



Programme Area: Smart Systems and Heat

Project: Value Management

Title: Overcoming barriers to smarter heat solutions in UK homes

Abstract:

Annexe 1a: Case studies. This report was initially produced in March 2015. The detailed information and analyses documented within may be out of date with current thinking.

Context:

This project studied how value can be delivered across a smart energy value chain - in the context of the UK. It built a clear understanding of how smart energy systems can deliver combined consumer value alongside commercial value for market participants - producers, suppliers, distributors. The analysis will help to make the commercial deployment of smart energy systems more likely. This £600,000 project was delivered by Frontier Economics, a leading economic consultancy.

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Overcoming barriers to smarter heat solutions in UK homes

Annexe 1a: Case studies

PREPARED FOR THE ETI

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1 Introduction

The transition to a low-carbon economy will involve the application of many new technologies. Because of their newness, there is limited evidence on the drivers of uptake from within the heat sector.

To help us develop a greater understanding of uptake, we have looked at case studies of uptake from other sectors. We chose these case studies for the following reasons:

- uptake of a new proposition has occurred;
- the demand side characteristics are similar; and
- the supply side characteristics are similar.

For each case study, we have asked the following questions:

- Which of the barriers and risks that are important to uptake in the SSH sector are important to uptake in the case study sectors and why?
- How do these vary by customer type?
- How have these barriers and risks been overcome?

We cover the following case studies in this annexe¹:

- mobile phones;
- mortgages;
- boiler insurance;
- dynamic teleswitched meters and tariffs;
- Nest; and
- the motor industry.

In the remainder of this annexe, we first summarise our main conclusions, before setting out our findings for each case study.

¹ Case studies on the water industry, on the rollout of gas networks in Northern Ireland and on pensions are contained in the solutions annexe.

2 Summary of findings

- **Consumers focus on near term costs and benefits², placing a high weight on ‘free’ technology received up front.** Focusing on the near term is a very prevalent feature of consumer decision making.³ This focus means customers do not realise the loss of option value from long term commitments, and put a lot of weight on the ‘free’ handset that they receive at the start of the contract or as an upgrade during a contract. This enables mobile companies to meet consumers’ preferences for upgrading their phones as new technology comes out, while recovering the costs over the contract period.
- **Even where consumers engage in extremely large financial decisions (e.g. in understanding and choosing a mortgage product⁴), their decisions are often suboptimal in an economic sense.** Despite higher levels of engagement, cognitive barriers are evident in decision making in the mortgage market requiring costly regulatory intervention to try and improve customers’ choices. This is relevant to smart heating where the degree of financial complexity can be high (e.g. due to long payback periods). It should not therefore be assumed that even if engagement barriers can be overcome, consumers will be able to make economically optimal decisions.
- **There are opportunities from leveraging existing relationships.** Where consumers have already accepted technology and learnt how to use it, using the same interface to operate smart heating systems may overcome barriers. Smart thermostats such as Hive use customers’ mobile phones to operate the thermostat and this appears to be popular with users. Links to known brands, such as Nest’s relationship with Google, can also help raise awareness of this new technology among customers that may otherwise be disinterested. The smart home technology market is one that has interested many big and premium brands, as shown for example by Nest being able to interact with Mercedes cars to understand when the consumer is away from or travelling home.

² Oren Bar-Grill and Rebecca Stone, Mobile Misperceptions, Harvard Journal of Law & Technology

³ For example, Laibson, D., 1997, Golden eggs and hyperbolic discounting, The Quarterly Journal of Economics, May 1997

⁴ For example, evidence from the USA suggests that only a small minority of customers (11%) choose a mortgage without shopping around. Collins, J. Michael (2011), ‘Mortgage Mistakes? Demographic Factors Associated with Problematic Loan Application Behaviors’, Journal of Family and Economic Issues, 32: 586-599.

- **A strategy for data sharing is crucial.** Experience of data sharing preferences in the mobile sector emphasises the role of strong regulation to enforce data privacy. **It also shows what may make consumers willing to share data:**
 - consumers can be happy to share data when they perceive they get benefits in return;⁵
 - the extent of the control consumers have over the data that they can share also shapes their willingness to share data,⁶ and
 - the type of company taking the data also matters, with greater trust of mobile operators compared to online platforms such as Google, Facebook and mobile apps.⁷

- **High take up of boiler insurance indicates the importance of managing risk and reducing hassle.** The boiler insurance market covers an estimated 36% of households, with the wider home emergency insurance market growing significantly in the last decade, with 13.9m contracts now compared to 4.5m in 2004⁸. This is despite the fact that for the vast majority of customers, boiler insurance works out more expensive when compared to paying for a boiler service once a year, and required services and repairs on an *ad hoc* basis⁹. Take up despite this provides evidence that a large number of consumers both care more about lump sum costs than ongoing costs, and really wish to avoid hassle.

- **Experience in the boiler insurance and smart thermostat markets shows that energy suppliers are increasingly broadening the set of services that they offer alongside supply.** All six of the major energy retailers (SSE, Scottish Power, E.On, EDF, RWE and Centrica) operate in

⁵ <http://www.pwc.com/sg/en/tice/assets/ticenews201208/consumerintelligence201208.pdf>

⁶ <http://www.pwc.com/sg/en/tice/assets/ticenews201208/consumerintelligence201208.pdf>

⁷ http://europa.eu/rapid/press-release_SPEECH-13-720_en.htm

⁸ Data Monitor (2012) UK Home Emergency Insurance 2012: An analysis of the UK home emergency insurance industry

⁹ For example, Which? analysed the results of their boiler reliability survey against the cost of a typical boiler servicing contract (£183), and found that 93% of people would be at least £50 better off in any given year if they didn't pay for a boiler servicing contract and instead had their boiler serviced by an independent repairer once a year, at an average cost of £70, and paid for any repairs and faults as and when they happen. <http://www.which.co.uk/home-and-garden/heating-water-and-electricity/guides/how-to-choose-the-best-boiler-cover/>

the boiler insurance market.¹⁰ Centrica and RWE also market tariffs with Hive and Nest thermostats respectively.

- Experience with the Nest smart thermostat suggests that the following are important in addressing smart heat barriers:
 - **ensuring an appealing and simple consumer interface;**
 - **engendering trust by joining up with other companies that are considered superior and trusted in their industry; and**
 - **marketing the technology as a means of reducing energy costs.**

- **In markets with new, unfamiliar products, business model providers have offered risk transfers.** The model of electric vehicle (EV) finance where the battery is leased separately from the vehicle is an example of this. Risk transfer can also be supported by policy, for example as has been the case for EV subsidies, which specify performance guarantees that manufacturers must provide.¹¹

- **Designing user interfaces to be simple and fun ensures the widest range of consumers find the technology acceptable.** This has been found in the mobile market, a market where smart phones in particular are complex pieces of technology. However, core features (e.g. voice, texting) have been developed to be simple and user-friendly, ensuring acceptability to consumers. **The research into consumers with dynamic teleswitched (DTS) meters also shows what happens when this isn't achieved: there low understanding and engagement resulted in inefficient use of heating systems.** This reinforces the importance of getting the interfaces right in the smart heat market.¹²

- **Segmentation and branding are important.** The mobile market shows the importance of providing different product offerings to attract consumers with different characteristics (for example, those that want the latest technology; those that want a simple solution; those that are worried about cost).

¹⁰ See for example, Which: <http://www.which.co.uk/home-and-garden/heating-water-and-electricity/reviews/boiler-servicing-contracts/>

¹¹ The Plug-in Car Grant offered by DECC for purchasing an EV is conditional on the vehicle and battery having three-year warranties, with an option to extend the battery warranty by two years. The three year vehicle warranty can alternatively be met by providing a 60,000 mile warranty. See: <https://www.gov.uk/government/publications/plug-in-car-grant/plug-in-car-grant-vehicles>.

¹² Big Sofa for Ofgem, 2014, Understanding the consumer experience of Dynamically Teleswitched (DTS) meters and tariffs, available at: <https://www.ofgem.gov.uk/ofgem-publications/91259/understandingthecustomerexperienceofdtsmetersandtariffsfinalversion.pdf>

3 Mobile phones

Designing user interfaces to be simple and fun for core features ensures the widest range of consumers find the technology acceptable. Segmentation and branding are also important in the mobile market.

Consumers have shown willingness to share data in the mobile market, under certain conditions. This suggests that partnering with mobile phone companies and strong regulation to enforce data privacy may be useful for the low-carbon heating sector.

It is useful to consider the mobile phone sector as there has been both significant technological change and uptake of new technologies by consumers.

3.1.1 Barriers

Complexity

Like HEMS and heat pumps, mobile phones, especially smart phones, are complex pieces of technology. However, the user interface has been developed to be simple and fun.

Ofcom has found that complexity can be a barrier at every stage of interaction with communications equipment (from understanding what technology to purchase to connecting, setting up and using devices)¹³. Given the high penetration of mobile technologies (over 100% in some groups), it is clear that this complexity has not presented a significant barrier to take up of new technologies in the mobile sector. So how has the mobile sector overcome the issue of complexity, and what can we learn for the heating sector?

First, while mobile phones contain many complex features, which are not always easy to use, the features that most people use (voice, texting) have a simple and user-friendly design. Focussing on the usability of these core features ensures the widest range of consumers find the phones acceptable.

Second, while mobile technologies can differ substantially in very technical ways, marketing does not focus on this. Instead it tends to focus on price, and presenting the features as new and exciting. This could apply to the design of technologies such as heat pumps and HEMS. In addition, linking heating

¹³ <http://stakeholders.ofcom.org.uk/binaries/research/tv-research/easeofuse.pdf>

controls to familiar technologies (i.e. mobiles) can be seen as a way to overcome complexity issues, and this is already the case in marketing of smart thermostats¹⁴.

It is also notable that complexity seems to affect consumer groups differently in the mobile sector, depending on age. Complexity of mobile phones affects both young and old groups, but the issue is most prominent amongst older users¹⁵. Smart phone ownership is higher (80%) for younger consumers, whereas 14% of older consumers own a smart phone¹⁶. This is likely to be related to differences in technological knowledge between age cohorts, with older cohorts having lower technological knowledge on average.¹⁷

Lack of trust

Trust around data collection and use may be an issue in relation to HEMS. There are useful lessons to be learned on this from the mobile sector.

- Consumers can be happy to share data when they perceive they get benefits in return¹⁸. In their marketing, mobile companies tend to tell consumers that they use their data to provide targeted services and improve their business proposition. This suggests that consumers may be happy to allow HEMS to use their data, if the benefits in terms of a tailored heating system are made apparent.
- The extent of the control consumers have over the data that they can share also shapes their willingness to share data¹⁹. One aspect of this control that consumers appear to particularly like is the supply of services that allow them to manage the risk that they will lose their data²⁰. Mobile operators have addressed this by allowing customers to store data in SIM cards, and introducing sync devices with PCs.
- The type of company taking the data matters. Consumers happily give away a lot of data to mobile operators, but show less trust to online platforms such as Google, Facebook and mobile apps²¹. This is the despite the fact

¹⁴ For example, the statement “Control your heating from your mobile” is prominent on Hive’s website (<https://www.hivehome.com/>).

¹⁵ Study by Ziefle and Bay (2005) – cited in Ofcom paper.

¹⁶ Ofcom, 2014, The Communications Market Report, available at: http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr14/2014_UK_CMR.pdf.

¹⁷ Ofcom, 2014, The Communications Market Report

¹⁸ <http://www.pwc.com/sg/en/tice/assets/ticeneews201208/consumerintelligence201208.pdf>

¹⁹ <http://www.pwc.com/sg/en/tice/assets/ticeneews201208/consumerintelligence201208.pdf>

²⁰ Oren Bar-Grill and Rebecca Stone, Mobile Misperceptions, Harvard Journal of Law & Technology

²¹ http://europa.eu/rapid/press-release_SPEECH-13-720_en.htm

that mobile operators often sell the data to other business sectors (i.e. retail shops) in return for a fee. For instance, Smart Steps is a data analytics tool from Telefónica which shows trends on how many people visit an area across the UK by time, gender and age using anonymised and aggregated data from the O2 mobile phone network²². One possibility is that tight regulation over many years has built strong customer trust in the sector²³. There are two potential consequences of this for the low-carbon heating sector: partnering with mobile phone companies and emphasizing the role of strong regulation to enforce data privacy may be helpful.

Consumers' tendency to focus on costs and benefits in the near term

Mobile companies segment the market depending on the broad preferences of different types of consumers (for example those that are attracted to the latest technologies, those that like simplicity, those that want the lowest cost).

In the mobile sector, there are numerous tariffs available, coupled with different lock in clauses and termination fees. Different operators offer different handset subsidies which add further complexity. It is very difficult to estimate the true cost of contracts, since it will partly depend on the use patterns of consumers²⁴. Mobile providers have addressed this issue partially by coming up with marketing strategies to present over-simplistic categories of tariff plans – explicitly targeted to different customer groups. An example is Orange, who introduced a range of tariff plans, each corresponding to key types of users' behavioural characteristics. Orange used animals to present each customer group – allowing customers to identify the animal that best matches their behavioural characteristics, and consequently identify the right plan for them.²⁵ Explicitly branding different bundles of interventions to different customer groups could make it easier for customers to understand the bundles that they would most benefit from.

Mobile technologies involve high upfront costs coupled with ongoing running costs, comparable for example to the costs of HEMS technologies²⁶. Mobile handsets have become increasingly expensive in recent years, with the added

²² A study by the European Commission found that 92% of Europeans were concerned about mobile apps collecting their data without their consent. <http://dynamicinsights.telefonica.com/author/jaime>

²³ E.g. European Directive – Electronic Data Privacy.

²⁴ For example, the time of the day that customers use their mobile phones (some providers offer unlimited weekend calls), the duration of the call and the provider that they will call.

²⁵ <http://stakeholders.ofcom.org.uk/binaries/research/tv-research/easeofuse.pdf>

²⁶ This only applies to domestic consumers. In UK the businesses accounted for 14% of all mobile connections at the end of 2013. http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr14/2014_UK_CMV.pdf

capabilities of smart phones. Unlike heating technologies, mobile technologies have a very short time span before they become outdated with new technologies.

The mobile industry has responded to this by offering ‘post-paid’ contracts which spread the cost of handsets for up to 3 years. This option would also be possible in the low-carbon heating sector. However, there are two important differences that may mean this would be more challenging in the heating sector. First, higher upfront costs associated with heating technologies may mean that the contract lengths may have to be longer, to allow monthly fees to be kept at a reasonable level. Second, mobile operators have near zero marginal costs in the voice and data services, which gives them greater flexibility in the pricing. Running costs for heating services (e.g. in terms of energy supply) on the other hand can be significant.

On the other hand, mobile companies face the challenge that people like to upgrade their phones as new technology comes out. In some ways, consumers’ tendency to focus on near term costs and benefits may help reduce this challenge²⁷. Customers focusing on the near term costs and benefits do not realise the loss of option value from long term commitments as they tend to heavily discount the future, and put a lot of weight on the ‘free’ handset that they receive at the start of the contract. In addition to this, mobile customers may also be offered ‘free’ handset technology upgrades available within the contract period, which minimise the downside of being locked in a specific technology for more than a year.

Recognising that some consumers prefer to keep their costs under control, the mobile industry also offers ‘pre-paid’ propositions, which allow budget-conscious consumers to access lower entry cost contracts, and make it easier for them to control their bills.

²⁷ Oren Bar-Grill and Rebecca Stone, *Mobile Misperceptions*, Harvard Journal of Law & Technology

4 Mortgages

A suboptimal choice can cost thousands over the course of a mortgage and this appears to motivate many people to engage in understanding and choosing a product.²⁸ Cognitive barriers are nonetheless evident in decision making and can result in suboptimal choices. This is relevant to smart heating where the degree of financial complexity can be similar (e.g. due to long payback periods), and could result in suboptimal outcomes even where engagement barriers are overcome.

It is useful to look at the mortgage market because there are similarities with the smart heat market in terms of engagement and decision cycles. In both markets there is financial risk, and customers must take a long run financial outlook. In addition, getting a mortgage (or re-mortgaging) can be an effective trigger point for taking up smart heat interventions, by allowing consumers to access finance for the intervention through their mortgage. This makes the mortgage market important to understand in relation to smart heat take up.

A key take away from the mortgage market is that where financial incentives are large enough, many, but not all, of the barriers relating to interest, awareness, perception and decision making fall away. A suboptimal choice can cost thousands over the course of the mortgage and this appears to motivate many people to spend some time thinking about the options and choosing.²⁹

Despite this, consumers' tendency to focus on near term costs and benefits is still evident in the mortgage market. Mortgage contracts are getting longer, and customers are often drawn in at teaser rates without looking at the long term rates³⁰. A downside of this is that it may lead them to overestimate their ability to pay back their mortgage.

Cognitive barriers are also evident. For example, many consumers did not understand the pricing of payment protection insurance (PPI) products, and what

²⁸ For example, evidence from the USA suggests that only a small minority of customers (11%) choose a mortgage without shopping around. Collins, J. Michael (2011), 'Mortgage Mistakes? Demographic Factors Associated with Problematic Loan Application Behaviors', *Journal of Family and Economic Issues*, 32: 586-599.

²⁹ For example, evidence from the USA suggests that only a small minority of customers (11%) choose a mortgage without shopping around. Collins, J. Michael (2011), 'Mortgage Mistakes? Demographic Factors Associated with Problematic Loan Application Behaviors', *Journal of Family and Economic Issues*, 32: 586-599.

³⁰ FPC, the Bank of England (June 2014) 35: Financial Stability Report

they would get from this coverage.³¹ In addition, there was evidence of use of rules of thumb by consumers when comparing prices (focusing on mortgage interest rates but not PPI pricing).³² This could result in sub-optimal product choices by consumers (by not focusing on the overall cost across both the mortgage and insurance). In addition, this type of decision making may impact on pricing structures offered by lenders (e.g. providing incentives to cross-subsidise the price of the mortgage product with the insurance product). This suggests risks of adverse outcomes for consumers as a result of cognitive barriers in decision making. This is relevant for considering take up of low carbon heating technologies, where long payback periods and different cost structures result in similar financial complexities.

Consumers' tendency to focus on near term costs and benefits and cognitive barriers have had major consequences in the mortgage sector, to the extent that they resulted in people taking up mortgages that they could not pay. Over-borrowing increases the likelihood of defaulting on mortgages. There are externalities from defaults: home repossessions can result in increased risk of foreclosure in the surrounding area, by decreasing the prices of nearby properties³³.

The market does provide services to mitigate poor decision making. There are several websites devoted to giving more information and clarifying options³⁴. However, because of the importance of the default externality, the Government has introduced a new policy to reduce the risk of over-borrowing: The Mortgage Market Review (MMR). This applies affordability checks, and constraints on the number of mortgages made to multiples of the customer's income³⁵. As part of this reform it is mandatory to have advice for taking out a mortgage, unless you are a high net worth individual. Stress testing mortgage applications as part of this process helps customers see past short term teaser rates into what future costs are going to be.

Mandatory advice makes individuals³⁶ aware of process and risks, but can add to hassle costs. With the new affordability measures, the meeting between the mortgage applicant and the lender to establish spending patterns can now last up

³¹ The Financial Conduct Authority (FCA) (April 2013) 'Applying behavioural economics at the Financial Conduct Authority', Kristine Erta, Stefan Hunt, Zanna Iscenko, Will Brambley

³² The Financial Conduct Authority (FCA) (April 2013) 'Applying behavioural economics at the Financial Conduct Authority', Kristine Erta, Stefan Hunt, Zanna Iscenko, Will Brambley

³³ The Financial Conduct Authority (FCA) (April 2013) 'Applying behavioural economics at the Financial Conduct Authority', Kristine Erta, Stefan Hunt, Zanna Iscenko, Will Brambley

³⁴ This avoids a potential Principal-Agent problem, as previously outlined.

³⁵ The Financial Policy Committee (FPC), the Bank of England (June 2014) 35: Financial Stability Report

³⁶ High net worth individuals are exempted

to several hours³⁷. This is a new policy so its success is as yet untested. However it may be that lessons can be taken about whether face to face guidance helps consumers make better long term financial decisions.

³⁷ *The Financial Times* (25/04/2014), 'Will you pass UK lenders' tough new mortgage test?' <http://www.ft.com/cms/s/0/f5443022-ca32-11e3-bb92-00144feabdc0.html#axzz3INlgfk7H>

5 Boiler insurance

The boiler insurance market covers an estimated 36% of households, with the wider home emergency insurance market growing significantly in the last decade, with 13.9m contracts now compared to 4.5m in 2004³⁸. For the vast majority of customers, boiler insurance works out more expensive when compared to paying for a boiler service once a year and required services and repairs on an *ad hoc* basis. Take up despite this provides evidence that a large number of consumers both care more about lump sum costs than ongoing costs, and really wish to avoid hassle.

The boiler insurance market can give us insights into people's preferences for risk management in the heating context, as well as preferences for reducing hassle and consumers' tendency to focus on near term costs and benefits.

Both installers and manufacturers of boilers offer insurance contracts. These are typically structured like an insurance contract. Customers sign contracts (usually annual) to receive repairs and replacements up to a specified value in the event of a fault or failure of the boiler in return for monthly payments. The precise level of cover varies. At the cheaper end, there may be an excess charge payable for repairs and a relatively low maximum value of repair. In contrast, more expensive policies may have no limit to the value of repairs included.

Private and social landlords are responsible for ensuring there is adequate heating in rental properties. As a result, consumers in this market are homeowners and landlords, rather than tenants.

All six of the major energy retailers (SSE, Scottish Power, E.On, EDF, RWE and Centrica) operate in this market, along with larger independents such as The AA, and Homeserve and boiler manufacturers such as Valliant and Worcester-Bosch³⁹.

Uswitch estimate that around 36% of households are covered by boiler insurance.⁴⁰ Centrica are the largest in the domestic maintenance market, with 8.9

³⁸ Data Monitor (2012) UK Home Emergency Insurance 2012: An analysis of the UK home emergency insurance industry

³⁹ See for example, Which: <http://www.which.co.uk/home-and-garden/heating-water-and-electricity/reviews/boiler-servicing-contracts/>

⁴⁰ Uswitch survey 2013, <http://www.uswitch.com/media-centre/2013/10/boiler-bother-leaves-householders-facing-314-bill/>

million contracts in total.⁴¹ Homeserve had 2.7 million customers in 2012⁴². The operations of other providers are somewhat smaller, for example with E.On covering 126,000 customers in 2011.⁴³ Home emergency insurance usually covers plumbing and electrical emergencies as well as boilers. This wider market has grown significantly in the last decade, with 13.9m contracts now compared to 4.5m in 2004⁴⁴.

For the vast majority of customers, boiler insurance works out more expensive when compared to paying for a boiler service once a year, and required services and repairs on an *ad hoc* basis⁴⁵.

Marketing of boiler insurance tends to focus its ability to deliver peace of mind,⁴⁶ as well as avoiding unexpected large bills in the event of boiler breakdown. A survey by Uswitch also suggests that risk management is the key driver of uptake⁴⁷. Boiler repair or replacement can entail very high upfront costs, and some people appear to have a preference to pay an ongoing payment to avoid these costs.

On the one hand, investing in a boiler contract suggests a consumer is looking ahead. However, boiler service contracts also show that people will focus on near term cost more. Many boiler cover companies quote only the cost of the first year of cover, and then raise the cost they charge in the second year (by as much as 300% in some cases).⁴⁸ In addition, the fact that people take up boiler insurance, when on average not having insurance will be lower cost, provides evidence that lump sum costs mean more to consumers than ongoing costs.

⁴¹ Centrica (2012) *Annual Report 2011*

⁴² Homeserve (2012) *Annual Report 2012*

⁴³ E-on (2012) *Annual Report 2011*

⁴⁴ Data Monitor (2012) UK Home Emergency Insurance 2012: An analysis of the UK home emergency insurance industry

⁴⁵ For example, Which? analysed the results of their boiler reliability survey against the cost of a typical boiler servicing contract (£183), and found that 93% of people would be at least £50 better off in any given year if they didn't pay for a boiler servicing contract and instead had their boiler serviced by an independent repairer once a year, at an average cost of £70, and paid for any repairs and faults as and when they happen. <http://www.which.co.uk/home-and-garden/heating-water-and-electricity/guides/how-to-choose-the-best-boiler-cover/>

⁴⁶ For example: Uswitch: "If you'd like the security of having your boiler and central heating checked regularly and knowing that someone will come round in case of a boiler breakdown, then you should consider heating cover." <http://www.uswitch.com/boilers/guides/boiler-insurance/>

⁴⁷ Uswitch found that 34% considering taking out boiler cover are doing so because they wouldn't be able to afford any financial surprises this winter, (33%) are looking for peace of mind as they are worried that this winter will be another cold one, while over a quarter (27%) are worried that their boiler is old and more likely to breakdown. <http://www.uswitch.com/media-centre/2013/10/boiler-bother-leaves-householders-facing-314-bill/>

⁴⁸ Which? <http://www.which.co.uk/home-and-garden/heating-water-and-electricity/guides/how-to-choose-the-best-boiler-cover/>

The wish to avoid hassle is also likely to be a driver. Boiler maintenance contracts generally offer 24-hour, 365-day cover for boiler failure. Hiring an engineer on an ad hoc basis can be more difficult, particularly on weekends or during holidays.

The reasonably high levels of take up of boiler insurance suggest that it has been possible to overcome awareness and interest barriers for this product. This may be partly down to the strategy of firms in bundling boiler insurance with existing products. Energy retailers offer additional maintenance services for households at the point of sale of energy, a move into energy services that is likely to grow as smart meters are rolled out and additional energy services become profitable to offer. HomeServe maintain relationships with “affinity partners”⁴⁹ providing complementary products which can then be bundled with Homeserve insurance at the point of sale.

⁴⁹ Homeserve affinity partners cover 24million households in the UK, roughly 90% of the total number of households. <http://www.homeserveplc.com/download/ar2012.pdf>

6 Dynamic teleswitched (DTS) meters and tariffs

Consumers with DTS meters were found to have low understanding and engagement, resulting in inefficient use of heating systems and appliances. The finding reinforces the importance of a simple and engaging consumer interface found in other sectors, by illustrating that it impacts not just on take up but also on use of smart heating. The research on consumers with DTS meters also found that engagement with electricity supply in general was low, with there being little interest in electricity supply, and with the meters considered to be the supplier's, rather than part of the home.

Recent qualitative research for Ofgem on consumers with DTS meters and tariffs provides insights on their engagement with their energy supply⁵⁰. DTS meters allow customers to be charged on a different tariff during the night, which is designed to reduce the costs of using storage heating. DTS is a special case, with these arrangements having been in place a long time, and specific concerns around whether all suppliers compete for consumers with DTS metering technology. The roll out of smart meters will enable all suppliers to offer these types of tariffs.

However, the research nonetheless provides insights on barriers to engagement with electricity supply for a specific segment of the UK domestic market. It found low understanding and engagement, resulting in inefficient use of heating systems and appliances. This was the result of the following.

- **Factors specific to DTS contributed to a lack of understanding and engagement.** This included consumers inheriting their tariff and heating systems, and DTS being more difficult to understand than other metering systems and tariffs. The research found that inertia was common, with few making a significant effort to increase their understanding.
- **Consumer characteristics also contributed to low engagement:**
 - DTS consumers found it more difficult to understand the arrangements as they were more likely to be older, less affluent, and with a lower level of education than average; and
 - many DTS consumers live in rural areas and this was associated with a greater likelihood of accepting that this restricted choice of energy

⁵⁰ Big Sofa for Ofgem, 2014, Understanding the consumer experience of Dynamically Teleswitched (DTS) meters and tariffs, available at: <https://www.ofgem.gov.uk/ofgem-publications/91259/understandingthecustomerexperienceofdtsmetersandtariffsfinalversion.pdf>

suppliers and heating types. This could be the result of lack of understanding of supplier and heating types available, or limited choice for some of these consumers (e.g. inability to connect to the gas grid)

- **More broadly, engagement with electricity supply in general was low.** The research found that consumers had little interest in electricity supply and meters, with meters considered to be the supplier's, rather than part of the home. Outside billing, most consumers had little or no contact with their supplier. For the majority of consumers, their understanding of their metering arrangements was from electricians or heating engineers, or family and friends.

7 Nest

Take up of smart thermostats, while low overall, appears to be increasing. Hive has been installed by 100,000 people in the UK after 12 months in the market.⁵¹ No such data are available for Nest due to the short life of the product in the UK, but interest in it appears to be high.

Development of the smart thermostat market to date also demonstrates that there are opportunities from leveraging existing relationships. Where consumers have already accepted technology and learnt how to use it, using the same interface to operate smart heating systems may overcome barriers. Links to known brands, such as Nest's relationship with Google, can also help raise awareness of this new technology among customers that may otherwise be disinterested.

We are looking at Nest because it has addressed some of the barriers in the heating sector for some consumers, not least awareness and interest. It is therefore relevant to examine which barriers were addressed and to what extent.

Nest is a smart thermostat allowing users to remotely control their heating through their handset, tablet or laptop. It also learns peoples' preferred temperature and it adjusts based on their personal daily schedule. It has built-in sensors that detect when the house is empty, and automatically turns down the temperature helping to save energy.

The rest of this section is structured around three questions:

- how does the Nest thermostat compare to other thermostats in the UK market?
- how attractive is the Nest nPower tariff?
- how and to what extent Nest is addressing barriers identified in the heating sector?

7.1.1 Comparison of Nest with other smart thermostats

Nest thermostat was released in the UK in April 2014. The UK price (including installation) is £249⁵². Nest thermostat provides functionality that is a step

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http://www.centrica.com/managed_content/newsandviews/2014/pdf/Nina%20Bhatia%20Energy%20Customer%20Conference%20October%2020141.pdf

⁵²

Consumers can purchase Nest without professional installation for a lower price of £179, even though professional installation is highly recommended because Nest connects to the heating system using high-voltage cables.

towards increased home automation. In 2014, Nest launched a new platform called “Works with Nest” that allows different Nest devices to interact with each other, a few examples are:

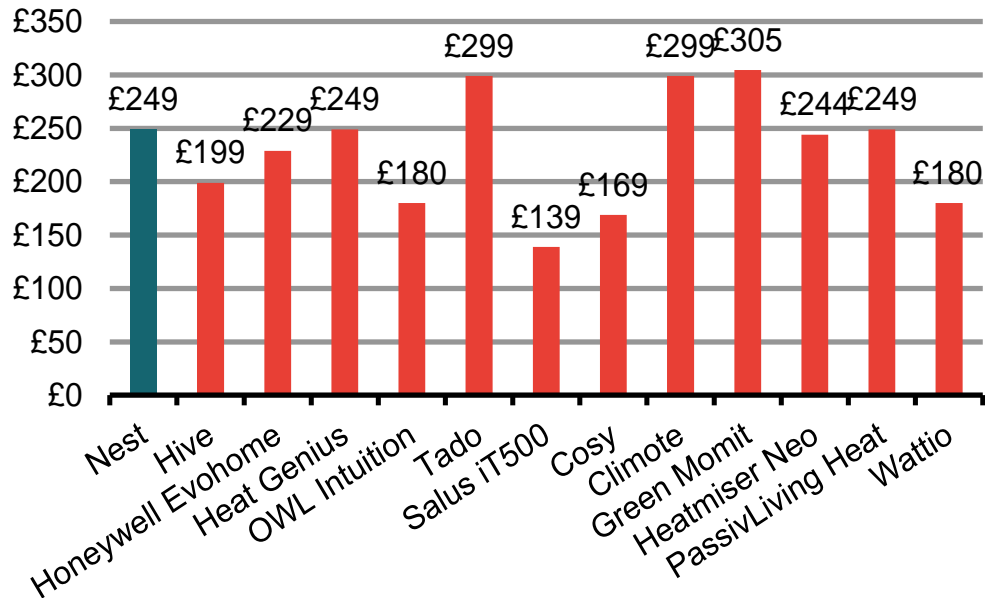
- Mercedes and Chamberlain (home garage) can be programmed to tell Nest that the user left the house or is on his/her way home;
- Dropcam, which is a security camera links to the Nests’ smoke alarm device and automatically saves footage if the alarm goes off such that consumers can see what happened; and
- there is a Nest bracelet that will tell Nest when users are awake or asleep and will adjust temperature accordingly.

Nest also offers opportunities to save energy when occupants are wasteful, for example if they forget to turn off or turn down the heat.

Despite the fact that Nest is one of the most expensive smart thermostats and its offer is not significantly different to some of the other thermostats in the UK, it has received a lot of interest.

Figure 1 shows how Nest’s cost compare to the cost of other smart thermostats. There is some correlation between cost and functionality:

- A range of smart thermostats (i.e. Hive, Owl Intuition, Salus iT500, Cozy and Wattio) are all less expensive than Nest. But at the same time they offer less functionality than Nest. For instance, they do not have ‘learning’ features or motion detection like Nest.
- On the other hand, other thermostats like Tado offer more capability than Nest. Tado is completely hands off, in the sense that it doesn’t require consumers to ‘train’ it first (unlike Nest), and uses occupants’ smartphones to detect when the last person left the house.

Figure 1. Cost comparison Nest vs. other UK smart thermostats

Source: Recombu, Frontier Economics

Despite the wide variety of smart thermostats available in the UK market, Nest and Hive (of British Gas) have received most interest. British Gas revealed that Hive has been installed by 100,000 people in the UK after 12 months of its release in the market.⁵³ No such data are available for Nest due to the short life of this product in the UK.

Nest and Hive have followed different approaches for offering consumers a smarter home heating system:

- Hive has put complete control in the hands of the users. It allows users to adjust their heating remotely and doesn't adjust the temperature automatically to match consumers' preferences.
- Nest, although allowing consumers to have control over their heating, adjusts heating remotely based on its learning from consumers' temperature preferences and daily routine.

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http://www.centrica.com/managed_content/newsandviews/2014/pdf/Nina%20Bhatia%20Energy%20Customer%20Conference%20October%2020141.pdf

Table 1 shows an initial comparison between Nest and Hive in terms of price, functionality and retail availability. Hive is cheaper, but offers less intelligent capability than Nest as described above. Both products are available through energy suppliers, bundled with a fixed energy tariff.

Table 1. Comparison of Nest and Hive

	Nest	Hive (British Gas)
Price	<ul style="list-style-type: none"> □ £249 (incl. installation) □ Available for multi-zonal heating 	<ul style="list-style-type: none"> □ £199 (incl. installation) □ Not available for multi-zonal heating.
Savings	<ul style="list-style-type: none"> □ Claims £150 savings on heating bill a year. 	<ul style="list-style-type: none"> □ Also claims £150 savings on heating bill/year.
Key functionality	<ul style="list-style-type: none"> □ Allow users to control their heating remotely through a device. □ Can be re-programmed based on peoples' behaviour, incl. a motion sensor that detects when the house is empty and automatically turns down the temperature. 	<ul style="list-style-type: none"> □ Allow users to control their heating remotely through a device. □ Doesn't include intelligent features yet. In 2014, British Gas added a location feature, where users receive a phone alert reminding them that they are arriving home or have left home in case they want to adjust their heating temperature.
Retail availability	<ul style="list-style-type: none"> □ Retail availability from Nest online store, Amazon, Apple and John Lewis. □ Available for free from nPower fixed bill tariff. 	<ul style="list-style-type: none"> □ Similar retail availability. □ British Gas customers benefit from £50 off. □ Also available for free through a fixed bill tariff from BG.

Source: Nest, Hive

In terms of savings, it is difficult to make a like for like comparison between technologies given the lack of comparable data on this area. Both Nest and Hive mention the potential for savings of £150/year on heating bills⁵⁴. This is

⁵⁴ Hive's website states: "Save up to £150 a year on your heating bills" <https://www.hivehome.com/> Npower states regarding Nest that: "According to Energy Savings Trust, installing and correctly using a room thermostat and thermostat radiator valves could save you up to £150 per year. What's more, turning your heat down by just one degree could save you an additional £75."

approximately 30% of the gas bill for space heating, which implies a significant reduction in heating costs.

The savings quoted by Nest captures only savings to customers from better management of energy consumption. It comes from analysis by the Energy Savings Trust, which stated that correcting using a room thermostat and thermostat radiator valves could save a consumer up to £150 a year⁵⁵. It is not clear that this is the appropriate benchmark for assessing the change in behaviour expected to be generated by application of a smart thermostat. In addition, it ignores that some customers may well use the smart thermostat to increase comfort levels (for example by turning heating on before coming home when previously they would have waited until they were home).

Interestingly, British Gas has the same savings quotes on annual heating bills⁵⁶. According to British Gas this was calculated using data from their smart meter customers, which implies some saving may therefore come from only smart meters as opposed to smart thermometers. Consumers seem to also perceive savings from installing smart thermostats as 70% of consumers from a sample of 2,000 users of Hive claimed that they have saved on their energy bill after they installed the thermostat⁵⁷.

Nest is capable of delivering savings through additional functionality, although this is not yet available in the UK:

- **Nest offers users a Rush Hour Reward for avoided summer air-conditioning peak in the US.** Current payments to US customers on the Nest “Rush Hour Rewards” tariff are in the order of £50 per year. Rush Hour Rewards is different to a standard Demand Side Response programme in that:
 - it can adjust energy to avoid peak hours in a number of ways depending on what Nest has learnt for the user – making sure consumers are comfortable during the peak hours⁵⁸; and

https://customerservices.npower.com/app/answers/detail/a_id/1195/~how-much-can-i-save-with-nest%3F

⁵⁵ https://customerservices.npower.com/app/answers/detail/a_id/1195/~how-much-can-i-save-with-nest%3F

⁵⁶ <https://www.hivehome.com/>

⁵⁷ <http://www.telegraph.co.uk/finance/personalfinance/energy-bills/11227168/Control-your-heating-by-phone-and-save-150.html>

⁵⁸ <https://nest.com/support/article/What-is-Rush-Hour-Rewards>

<http://www.sustainabilityfirst.org.uk/docs/2014/Paper%2011%20%96%20How%20could%20electricity%20demand-side%20innovation%20serve%20customers%20in%20the%20longer%20term-%20Frontier%20Economics%20&%20Sustainability%20First%20-%20April%202014.pdf>

- the user remains in control of their heating, so consumers can always adjust temperature during Rush hour instead of the energy company taking away control during the peak hour.

In the US, energy companies that have a partnership with Nest will pay ‘rewards’ through a mixture of ways⁵⁹:

- flat fee per cooling/heating season;
 - payment or rebate for Nest ‘bundled’ into a contract; and
 - payment per event (calculated in terms of difference against a normal consumption benchmark).
- **Seasonal savings services are included in the nPower fixed tariff plan.** Seasonal savings will automatically make small tweaks in some temperatures in consumer’s schedule to make them more efficient. It will do so in two ways⁶⁰:
 - seasonal savings will see if there’s any room for improvement in the night time temperatures or when users are away from home– where usually the biggest improvements happen and they are often unnoticeable; and
 - seasonal savings may adjust temperature when consumers are home – but typically those adjustments will be very subtle to make sure consumers stay comfortable.

Seasonal savings are different to Rush Hour Rewards in that the tweaks in the temperature are made in order to make consumers’ heating profile more efficient rather than reduce load at peak hours. Also, those adjustments will typically be made during night hours that are off-peak, because that’s when consumers could benefit the most for energy savings without comfort being compromised.

7.1.2 How has Nest addressed barriers?

Actual features

Nest’s technology and associated value proposition that focuses on end outcomes both aim to reduce hassle. By optimising consumption while

⁵⁹<http://www.sustainabilityfirst.org.uk/docs/2014/Paper%2011%20%96%20How%20could%20electricity%20demand-side%20innovation%20serve%20customers%20in%20the%20longer%20term-%20Frontier%20Economics%20&%20Sustainability%20First%20-%20April%202014.pdf>

⁶⁰ <http://nest.com/support/article/What-is-Seasonal-Savings>

ensuring comfort, Nest reduces consumers' need to engage with their heating systems.

Also, as **Nest is wireless, the hassle associated with installation is deemed to be relatively low.**

Awareness and interest

Nest has used design to overcome awareness and interest barriers. It has been designed with iOS and Android interfaces to indicate that it looks good and is easy to use. It has been characterised as an “iPhone on the wall” and has been created by the designers of iPod, which makes it a desirable product.

Nest has been joining up with other companies that are considered superior in their industry and are trusted which might help consumers build trust in Nest product and make it more widely desirable, for instance:

- linking the product with Mercedes might make the product more desirable and build trust for the product; and
- using a bracelet to collect information on behaviour – which might not be perceived as intruding by consumers given that they have control over the bracelet (whether to take it off or not). The recent use of bracelets to track fitness is a parallel to this.

Also, Nest is explicitly branded as a means to save energy costs, with a claimed payback period of approximately 2 years.

Financing

Nest has a relatively high upfront cost of £249. However, this cost is not so large that it cannot be recouped from customers over a two-year contract. **The bundle offered by nPower which spreads the cost of Nest across a 2 year contract can overcome the financial barrier faced by budget-constrained customers.**

8 Motor industry

The model of electric vehicle (EV) finance where the battery is leased separately from the vehicle itself is an example of risk transfer from consumers to manufacturers. Risk transfer has also been supported by policy subsidising EVs.⁶¹

The evidence on overall carbon emission requirements placed on manufacturers of passenger vehicles suggests that these requirements may be an effective alternative to mandating standards at an individual vehicle level.

We looked at the motor industry as it provides an example of a new finance proposition being used to address risks associated with taking up electric vehicles (EVs). This has read across to the smart heat market where there are similar risks and uncertainty associated with taking up new, unfamiliar, technologies; and the need for finance is likely to be high (e.g. for interventions such as heat pumps with high upfront costs). We also look at the use of fleet emissions requirements on manufacturers, which can be used as an alternative to mandating emission requirements for individual vehicles in driving reduced emissions.

8.1.1 EV finance

The performance of EVs and EV batteries, which affects depreciation of the EV and its battery, may be poorly understood by consumers or finance providers, resulting in high perceived risk.⁶² Depreciation risk is therefore likely to be a more important barrier for EVs relative to conventional cars, given that EVs are less well established, the technology is changing more rapidly, and EVs may be poorly understood by consumers. This may reduce consumer willingness to take up EVs.

The typical finance model for cars is a ‘personal contract plan’ (PCP). This is a loan secured against the car over a fixed period (typically 2-4 years), with the option to make a final ‘balloon’ payment to buy the car at the end of the term, to return the car to the dealer, or to upgrade to a new car financed on a PCP. This is widely used, with 64% of new cars bought using a PCP.⁶³

⁶¹ The Plug-in Car Grant offered by DECC for purchasing an EV is conditional on the vehicle and battery having three-year warranties, with an option to extend the battery warranty by two years. The three year vehicle warranty can alternatively be met by providing a 60,000 mile warranty. See: <https://www.gov.uk/government/publications/plug-in-car-grant/plug-in-car-grant-vehicles>.

⁶² Frontier Economics for the Committee on Climate Change, 2014, Reducing the cost of capital for household low-carbon investment decisions

⁶³ <http://www.economist.com/news/britain/21595046-increasingly-popular-way-finance-car-buying-has-helped-boost-sales-fast-lane/>

A finance proposition for EVs has been developed that enables consumers to take up an EV while the risk associated with the battery performance and depreciation is taken by the manufacturer. Under this model, EV manufacturers such as Nissan and Renault offer a PCP for the EV itself, while the EV battery is leased separately, with a guarantee over its performance.⁶⁴

Leasing the EV battery addresses high and uncertain depreciation rates, by:⁶⁵

- transferring the risk around the battery performance away from the consumer; and
- enabling the battery capital cost to be spread over a longer time period compared to a typical PCP period.

This type of risk transfer has also been supported by policy. The Plug-in Car Grant offered by DECC for purchasing an EV is conditional on the vehicle and battery having three-year warranties, with an option to extend the battery warranty by two years.⁶⁶

A PCP can be secured against the vehicle, reducing the cost of the finance compared to unsecured finance. Using the intervention as security is less applicable to many smart heat interventions, which would not be recoverable upon default. However, manufacturers seeking ways to offer their products to consumers to circumvent perceived risks associated with untested products, is extremely relevant.

8.1.2 Regulation of passenger vehicle carbon emissions

We looked at the impact of requirements that manufacturers reduce the carbon emissions associated with the passenger cars they sell. This is relevant to low carbon heat, where supplier incentives may be required to improve the low carbon offerings available in the market.

Under EU legislation, there are mandatory emission reduction targets for new cars sold. These require that emissions of new passenger cars are:⁶⁷

- 130 grams of CO₂ per km by 2015, phased in from 2012; and
- 95 grams of CO₂ per km by 2021, phased in from 2020.

⁶⁴ Frontier Economics for the Committee on Climate Change, 2014, Reducing the cost of capital for household low-carbon investment decisions

⁶⁵ Element Energy for The Committee on Climate Change, 2013, Pathways to high penetration of electric vehicles, final report, available at: http://www.theccc.org.uk/wp-content/uploads/2013/12/CCC-EV-pathways_FINAL-REPORT_17-12-13-Final.pdf.

⁶⁶ The three year vehicle warranty can alternatively be met by providing a 60,000 mile warranty. See: <https://www.gov.uk/government/publications/plug-in-car-grant/plug-in-car-grant-vehicles>.

⁶⁷ http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm

This compares to average emissions in Europe of 159g/km in 2007, and 165g/km in the UK.⁶⁸ For a given manufacturer, these emission reductions must be achieved at the average level for the overall fleet sold. This enables vehicle manufacturers to meet the targets flexibly (e.g. a manufacturer could focus on increased sales of EVs within its fleet, or on reducing the emissions associated with conventional vehicles it produces). There are additional incentives available for ultra-low emission vehicles, and penalties payable per vehicle sold if the emissions threshold is exceeded.

In 2013, CO₂ emissions of new cars in the UK were 128g/km on average, meaning that, at a national level, new cars sold were within the level required to be met by 2015 under the EU legislation.⁶⁹

Within this, there had been a rapid increase in the proportion of vehicles sold that are at or below the 130g/km threshold, from 10.6% in 2007, to 63.3% in 2013.⁷⁰ This is likely to have been driven both by the phasing in of the emissions requirement, but also by vehicle excise duty (VED) for new cars being zero in the first year for cars below the 130g/km threshold, and thereafter non-zero, but in bands that set lower rates for lower emissions.⁷¹

The evidence suggests that overall carbon emission requirements may be an effective alternative to mandating standards at an individual vehicle level; the approach used for appliances under the EU Minimum Efficiency Requirements. Combined with financial incentives that drive demand for lower emission cars, overall fleet emission mandates incentivise manufacturers to develop lower emission vehicles.

⁶⁸ http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm and SMMT, 2014, New Car CO2 Report 2014, available at: <http://www.smmt.co.uk/co2report/#responsiveTabs1>.

⁶⁹ SMMT, 2014, New Car CO2 Report 2014, available at: <http://www.smmt.co.uk/co2report/#responsiveTabs1>.

⁷⁰ SMMT, 2014, New Car CO2 Report 2014.

⁷¹ <https://www.gov.uk/vehicle-tax-rate-tables>

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