organisations and networks** that the service should look to engage with, as potential advocates and amplifiers of the service locally, such as the **Refill Station** in Chapel Allerton and the local estate agent, **Fowler and Powell**, which are well-embedded in the community and among potential early adopters of the service.

Identify advocates and ambassadors: once people begin participating, we will create a suite of ambassadors and advocates for the programme to drive peer to peer messaging, this will include building a library of case studies of successful retrofit activity.	The focus groups strongly validated this initial hypothesis. As well as trust being one of the top issues cited by focus group participants, local community channels – including local advocates – were the marketing tactics that scored highest among participants. Phase 2 engagement activity has identified some initial advocates about whom initial case studies, videos and testimonials can be built. The content of these case studies should provide real-life, informative testimony about the benefits of retrofit interventions and factors to consider, and rebut common misconceptions about retrofit technologies. Alongside these case studies, it is recommended that local events, pop-ups and open house sessions be organised, giving potential BHL customers the opportunity to see technologies in situ, ask questions and hear from those who have "been there and done it" first-hand.
Continuous content development: to be used throughout to explain the BHL programme. This will be designed around the core principles of using simple, jargon-free, locally focused language using local individuals to articulate the benefits of the programme. This will provide a consistent tone of voice for the programme. Channels used for this work will include – PR, advertising, social media channels, community events, leafleting and as highlighted in the customer journey section, a physical shop front.	Alongside community-based activity, advocate case studies and local events, a wider programme of communications and marketing activity will be required to build awareness of the programme and drive potential customers to the website and local events. The focus groups provided some further detail to shape and target this marketing programme appropriately. The preferred channels among participants were local events and pop-ups, followed by leafleting and letter drops (it was noted that the letter drop to promote the focus groups was effective and was the main way that participants had found out about the session). Council channels should also be used to demonstrate endorsement and promote trust in the service. There was some scepticism about use of local media, social media and, particularly, advertising. Focus group participants highlighted the large volume of social media adverts about retrofit and boiler upgrades, which are contributing to confusion and mistrust about

	both technologies and individual providers. As such, it is recommended that PR and social media content focuses on rebutting myths, providing information, using real-life case studies and testimonials from local residents, and showcases Council endorsement wherever practicable.
Research: throughout the programme we will undertake research with users to test hypotheses of the initial design and refine the design. This research will be used to target prioritised use groups, those who are considered most likely to take up a retrofit scheme and community influencers to make people aware of and advocate for the BHL programme.	It is recommended that research and community engagement continue throughout the development of the service. Although the focus groups have enriched our understanding of target users' motivations, triggers and marketing/ messaging preferences, it should be noted that participants were all self-selecting, and therefore not a representative sample of the Chapel Allerton community. Although the focus groups represented a broad spectrum of ages, socio-economic backgrounds (although all were homeowners, feedback suggested that participants lived in different types of housing and neighbourhoods) and of proto persona types, it is recommended that future phases of research focus on hearing from from Black, Asian and Minority Ethnic (BAME) residents, those with disabilities and landlords in particular, as audience groups under-represented in the focus groups.

Appendix 6: Service Design

Snook

WP3: Snook outputs Service Design

October 2023

Tackling Poverty and Inequality

Health and Wellbeing • Inclusive Growth • Zero Carbon

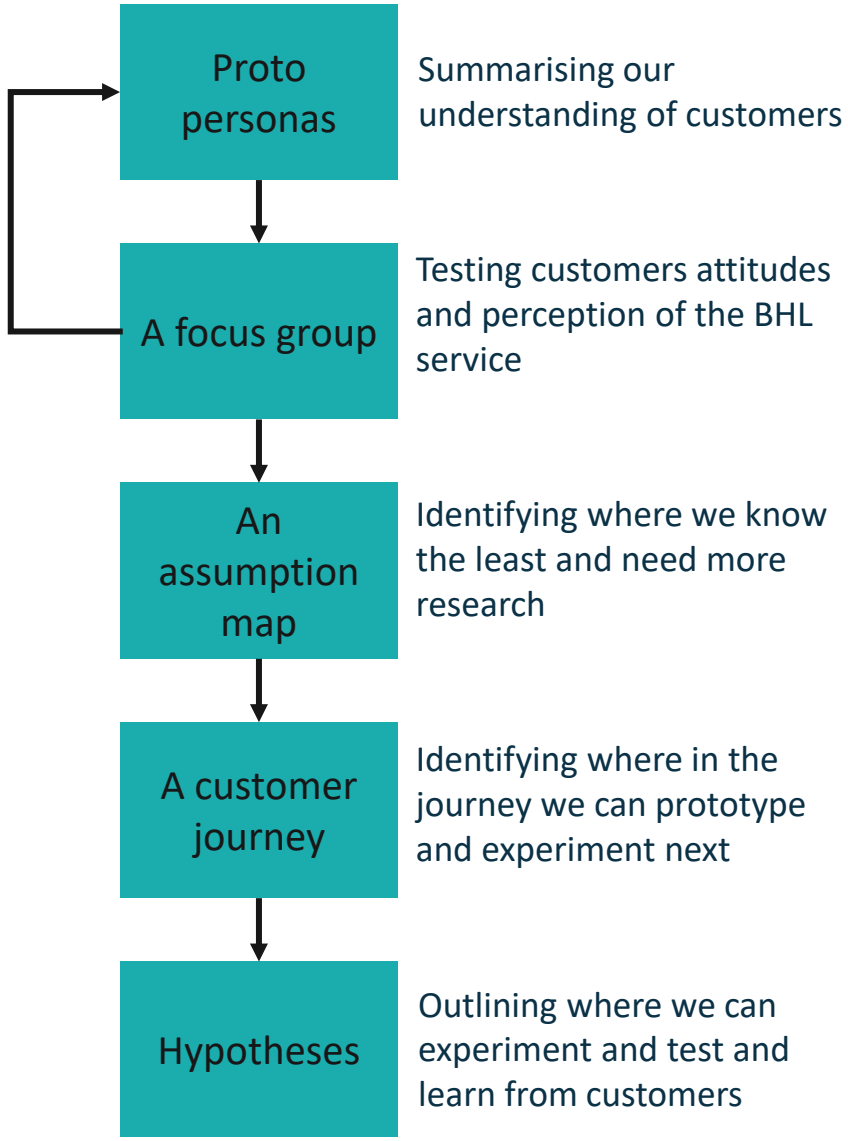
Leeds CITY COUNCIL

Design process

We started our design process with creating **proto personas** based on existing research and data. This was taken, alongside with the BHL service value proposition, to **a focus group** with residents in Chapel Allerton to explore their attitudes and perception of the BHL service.

The learnings from the focus group were reflected in the proto personas, where our understanding so far of customers is summarised. We then used **an assumption map** to identify where in the journey we have least confidence in these assumptions, and which will have the most impact if we are wrong for each proto persona.

The assumptions informed where in **the customer journey** requires further exploration to push our thinking of the BHL service forward. They formed various **hypotheses** that can be prototyped and experimented in the next phase.



COMMERCIAL IN CONFIDENCE

Proto personas

Proto persona are assumptions about a cluster of target customers who exhibit similar motivations, goals and behaviours in relation to the BHL service. They are not mutually exclusive. An individual target customer could find themselves resonating with more than one proto persona or shifting their corresponding proto persona when their circumstances change.

We created 6 proto personas that are based on existing research data, the previous phase of work and the learnings from the focus group in Chapel Allerton in July 2023. Due to the lack of available data, the proto personas do not include relevant demographic data, nor their appetite for different financial products. They require further validation through research with the residents of Chapel Allerton.

The proto personas are **Smart Life Enthusiasts**, **Committed Greens**, **Home Improvers**, **Home Buyers**, **Busy and Unsure** and **Property Improvers** (see next page for overview). Out of the 6 proto personas, we identified 4 of them as early adopters of the service : Smart Life Enthusiasts, Committed Greens, Home Improvers and Home Buyers.

These four proto personas are less likely to wait for policy change to start investing in low carbon and energy efficient measures, whereas the Property Improvers are likely to be more motivated by government regulations or incentives. They also take a more active position in investing in low carbon and energy efficient measures, in comparison to Busy and Unsure.

As we learnt from the focus group, Busy and Unsure exhibited the attitude of ‘wait and see’. However, Busy and Unsure could still be a candidate for early engagement with the One Stop Shop if the BHL service provide simple steps onto the journey, such as access to energy saving information. We have identified this as one of the assumptions for future exploration.

Full details of each proto persona can be found here.

Proto persona overview

Smart Life Enthusiasts

- Have **high interest in new technology** and feel comfortable using it.
- Have **multiple smart devices** at home already.
- Enjoy the **convenience, time saving and control** that smart devices can bring.

Committed Greens

- Are **very interested in** environmental issues.
- Consider **greener options** when making decisions about their daily life.
- Are interested in making **long term energy improvements** to their home to help tackle climate change.

Home Improvers

- Want to improve their home to **better meet their family's needs.**
- Making or considering home improvements **due to changes to the family or life events.**
- Are likely to fund the improvement works **through savings or windfalls.**

Home Buyers

- Are currently **in the process of buying** a new home or considering doing so.
- Want to know how to **fix issues** raised in their home buying survey.
- Want to **improve the living space** in their new home before or soon after moving in.

Busy and Unsure

- Notice **the increase in energy bills** and want to know how to reduce them.
- Have a busy life and find it **hard to find time** to consider energy efficiency improvements.
- Home improvement plans are **stalled due to busyness.**

Property Improvers

- Plan to **sell or rent** one or more properties.
- Take **a functional and economic approach** to upgrading their properties.
- Improving home energy efficiency to increase re-sale value or to **meet renting regulations**.

Assumption map

Based on previous research and the focus group in Chapel Allerton in July 2023, we mapped out our key beliefs at each stage of the customer journey for each proto persona, except for the Property Improvers. They are mapped out as an assumption map.

Beliefs on Property Improvers were not represented in the map because they were not identified as early adopters of the service. Busy and Unsure were included as we believe that they have potential to be the BHL service customers.

The five stages in the customer journey are: Awareness, Consideration, Decision, Delivery and Advocacy. Within both the Consideration and Decision stages, we looked at beliefs using two lenses: how customers consider or decide on the **home improvement works** they need or require, and **financial products** that could fund the works.

Our beliefs are condensed into 6 themes that describe our key assumptions about how the service can be designed to meet customer needs.

There are 6 key assumptions underpinning the customer journey (see next page for details):

1. Simple steps onto the journey
2. Hyperlocal marketing
3. A visualisation tool
4. Financial information
5. Personal plans
6. Financial products

See the full map here.

Key assumptions

1. Simple steps onto the journey

We assume that by providing simple steps into engagement with the BHL service, such as access to energy saving information, we will convert residents into future customers.

2. Hyperlocal marketing

We assume that a hyperlocal marketing strategy will help raise awareness, stimulate networks of influencers, and build trust in the BHL across all target customer groups. Focus group feedback validates this assumption, however further testing of messaging and marketing assets will be required.

3. A visualisation tool

We assume that being able to visualise future home improvements and ROI will help people weigh the benefits and costs of their decision.

4. Financial information

We assume that having financial information signposted as part of the BHL journey will increase people's trust in the service and confidence in paying for improvements.

5. Personal plans

We assume that creating personalised and flexible home improvement recommendations is fundamental to creating long-term customer engagement.

6. Financial products

We assume that people need finance products to fund their improvement work and each proto persona is attracted to a different offering.

Customer journey

The customer journey outlines a high-level future experience that the BHL service intends to provide. It indicates the customer touchpoints with the BHL service, and the roles required within the BHL team in order to deliver the customer journey.

Based on the assumption map, we identified where in the journey that we can turn the assumptions into hypothesis that we can test in the future through service prototypes.

This represents a generalised experience across all proto personas and is largely from the perspective of a whole house retrofit. The journey detail can be refined once further research validating the proto personas and service assumptions is carried out with residents in Chapel Allerton.

Full customer journey map can be found here, and an overview of the hypotheses are here.

Roles in the BHL team

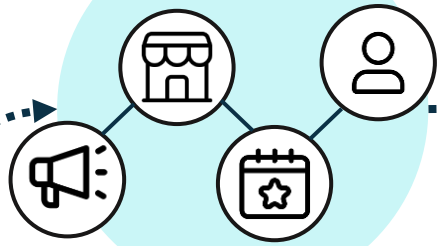
We believe three roles are required in the BHL team to provide consistent and supportive service to the customers. This requires further research to test these beliefs and understand the requirements for each role.

Customer liaisons will hold the relationship with the customers. Customer liaison agents will introduce the service to customers as part of a free consultation. They will also explain the home assessment to the customers and follow up on future works and signpost information on financial products and smart tariffs.

Retrofit coordinator will act as a bridge between the retrofit contractors and the customers. They will be the project manager for the works and will ensure the quality of the delivery.

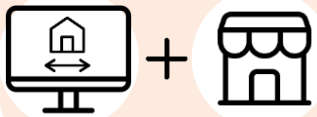
As a customer, I...

1. Awareness



Find out about the BHL service through my local network

2. Consideration



Explore the BHL service online or in the pop-up store

Visit the pop-up store for free consultation provided by a customer liaison

3. Decision

Discuss the personal home assessment report with a customer liaison

4. Delivery

Walk through the retrofit plan with a retrofit coordinator

5. Advocacy

Enjoy my upgraded home and advocate for BHL in the local network

1. Awareness

Customers find out and learn about the BHL services. This is when they become aware of the service.

Touchpoints

Customers could interact with the BHL service through a hyperlocal marketing campaign, which focuses on local messaging, networking and advocacy.

The touchpoints could be local promotions, pop-up stores, local events and local advocates.

This would be underpinned by wider, targeted PR and marketing tactics to generate awareness and prompt further exploration of the service.

Messaging

Simple messages about the core benefits of the service to draw in potential customers and encourage them to find out more, via the website or a community-based event:

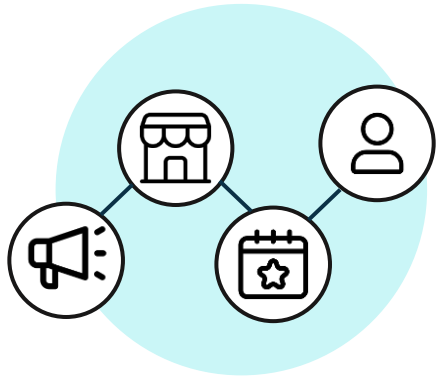
Support to help you make your home greener, warmer and more energy-efficient

This will be underpinned by the core messages about the service:

- Making energy-saving easier and more affordable
- Expert support to make informed decisions
- Personalised to you and your home

Hypothesis

If we focus on building presence in the local area and work with early adopters, we will narrow the trust deficit so that people become more confident about investing in energy saving home upgrades.



2. Consideration – initial conversation

Customers get to know what the BHL service offers and explore potential future home improvement options based on their current circumstances.

Touchpoints

Customers visualise their future home improvements online through use of a modelling tool. The tool plugs into the EPC data on gov.uk website when available via an API to provide specific house data.

Customers can also visit the pop-up store where customer liaisons introduce the service and explore real-life case studies via the website.

Messaging

At this stage, messaging will focus on customers' individual needs and circumstances, and how the service can help them find the right solutions for them.

- Every home is different – we will help you navigate different energy-saving options and find the right solutions for you

Hypothesis

If we build an online modelling tool that visualises home improvements and likely payback for customers and can be accessed at home or at a popup store, customers will be become more confident when making investment decisions and will increase their trust in the BHL service.

2. Consideration – potential improvements

Customers discuss their future home improvement options with customer liaisons during their free consultation meeting at the popup store or via a phone call.

Touchpoints

Customer liaisons will be the main touchpoint providing consultation. They can use the online modelling tool and EPC data on gov.uk to guide discussions with customers.

They introduce and explain the service, including the home assessment fee that customers pay if they decide to use the service.

Messaging

At this stage, customers will be introduced to different options. The tone and delivery of messages will be simple, informative and supportive, helping customers to navigate options and find the right solutions for them:

- Different ways you can make your home greener and more energy efficient – reduce, produce, manage, sell
- Different types of intervention – quick improvements, home improvements, technology, smart energy use

Hypothesis

If we use EPC data on the gov.uk website to facilitate the consultation and visualise home improvements and likely ROI, we will increase customers' interest in undertaking future home improvements and confidence in the BHL service.

2. Consideration – potential financial support

Customers explore different financial options to understand how they can potentially fund the home improvement work.

Touchpoints

Up to date information will be provided on available financial products for funding works, such as government grants, green finance and smart tariff options.

There will be online and offline materials to facilitate the discussion with customers. The materials will be designed to help customers discuss options with family and friends.

Messaging

Different finance options are available, depending on your needs, circumstances and the type of energy-saving improvements you'd like to make.

- Clear, accessible and jargon-free explanations of the different options available to customers
- Supportive, reassuring information to help customers make informed choices about the right blend of finance for them

Hypothesis

If we have information on available financial products and energy tariffs available to consumers, we will increase customers' confidence and trust in the BHL service.

3. Decision

Customers decide to pay the fee and carry out a home assessment report and discuss next steps.

Touchpoints

Customer liaisons discuss the home assessment report created by retrofit assessor with customers.
They interpret the technical content of the report for customers and discuss possible next steps.

The home assessment report will be personalised so that it could be tailored to customers' circumstances and enable the customer liaison to follow up with the customer in the future.

Messaging

The home assessment report should be in simple, accessible and jargon-free language that customers with different understandings of retrofit technologies can understand.

It should include a concise, one-page summary of the options – similar to a "key facts" document that accompanies insurance policies or mortgage information so that customers are empowered to make informed, confident decisions.

Hypothesis

If we create personalised home improvement recommendations and make sure customers understand these, we will encourage customers to commence the works and have a means to engage with them at the right time in the future.

4. Delivery

Customers receive funding and home improvement works commence.

Touchpoints

Retrofit coordinators discuss the retrofit plan with customers and schedule the works accordingly with the retrofit contractors.

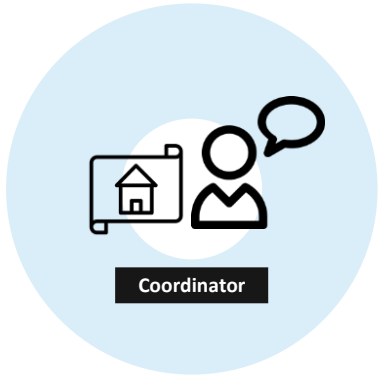
They will be main point of contact for customers and are responsible for scheduling of the work and the assuring the quality of the work conducted.

Messaging

Customers should receive a clear summary of the works to be undertaken, including a description of each stage, what to expect and what they need to do to prepare for the works.

This should include all practical information, such as timings, contractor names and contact names/ numbers.

There should be clear information about who to contact in case of issues or complaints.



5. Advocacy

Customers enjoy their upgraded home and sign up to be the advocate of the BHL service.

Touchpoints

Customer liaison maintains and continues the relationship with the customer. They stay in touch and follow up with customers regarding any future works and alert the customer to relevant changes to regulations, policy incentives and financial products.

They, with the customers permission link the customer to others considering similar improvements in order to share their learning and experience.

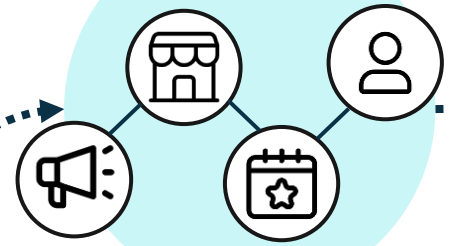
Messaging

This stage is more about feedback – capturing the key benefits and issued that the customer experienced, so that this can be reflected in case studies and future marketing materials.

Clear, documented permissions will be required to link customers with others considering similar improvements, with a range of measures offered that customers can opt into – from simple testimonials or case studies, to participation in events or open houses.

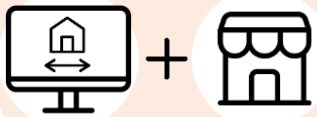
Hypotheses overview

1. Awareness



If we focus on building presence in the area and working with early adopters, we will narrow the trust deficit and make people more confident about investing in energy saving home upgrades.

2. Consideration



If we build an online modelling tool that visualises home improvements and likely ROI for customers and can be accessed at home or at a popup store, customers will be become more confident when making investment decisions and will increase their trust in the BHL service.

If we use EPC data on the gov.uk website to facilitate the consultation and visualise home improvements and likely ROI, we will increase customers' interest in undertaking future home improvements and confidence in the BHL service.

3. Decision

If we create personalised home improvement recommendations and make sure customers understand these, we will encourage customers to commence the works and have a means to engage with them at the right time in the future.

4. Delivery

5. Advocacy

Next steps

1. Prototyping the service experience

This could take place in the setting of a shop, e.g. taking over a vacant business unit for a week (see next page for example) , to test the end-to-end customer experience of a one-stop-shop including key messaging. This would focus on testing our key assumptions, and could include:

- Prototyping an online modelling tool to learn if it increases customer's confidence when regarding deciding on home improvements, tariff options, and/or finance options and their trust in the BHL service.
- Walking through the consideration stage of the journey with customers to learn if using available EPC data from gov.uk helps guide the consultation and increases customer's interest and confidence in home improvement and tariff choices.
- Prototyping messaging alternatives for the initial home assessment fee to learn the best approach to positioning the fee and communicating its purpose and value to customers.
- Role-playing the interaction between liaison and customers to refine the interaction and learn if the role of advisors increases customer's trust in the service.
- Engaging with customers to understand their appetite for financial products that support retrofit.
- Prototyping a variety of home improvement and energy efficiency reports to learn the best approach to delivering recommendations that encourage customers to undertake work or adopt new tariffs.

2. Evidencing personas and understanding customer needs

Use the prototype experience to generate the evidence needed to validate/develop our personas and define customer's needs. Insights from this activity will also help to inform messaging and engagement activities.

One stop shop prototype example

The Know Sugar shop

The Know Sugar Shop opened to test an idea over two days.

The Know Sugar Shop pilot took the form of a non-transactional, interactive retail space where visitors were provided with service prototypes to test the idea.

In the Know Sugar Shop, qualitative feedback was gathered to understand people's response to the prototype interventions introduced in the store.

People 'popped in' for a quick look out of curiosity, but the average time spent in the shop was in the order of 20 minutes.