



Programme Area: Smart Systems and Heat

Project: HEMS ICT Market Study

Title: HEMS ICT Market Study – Main Report

Abstract:

This document is the final report from the project and consists of 2 sections. Section A covers the “Future scenarios and opportunities” for the market. This starts with an overview of the conclusions and key market opportunities with detailing of each in full. It continues with an explanation of the likely scenarios that determine how the market could develop. The latter part of Section A covers the analysis of the key drivers affecting how the market is likely to develop, as well as the main areas of value in the market which underlay the scenarios. Section B covers the characteristics of the current HEMS and related ICT market, starting with an overview of key messages, critical success factors and risks. The report was initially prepared in August 2014. Some details and analysis may be out of date with current thinking.

Context:

The ETI commissioned the HEMS & ICT Market project to undertake an in depth study and assessment of HEMS along with what data, processes and controls and potential additional services enabled via a linked ICT system. The project delivers key insights and findings in terms of potential future offerings and capabilities of these products along with market assessment information. The aim of the project was to characterise the existing market for HEMS and ICT systems and to quantify the market/commercial opportunities for future HEMS and ICT propositions for both consumer and business.

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HEMS and ICT – Quantifying the Future Market Opportunity

Updated Final report – Work packages 1 & 2

Friday 22nd August

Key messages (1/3)

1. Current HEMS market in the UK is dominated by relatively simple products with slim margins

- Products such as NEST and HIVE focus on simplicity and elegance of design, straight-forward customer-focused propositions around comfort and convenience, and brand recognition.
- Prices across the range average around £150-250 but struggle to generate profit given low volumes

2. The real long term aim is to establish and own the customer relationship in the home; simple HEMS products are the gateway device to a connected-home

- Smart thermostats are a convenient gateway device to the home because:
 - Energy is the “golden thread” that connects to all other devices and appliances in the home;
 - Thermostats are already devices that consumers are used to interacting with to set outcomes in the home;
 - They are a clear step-up on existing primitive thermostats devices.
- The biggest value from this customer relationship is driven by the data collected and the services/products that could be offered through the in-home sales channel.
- This could well exceed £100/household p.a. (or market potential up to £100m by 2020¹) through accurate profiling of a customer’s lifestyle and choices and detailed monitoring of their energy using devices, enabling predictive marketing and servicing.

3. The connected-home market is most likely to be led by ambitious and well-funded technology players

- Companies most likely to drive and take advantage of this development are those with:
 - the ambition to build / leverage their brand to own the customer relationship in the home and ability to invest and innovate to achieve it;
 - Sufficient technical know-how and vision to develop the technology eco-system;
 - the understanding of business models built around recurring revenues from subscription services, freemium services, and data driven advertising and marketing.
- The business model here can be more readily exploited because it builds on ideas and business models already developed through the rise of the internet, taps into a ubiquitous customer acceptance of technology and monitoring in their lives, and is not reliant on, or constrained by, policy or regulatory intervention.
- Google are likely to be at the forefront of this development with an open platform approach to technology that can link in, as are Apple who would be more likely to take a closed “walled-garden” approach. Samsung also have ambitions of leading in this space but have less experience of operating with this sort of business model.
- In specific markets there may be a dominant local player that takes advantage of a preferred or monopoly status (e.g. RWE and the Deutsche Telecom-backed Quivicon in Germany), but there is no obvious example (British Gas may be closest) of such a player currently in the UK.

Key messages (2/3)

4. Telcos are also well-placed to move into the space with bundled offerings but no sign as yet

- The connected home creates opportunities from bundling services that are estimated at up to £40/household p.a. (or market potential up to ~£20m by 2020¹) per bundled service.
- Telcos have potential to exploit this due to their physical presence in the home, ownership of key infrastructure and positive customer perception, but, while tracking the area, have not yet been able to develop an attractive business model in the UK.
- In the US Telcos have made progress by adding connected peace of mind offerings to their bundle, led by companies such as Comcast and AT&T, taking advantage of (and justifying) their increasingly powerful broadband infrastructure and the buoyant US market for monitored security. This is partly in reaction to stock-market pressures to grow and lack of new opportunities elsewhere in their market.

5. Of the Big 6, currently only British Gas is demonstrating the ambition to drive development of the HEMS market

- Big 6 retailers are incorporating these devices into their customer offering, but while British Gas seem to be making a serious bid to develop a more sophisticated connected home proposition, other retailers do not appear to have coherent or ambitious strategies in the area.
- Based on their current positioning, utility-led development seems unlikely to lead the market and to develop more advanced energy service propositions given the challenges to their core business model.

6. Advanced ESCo offers are likely to take longer to, or may never, develop in the market

- Development of demand shifting services for networks likely to take time to develop – supplier motivation should be greater, especially with Smart Metering, but progress currently slow. Smart meter success will be a key driver as will the unpredictable development of electric vehicles and heat pumps to create demand shifting potential – clear policy/regulatory role to play here. Customer acceptance of technology and simplification/smoothness of installation processes also important.
- Even so there is significant potential value from this sort of offering through energy efficiency savings (~£170/household p.a. or up to ~£15m by 2020²) and HEMS enabled demand shifting (~£17/household p.a. or a market of £18m p.a. in 2020³, though this could rise to ~£80/household p.a. or £165m p.a. in 2025⁴).

7. Smart home development likely to develop later as an evolution from earlier automation

- Simpler offerings will gradually evolve into more complex multi-dimensional offerings over time, so that recurring revenue offerings increase in functionality to become the fully-fledged Smart Home.
- Companies that own the customer relationship, either through open platform approaches or through partnering, will bring in the hardware and software manufacturers under their umbrella [e.g. players such as Honeywell (heat), Phillips (light)]
- There are already companies that develop all-encompassing Smart Home solutions from an entertainment and home convenience perspective but the business case is unclear. With costs ranging from £7k - £30k for a smart home system, this sort of step change offering will only appeal to the top end of the market.

Key messages (3/3)

8. The big prize for ETI is in developing the Advanced ESCo proposition where there are 3 primary opportunities identified

- The analysis suggests that commercial value from energy benefits will not be the driver of the connected-home market over the coming 5 years at least.
- However, the per household value from Advanced ESCo propositions is potentially very significant and as other factors develop, the market associated with these could look promising (post 2020).
- This depends on policy and regulation enabling this development and players in the market having the vision and confidence to create new energy business models that link the selling of energy with optimising its usage.
- There is potential for the ETI to act as a leader in informing and advising the market towards making these propositions more viable.
- The three opportunities identified all involve complex data processing via the HEMS to maximise efficiencies in energy usage, these cover:
 - a) Right-sizing of heating solutions
 - b) Optimisation of time of use and demand response benefits via local storage
 - c) Arbitrage-driven operation of hybrid heat pumps
- Each has potential, though the most promising in the short to medium term may be to explore hybrid heat pumps as a practical transition to electricity powered heating in the home.

9. Preparing for a non-energy led scenario may also be sensible to consider, especially in the shorter term

- Given the expected market direction over the next five years, there may be a need for energy solutions to demonstrate their functionality and value as a component in a wider connected-home offering.
- As energy will not be the focus this will require a simpler approach without complex data processing.
- An opportunity has been identified using wireless TRVs to regulate room-specific temperature in the home leveraging a generic smart hub.
- The ETI could act to bridge the gap with technology and communications companies through exploring partner and joint venture opportunities, or as a match-maker facilitating constructive interaction.
- The ETI should also actively encourage the development of open industry standards and protocols so that there is flexibility in how energy could play a role in the connected-home.

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How to read this report

- This report is set out in a top-down format where the emphasis is put on the insight and key messages to take-away while supporting evidence is laid out afterwards for reference as and when needed.
- The **executive summary** sets out the combined narrative for the whole report showing how the characteristics of the current market and factors affecting its likely future development lead to conclusions around scenarios and opportunities.
- **Section A** covers the “Future scenarios and opportunities” for the market. This starts with an overview of the conclusions and key market opportunities with detailing of each in full. It continues with an explanation of the likely scenarios that determine how the market could develop.
- The latter part of Section A covers the analysis of the key drivers affecting how the market is likely to develop, as well as the main areas of value in the market which underlay the scenarios. A summary of the conclusions on drivers and values is contained in A3.
- **Section B** covers the characteristics of the current HEMS and related ICT market, starting with an overview of key messages, critical success factors and risks.
- Analysis of the HEMS and related ICT markets are provided separately; in each case a summary of key messages is laid out first, followed by slides giving the supporting insight which signpost back to these key messages. This is followed by a set of slides which provide back-up evidence to these key message slides, offering more detailed analysis and information. These should be used as reference and for investigation into the detail behind the key messages as desired.
- Finally B4 provides further back-up evidence on the specific subject of smart metering.

Methodology (1/2)

- We have taken a structured approach to answer the complex question of how the market for Home Energy Management Systems (HEMS) might develop.
- This fundamentally builds on the idea that opportunities should be built from the context of understanding the potential scenarios that could develop in the HEMS market.
- These scenarios themselves have been defined in terms of their likelihood, timescale and potential value associated with them.
- This is supported by:
 - An analysis of drivers and their respective impacts and likelihood, as well as an understanding of which driver combinations are most likely to lead to different scenarios outcomes
 - An analysis of the possible values available via HEMS and home control platforms and an alignment of these to different potential narratives that could develop.
- This is also supplemented by specific insight into the market developed through Work Package 1.
- This logical and structured approach means there is a clear basis for the conclusions set out which can be traced back to help us understand why certain outcomes may result.
- Also this should promote discussion by making it possible to pinpoint assumptions so that they can be challenged.

Methodology – structure of outcomes (2/2)

1. **Opportunities for the ETI have been developed that focus on different approaches to maximise heating efficiency in the home also linking in ToU/ DR offers,** these are as follows:
 - a) Energy services companies 'right-size' heating solutions then provide supply contracts with price guarantees
 - b) HEMS enable optimised Time-of-Use tariffs and DR benefits via local storage
 - c) Hybrid heat pump driving arbitrage opportunities in the home
 - d) In a world where home control systems are not focused on energy, wireless TRVs can offer energy benefits without complex data processing

2. **Five narrative scenarios have been developed that cover both energy and non-energy-led scenarios:**
 - a) Simple Energy: Energy companies dominate HEMS market with low-value offerings
 - b) Advanced ESCo: Development of Advanced ESCo models that utilise HEMS to unify energy services and supply
 - c) Trojan Horse: Data/ICT new entrants dominate using HEMS as an entry point to the 'Internet of Things'
 - d) Bundled Offer: Telcos lead the development of a platform in the home which is used to bundle communication linked propositions of which energy may be one
 - e) Smart Home: Non-energy appliances and entertainment lead visionary and purpose-built smart home offerings

3. **14 Key drivers have been identified that impact on the future HEMS market and the direction it may go in.** These inform the type of scenario that might develop in two main ways: how simple/complex the offering is and whether or not the scenario is energy led or whether alternative routes to home control will dominate - key drivers are: policy related, including Time of Use tariffs (ToU)/Demand Response (DR) and smart metering; energy market development; and technology related issues

4. **Six main buckets of value associated with HEMS & home platform solutions have been identified** – these show that there is potentially value of £100s/year per household that is at stake, but some are more dependent on wider factors than others. Buckets are:
 - a) Basic value proposition, in terms of profit per unit sold
 - b) Value from customer retention and acquisition for energy suppliers
 - c) Bundling of complementary offerings (cost economies and margin pricing strategies in bundled offerings)
 - d) Value from customer relationship and associated data (data analytics and channel to consumers)
 - e) Energy efficiency savings from improved control of energy use
 - f) Demand-shifting (ToU/DR) related value based on electricity load shifting

Executive summary

Executive Summary (1/2)



The current market

B2

1. The current market for HEMS is embryonic with a scattered range of product offerings testing different customer propositions, developing their brand and looking for an effective route to market (both in terms of selling and delivering their products).
2. Of these current offerings, the successful ones in the UK are simple and focused in their proposition; however, many have the potential to broaden into wider and more complex offerings.

Current simple value propositions

B2

3. The 'Simple Energy' customer value propositions associated with these current offerings are centred on providing some level of control and convenience in energy usage, as well as the potential for energy bill reductions. Commercial value comes from the revenue from selling devices, while Energy Companies are exploring the value from the development of their customer relationship to achieve improved customer retention/acquisition in partnership with HEMS providers.

Short-term development

B2

4. In the relatively short term (i.e. next 2-3 years) HEMS providers will be looking to strengthen their position to find a profitable and sustainable route to market that either avoids or more effectively manages their reliance on third parties such as Utilities and merchants, while also tackling two critical risks around customer perceptions and installation issues that also create opportunities for potential new entrants to the market.

More sophisticated value propositions

A2/5

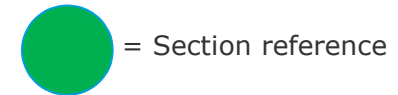
5. However, these simple propositions are expected to be only the start of the market's development, with the real value to be found value propositions associated with complex and sophisticated offerings – therefore the key question is **who will be best placed to offer this broader more complex offering?**
6. These more sophisticated value propositions can be split into 2 types, both of which offer significant value in the long term; these are the two main directions that the market could develop:
 - Energy led offerings which look to exploit value from energy efficiency and demand shifting (Advanced ESCo narrative)
 - Non-energy led offerings which extract value from collecting data on customers, exploiting the channel to market to customers, and the bundling of complementary services (Trojan Horse / Smart Home / Bundled Offer narratives)

Role of ICT

B3

7. In both cases these more sophisticated value propositions require cloud-based ICT platforms to play a key role (e.g. to offer remote control, processing of complex data...), however there is no great ICT barrier as current platforms are prepared for this in terms of their technology and infrastructure.

Executive Summary (2/2)



Companies that may lead

B3

8. The direction the market takes will be dictated by who is best able to use software and data analytics to take advantage of the potential data available and their ability to overcome any associated barriers – currently companies from outside of the Energy space look better placed to take advantage:
 - Telcos and data specialists are well placed to control this platform space in the future and some companies, notably Google, appear to have a clear strategy in place.
 - Energy companies, on the other hand, do not in general seem to have clear strategies to take control of this space

Smart meter impact

B4

9. The rollout of Smart Meters may assist the development of simple propositions (requiring one-way data flows only), however their ability to support more sophisticated value-added offers that require two-way data flows would be dependent on partnership between HEMS providers and Energy companies, and the (questionable) ability and desire of Energy companies to progress the market in that direction.

Market drivers and likely progression

A2/4

10. The drivers of the market also suggest that it will be more likely to go in a non-energy led direction as there is less reliance on factors beyond the control of companies (e.g. changes to policy and regulation), more complexity associated with value extraction (e.g. transformation of prevailing business models, building/ reforming customer relationships), and greater experience in developing new value propositions.
11. As a result of all these factors, it seems more likely that the market for home control will move towards value propositions that are not energy related, though these are likely to leverage the fact that energy offers a “golden thread” to all of the devices and appliances in the home that use it.

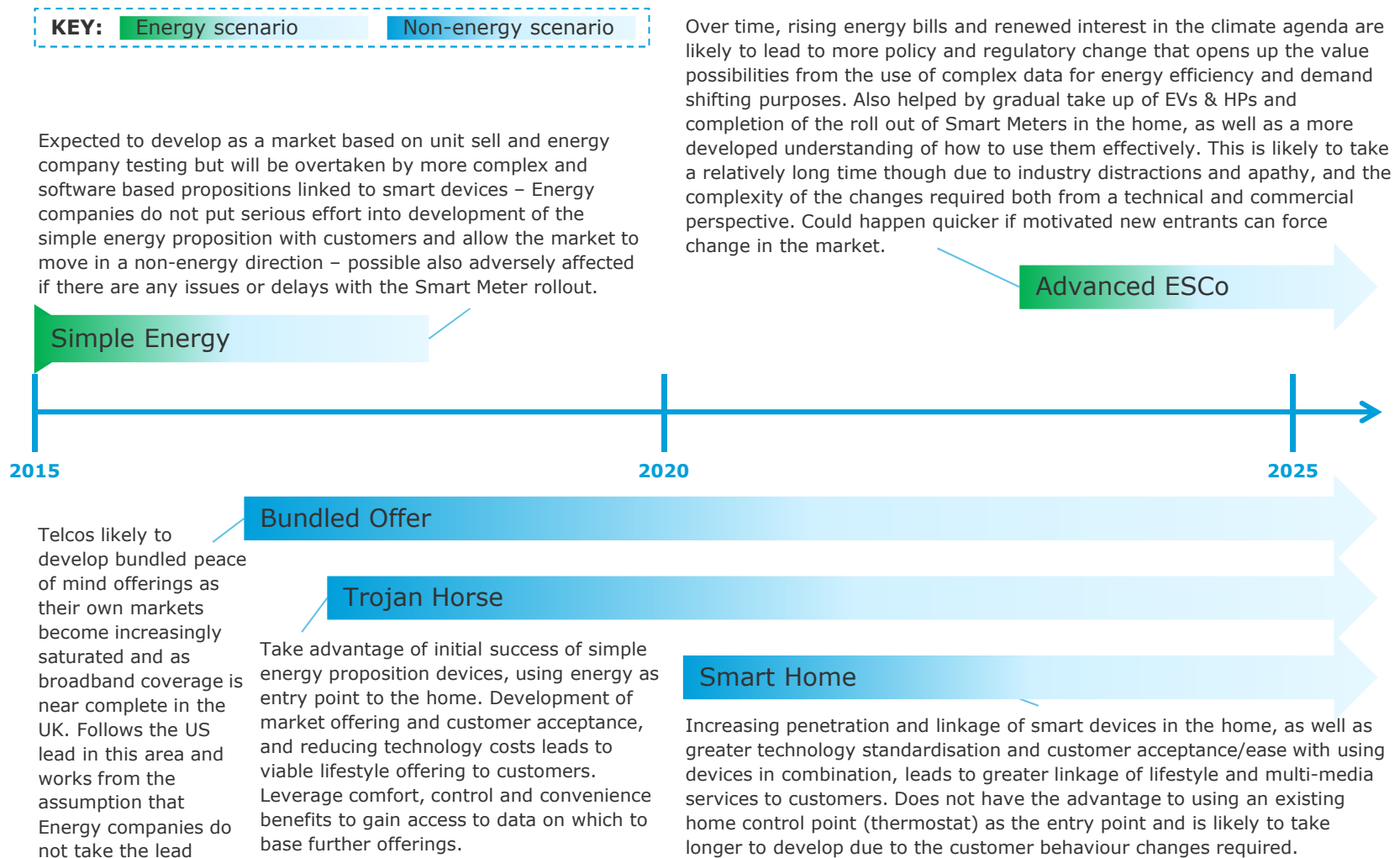
Key ETI considerations and opportunities

A1

12. Therefore, there are two things the ETI should consider in terms of the future development of the market:
 - How to lead and inform the market towards an energy-led (Advanced ESCo) scenario?
 - How to develop solutions that complement and fit into non-energy led scenarios?
13. The opportunities for the ETI feed directly from these considerations:
 - Three opportunities relate to driving the Advanced ESCo scenario where the primary gap being met is the link between energy as a commodity and the devices that use it, joining up the business model for efficient use of energy from both a domestic (micro) and system (macro) perspective.
 - A fourth opportunity has been identified within the non-energy led scenarios, where complex energy data is not available but the smart home hub can still be utilised. Here the energy offering has to be simple enough to add value in a scenario where energy is a marginal consideration as far as home control is concerned.

Following simple energy offerings, the market is more likely to move towards non-energy value propositions first rather than energy-led

Progression of the HEMS market – estimated narrative timeline



Section A

Future scenarios and opportunities

Section A

1. Key messages: future HEMS opportunities

There are two main opportunity areas for consideration which reflect the ways the market for home control could develop

Our prediction for market development is that while Advanced ESCo propositions could develop in the longer term i.e. post 2020, it currently looks more likely that the market for home control will be led by non-energy services and companies where energy may only play a marginal role.

As a result we believe there are two key considerations for the ETI in assessing future opportunities:

1 – Lead and inform the market towards an energy-led 'Advanced ESCo' scenario

2 – Develop energy solutions that would complement non-energy led scenarios

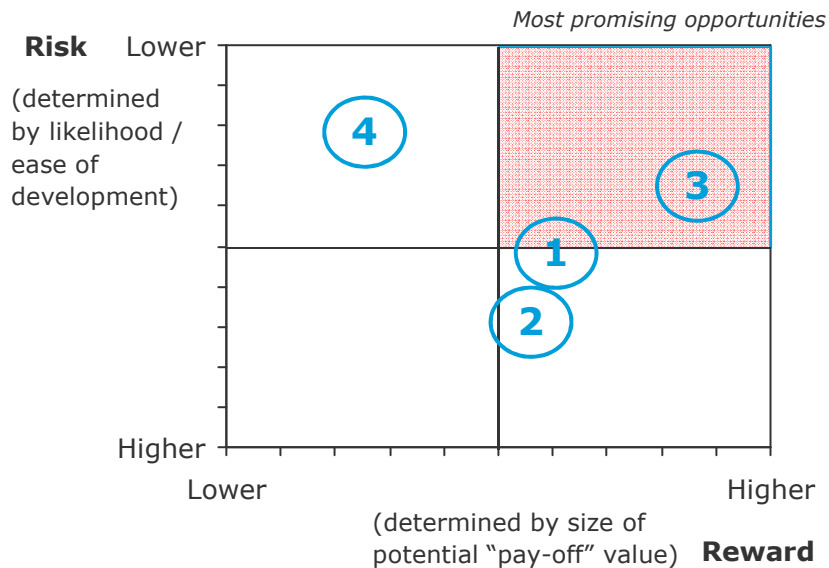
From these come four identified opportunities:

- There are three opportunities that relate to the development of the Advanced ESCo scenario involving the processing of complex data to optimise energy efficiency and demand shifting value. These focus on business propositions that link the selling of energy with optimising its usage:
 - 1. Energy services companies 'right-size' heating solutions then provide supply contracts with price guarantees** – ESCo optimises heating system in the home and drives energy efficiency savings utilising HEMS – savings shared between ESCo & customer through energy price guarantee.
 - 2. HEMS enable optimised Time-of-Use tariffs and DR benefits via local storage** – Value from price arbitrage shared between ESCo and customer utilising the flexible nature of heat pumps and electric vehicles to shift demand optimally.
 - 3. Hybrid heat pump driving arbitrage opportunities in the home** – Use characteristics of hybrids that can operate using both gas and electricity to extract energy efficiency, price arbitrage and demand shifting value.
- 4. In a world where home control systems are not focused on energy, wireless TRVs can offer energy benefits without complex data processing** – A simpler approach to regulate temperature based on individual room requirements leveraging a non-energy focused smart home hub.

'Summary of opportunities

Of the opportunities, hybrid heat pumps seem to offer the best balance of risk and reward, though wireless TRVs could be the safest bet

Opportunities mapping



Risk determined by likelihood / ease of development

Reward determined by size of potential "pay-off" value

Explanation

- Opportunity 1 ('right-sizing'):

- While the reward is limited to energy efficiency savings, the sophistication of the solution should allow for their maximisation.
- There is risk, especially around the ability to develop the business model.

- Opportunity 2 (demand shifting focus):

- Reward is limited to demand-shifting opportunities which are still very uncertain and relatively unexplored.
- Risks are similar to opportunity 1, but with the added uncertainty and reliance on external factors with regards to extracting value.

- Opportunity 3 (utilising hybrid heat pumps):

- Seems to offer the greatest reward potential as it combines value from energy efficiency benefits in the home from switching between gas & electricity usage, arbitraging gas and electricity prices, and taking demand shifting opportunities.
- While it does face costs and barriers similar to opportunities 1 and 2, its risk should be diminished due to its convincing potential role as an attractive transition solution, appealing to both policy makers and a cross-section of industry players.

- Opportunity 4 (wireless TRVs):

- Should offer the lowest risk as it relies less on external factors such as policy and regulatory support, while the business case should be more straight forward to develop.
- However, it also offers the smallest reward opportunity as it is likely it would only be able to explore a portion of the energy efficiency savings possible in the home due to its relative lack of sophistication.

Possible actions are split according to the expected direction the market will take and the desire to shape it – partnerships will be crucial either way

Approach

1 – Lead and inform the market towards an energy-led 'Advanced ESCo' scenario

2 – Develop energy solutions that would complement non-energy led scenarios

Action

1. Develop policy proposals to lobby/advise based on:
 - a) detailed assessment of barriers to the development of Advanced ESCo related business models (as set out in opportunities 1-3) and changes required to allow their development;
 - b) robust evidence of value associated with these business models and benefits to UK achieving energy and climate targets.
 2. Bring partners that would need to be involved in opportunities 1-3 together e.g. via a Joint Venture (could include HP manufacturers, building specialists, electricity networks, energy suppliers) to assist with:
 - Conducting in-depth cost/benefit assessment of heating system overhaul tested against the 3 opportunities
 - Conducting a root & branch assessment of how heating systems designed, quantifying wastage associated with inefficient systems and inefficiencies in the supply chain,
-
1. Inform key non-energy players on energy value opportunities through home control:
 - a) Become part of the Digital Economy conversation – getting out of the 'Energy bubble';
 - b) Promote value from energy management in wider smart home / 'Internet of Things' conversation;
 - c) Develop combined business case bringing energy value opportunity into non-energy thinking (e.g. with Telco bundled offering) – potentially involves the creation of a Joint Venture to cross vertical market barriers;
 - d) ETI could act as the match-maker facilitating and advising on constructive interaction between energy & non-energy players
 2. Encourage industry standardisation and development of open protocols:
 - a) It is not in the ETI's interests for closed platforms to develop in this scenario – want an open approach to allow flexibility in how energy could play a role.

Energy services companies 'right-size' heating solutions then provide supply contracts with price guarantees (1/3)

Design and install "right-sized" gas boiler based central heating systems, then carefully manage operational performance for optimum efficiency – combine energy services with supply, to offer ESCO-style price guarantees

Opportunity summary

- In this opportunity, a single company (or joint venture) takes an ESCo role making a combined energy services and supply offer to customers where it:
 - Fits right-sized gas boiler systems coupled with advanced HEMS monitoring systems in customer homes;
 - Provides a guaranteed price ceiling to the customer based on the system as designed and installed relying on its ability to manage the customer's energy usage within certain limits without impacting their comfort;
 - Monitors and manages ongoing usage to ensure the proposition remains economically viable;
 - Optimises home energy performance dynamically e.g. by taking account of occupancy data or implementing energy efficiency measures ;
 - Potentially offers remote service management and maintenance.

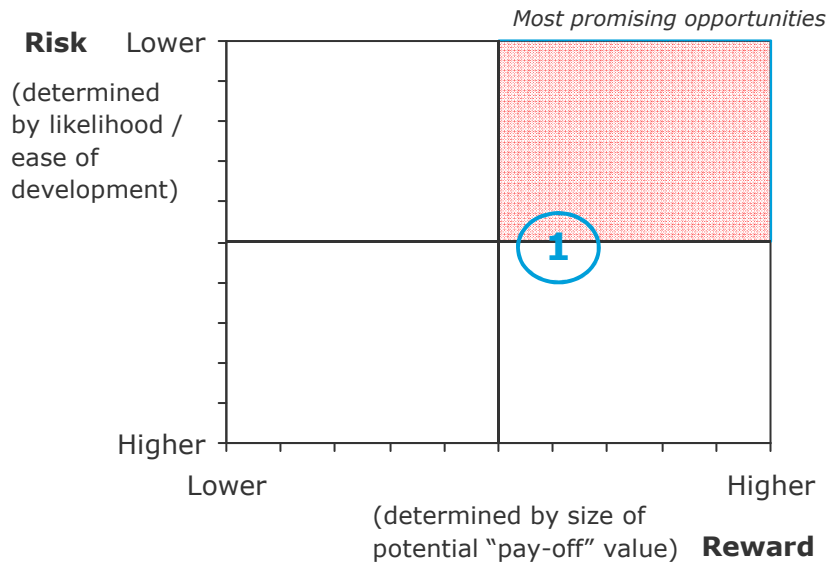
Gap being addressed

- The gap is the market failure that results from the split between energy supply and the provision of energy services – opportunities to increase efficiency not being taken due to misaligned incentives:
 - Incentive for installers of gas boiler heating systems is to oversize, erring on the side of caution to avoid call-outs later (e.g. on particularly cold days) – leads to under-performance reducing overall heating system efficiency and increasing gas consumption
 - Incentive for energy suppliers is to sell more energy to maximise revenue, therefore benefitting from oversizing of heating systems
- This problem is exacerbated by:
 - Small price increments within boiler price ranges, which make choosing an over-powered unit easier to justify;
 - Widespread policy-led installation of cavity, solid wall and loft insulation, often applied after boiler installation;
 - Energy services companies having no involvement in energy supply (i.e. don't take responsibility for increased gas bills).
- While heating system-led HEMS offered by the likes of Bosch & Viessmann today offer the opportunity to manage correctly designed systems well, ensuring ongoing compliance with performance and comfort, they do not combine this with an energy supply offering.

'Advanced ESCo' Opportunity 1: ESCo 'right-size' heating solutions

Energy services companies 'right-size' heating solutions then provide supply contracts with price guarantees (2/3)

Risk & Reward matrix



Value from Opportunity

- Value comes from energy efficiency savings which can be substantial and much of which could be exploited through this type of advanced approach.
- This would be shared between the customer and the ESCo offering the service/supply:
 - Customer benefits from lower energy bills but also the reduced billing uncertainty due to the price guarantee, as well as predictable comfort levels
 - Size of commercial benefit depends on how much of the saving is shared with the customer (dependent on where the guaranteed price is set)

Costs

- High-end heating systems and HEMS systems costs likely to be expensive with initial installation costs higher than with a conventional system, though this is somewhat offset as only incremental costs need to be recovered (assuming the system was due for replacement).
- Likely costs to the supplier will need to be fully identified at the design stage, and factored into the proposition.
- System installation cost could be amortised across the life of the supply contract, or, conceivably, recovered via a Green Deal-style loan arrangement.
- Payback needs to be achievable within normal lifetime of a domestic heating system – unclear currently how the cost/benefit case stacks up.

Risks and Barriers

- Potentially risky proposition to develop due to the barriers involved, in particular this is a fundamental change in the energy supply business model requiring commercial innovation but also customer acceptance.
- Likely to require policy support to permit supply contract lock-ins (to provide time for cost recovery), otherwise customers would need to pay more of the upfront cost, which is likely to put off widespread take-up.
 - In its favour, this type of proposition should appeal to policymakers as it creates the supplier business case for energy efficiency, therefore incentivising virtuous behaviour.
- Development of installation supply chain critical; a JV with boiler/HEMS supplier would avoid merchant lock-in.
- Existing suppliers, in particular British Gas may be best placed to take advantage of this opportunity if they show the desire.

Energy services companies 'right-size' heating solutions then provide supply contracts with price guarantees (3/3)

More detail on the opportunity

- The HEMS would be central to exploiting this opportunity through detailed system monitoring to allow total system performance to be managed, and adjustments made either centrally within the boiler, or locally within individual emitters.
- Open windows, zoned occupancy, personal preferences and historical usage data may all trigger room-by-room responses.
- Remote service management and emergency warnings could be triggered in response to carbon monoxide sensors and gas appliance technical data.
- Energy efficiency actions may be instigated based on intelligent assessment of building fabric performance and thermal losses.

Data that the HEMS could measure

- Local room and zone temperatures
- Door and window sensors (inc. open/closed status)
- Wireless TRV data to give emitter temperatures
- Outward and return flow temperatures
- Smart meter half-hourly consumption data
- Room and building occupancy
- Local weather forecast
- Outdoor air and external wall temperature data
- Wind speed data
- Historic usage data and room performance statistics, mapped to past temperature and weather data
- Learned and pre-programmed personal preferences + manual overrides
- (Possibly) cooking equipment data (e.g. programmed heat settings)
- Carbon monoxide sensors
- Gas appliance technical data

HEMS enable optimised Time-of-Use tariffs and DR benefits via local storage (1/3)

Arbitrage time-of-use tariffs via the use of local energy storage technologies that are managed via the HEMS

Opportunity summary

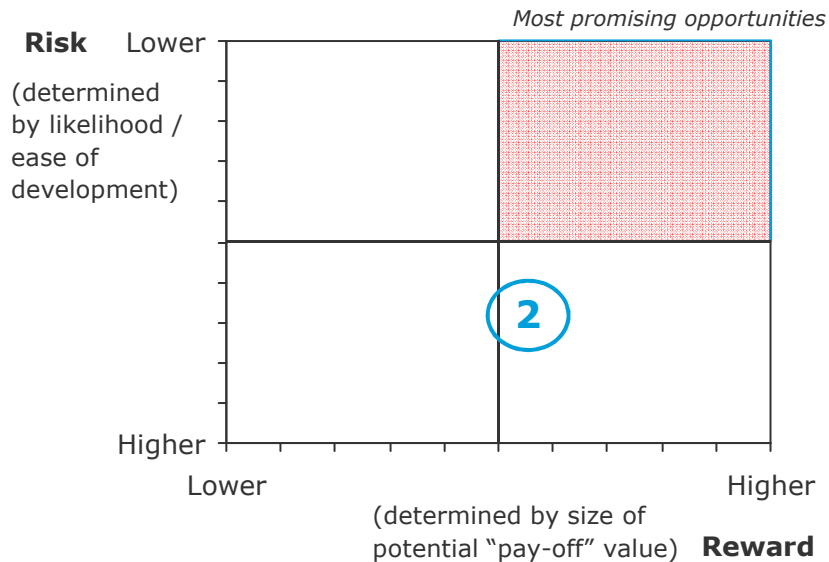
- This opportunity is again focused on an ESCo type proposition, bringing together the supply of energy and the provision of new electricity using devices that have clear demand shifting / storage potential, namely heat pumps and electric vehicles (battery charging), though thermal storage could also be used.
- The ESCo in this case would:
 - Work in partnership with the manufacturers of heat pumps and/or electric vehicles to understand the demand shifting potential from the devices as well as how to shift the energy they use without impacting on their performance and efficiency.
 - Install an advanced HEMS system when the device is purchased as part of a supply package that the ESCo would have with the customer.
 - Provide a discount on overall energy used (or at least energy used in conjunction with the HP/EV) in exchange for agreement to participate in demand shifting controlled remotely via the HEMS according to certain pre-set limits set by the customer.
 - The HEMS would monitor usage, learning about the customer's habits, while also monitoring the market price for energy to optimise when the heat pump is on or when the electric vehicle is charged.

Gap being addressed

- The gap in the market again links to the market inefficiency that results from the split between energy supply and the provision of energy services but in a slightly different way to the "right-sizing" opportunity.
- Here while heat pumps have an inherent energy efficiency benefit (they are simply more efficient than gas boilers), the benefit exploited through the HEMS comes from shifting demand through time-of-use or demand response.
- Opportunities to increase system efficiency, by aligning demand with availability of relatively cheap generation, are not being taken.
 - The manufacturers of the electricity-using devices that show most potential for demand shifting (heat pumps and electric vehicles) are not focused on the benefits that demand shifting could bring.
 - Suppliers of electricity have no incentive to shift demand in the absence of mandatory billing settlement based on actual usage – while they could make the choice to be settled in this way now, none have shown any proactive desire to do so.
- While there are some small suppliers who are exploring the development of their business model around this supply opportunity, they do not have the scale/scope to also consider being involved in the provision of these devices.

HEMS enable optimised Time-of-Use tariffs and DR benefits via local storage (2/3)

Risk & Reward matrix



Value from Opportunity

- Value primarily related to optimising electricity trading, time-shifting the demand for power to ensure the consumer's energy bill is minimised (assuming time-of-use tariffs)
 - Total demand is thus not reduced, but shifted to times of the day when it's cheaper to draw power from the Grid.
- Also potential value from network benefits from demand shifting but this would require an organised structure of aggregation

Costs

- Development and prototyping costs – control strategies with heat pumps and electric vehicles may take a lot of work to understand and optimise.
- For heat pumps:
 - Installation costs likely to be high, perhaps more so than a gas system.
 - Householders need a lot more education and support than they do with gas, as the unit is controlled in a completely different way.
 - As a matter of course, electric heat pumps also come with the requirement to apply energy efficiency measures to plug holes in leaky houses (i.e. avoid a new over-sizing problem).

Risks and Barriers

- Again this type of proposition should appeal to policymakers, but similar risks to opportunity 1 with regard to: the shift in business model requiring commercial innovation and customer acceptance; permission for supply contract lock-ins; existing energy suppliers may be best placed.
- Need to create an installation supply chain from scratch.
- Potential customer resistance to the concept of electric-only heat should not be underestimated.
- Traditional questions around performance of heat pumps at ultra-low temperatures must also be addressed (risk, in extreme weather, that parasitic losses can undermine unit performance).
- Selection of correct heat pump partner is critical – few heat pumps originally designed for the UK market, where the maritime climate demands different performance characteristics.
- Best market for this solution may be larger high-end property given physical footprint (also biggest returns & most sophisticated consumers).

HEMS enable optimised Time-of-Use tariffs and DR benefits via local storage (3/3)

More detail on the opportunity

- With a heat pump, the system effectively uses water as a proxy for power, with heat being drawn from the thermal store in offline mode at times of peak pricing. The cylinder is then recharged when electricity prices have fallen. This approach resembles opportunity 1 by tying up energy supply and service to provide satisfactory levels of comfort at reduced prices.
- With an electric vehicle, the car battery is used to store and release power as required, allowing for both domestic usage and transport needs. Battery charging would be done at periods of vehicle inactivity and low power demand (and hence low cost), allowing time-of-use tariffs to be exploited. In practice, this almost certainly means overnight, owing to charging period duration. It may even be possible to extend current Economy 7 arrangements as a starting point for such tariffs.
- A third variant of the strategy involves use of smart storage heaters, based on thermal bricks of the type used in traditional storage systems. Unlike heat pumps, storage heaters do not exploit the 'free heat' available in the air or ground, so do not provide anywhere near the same levels of efficiency. However, they may have a role to play in certain sectors (e.g. social housing), as the basic technology, though relatively unsophisticated and sub-optimal, is also cheap.

Data that the HEMS could measure

- Closely monitored heat pump-based systems require high levels of local intelligence to manage large amounts of data:
 - Room, zone, emitter / TRV data;
 - Stratified water temperatures within the thermal store;
 - Half hourly smart meter consumption data & related tariff information;
 - Door and window sensors (inc. open and closed status);
 - Outward and return flow temperatures;
 - Room and building occupancy;
 - Local weather forecast;
 - Outdoor air and external wall temperature data;
 - Wind speed data;
 - Historic usage, temperature and weather data;
 - Learned and pre-programmed personal preferences + manual overrides;
 - Historic room and performance data (allows for thermal loss profiles of building fabric);
 - Heat appliance technical data;
 - Day-ahead demand forecast and market information for real-time pricing.
- Less information is required for vehicle battery charging, with the focus being on battery condition and life; vehicle usage and performance data; half-hourly tariff information & day-ahead demand forecasting.

Hybrid heat pump driving arbitrage opportunities in the home (1/3)

Arbitrage between gas and power through a hybrid heat pump, to optimise domestic heating efficiency and cost

Opportunity summary

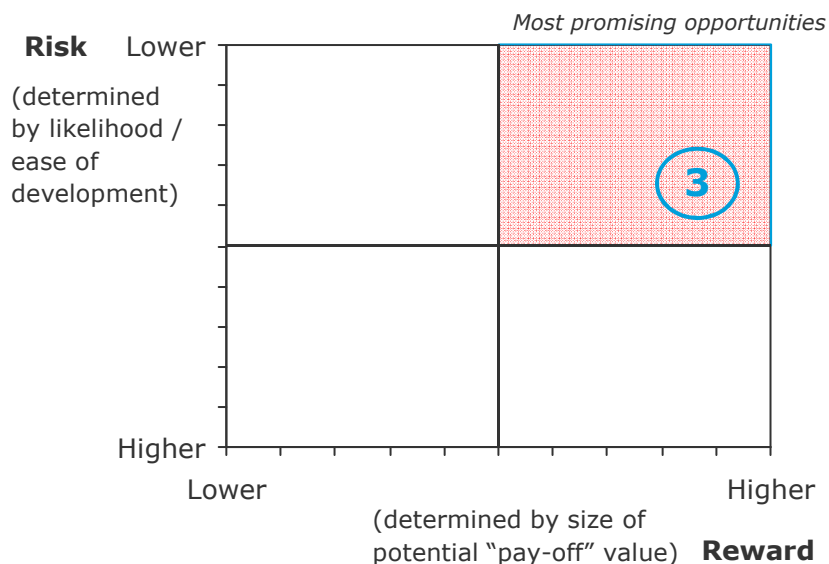
- This opportunity looks to exploit the specific technical characteristics of hybrid heat pumps to make intelligent choices in real time about which fuel source is used.
- While this may seem similar to Opportunity 2, there is actually a very different type of arbitrage taking place with the possibility of arbitrage between gas and power prices.
- Also provides operational flexibility to optimise system performance in the home. The ability to switch mode depending on the prevailing weather conditions offers the potential for significant efficiency savings:
 - Gas boilers tend to perform better than heat pumps in freezing conditions;
 - Heat pumps make more sense during milder winters.
- Here the ESCo would play a role that crosses over Opportunities 1 & 2:
 - Working in partnership with manufacturers of hybrid heat pumps to understand how they work most effectively (perhaps also becoming a registered installer);
 - Installing an advanced HEMS system with the hybrid heat pump as part of a supply package;
 - Providing a price guarantee to the customer for a given level of comfort;
 - Monitoring and managing customer behaviour and market prices to ensure optimum energy usage.

Gap being addressed

- The gap in this opportunity comes from the market's failure to exploit the value from hybrid heat pumps effectively due to the opportunities for arbitrage and energy efficiency not being combined into one business case.
- As with the Opportunities 1 & 2, this requires the roles of energy supplier and equipment provider/manufacturer to be married so that a joined up business case can be developed.
- In addition, within the supply businesses themselves, this requires consideration of gas and electricity prices against each other at a retail level, something they would not normally do.
- As a result opportunities at a domestic level to both operate more efficiently, and to take advantage of relative market priced for energy are not being taken:
 - The manufacturers of hybrid heat pumps are not market experts;
 - Suppliers of electricity are not focused on energy services solutions, have limited incentive to explore arbitrage solutions and are unlikely to make the connection between electricity and gas prices at a retail level.

Hybrid heat pump driving arbitrage opportunities in the home (2/3)

Risk & Reward matrix



Value from Opportunity

- Value comes from both energy efficiency and demand shifting opportunities:
 - Energy efficiency from using the optimum energy source (gas or electricity) depending on weather conditions;
 - Arbitrage between gas & electricity by shifting demand based on their relative prices;
 - Demand shifting based on time-of-use or network requirements (as in opportunity 2) e.g. switching to gas-only mode when the electricity network is stressed.
- As this opportunity combines both arbitrage and efficiency benefits, it may offer greater overall value than the first two.

Costs

- Cost similar to those applying to heat pumps in opportunity 2 in terms of installation, other energy efficiency measures in the home, development and prototyping costs, education and support for householders.
- Primarily the challenge is around developing the optimisation and control strategy
 - This will involve the development of appropriate software and algorithms that can optimise use in complex ways (i.e. balancing up energy efficiency, gas/electric price arbitrage, and network needs).
 - The complexity of control and optimisation is at its most complex in this opportunity given the variety of factors being traded off.

Risks and Barriers

- Similar issues as opportunity 2 around: new business model; supply contract lock-in; existing energy suppliers; customer resistance; and focus on large higher-end properties.
- Selection of correct heat pump partner and solution is even more critical than with electric-only systems as hybrids are a less mature technology and the supply chain will need significant development.
- The development of the business model has a further level of sophistication (and therefore complexity) due to the arbitrage of gas & electricity price, a link which currently does not get made.
- Powerful argument to policy makers around transition advantages:
 - Gas component makes unit a potentially easier sell to customers used to boilers, whilst still moving towards our electrified future.
 - Hybrids offer optionality in an uncertain future, enabling existing gas infrastructure to still play a role and offering security of supply benefits: in extreme weather events as they can switch into gas mode in a power blackout, or switch to power in a gas emergency.

HEMS enable optimised Time-of-Use tariffs and DR benefits via local storage (3/3)

More detail on the opportunity

- This approach thus opens up both trading and energy efficiency opportunities, with the HEM switching the appliance between fuel types according to prevailing weather conditions, time of use tariffs, and pricing and demand response signals (e.g. from DNOs).
 - The HEMS used as part of this offer could perhaps be the most complex in terms of intelligence and the different trade-offs that would need to be made as it would need to balance:
 - Optimisation from an energy efficiency standpoint in the home depending on weather conditions
- against**
- The relative gas and electricity prices
- and**
- The value of providing gas or electricity flexibility to the wider network/system to assist with stress levels
- It may even be possible to offer different modes, depending on user priorities, allowing trading, comfort or efficiency profiles to be set overall, with the HEM deciding on the best way of delivering the required benefit.

Data that the HEMS could measure

- The basic types of information that must be captured and managed by the HEM would likely be similar to opportunity 2 for heat pumps.
- However there would be an additional focus real-time relative market prices.

In a world where home control systems are not focused on energy, wireless TRVs can offer energy benefits without complex data processing (1/3)

A simple and effective approach to regulate temperature based on individual room requirements without the need for complex data processing

Opportunity summary

- In our predictions of how the market will progress, we suggest a world in which energy does not lead the way in home control over the next 10 years.
- However, while non-energy value propositions may dominate in terms of how complex data is processed, there could still be "low-tech" energy opportunities that leverage the smart home hub and which may be attractive enough for non-energy players to take an interest in.
- Even today, many of the newer smart heating solutions, such as Nest, focus on better management of a single domestic thermostat.
- A potentially simpler and more effective approach may be to regulate temperature based primarily on individual room requirements, e.g. by taking account of local occupancy or solar gain.
- There is therefore an opportunity to introduce wireless TRV units that can be managed remotely, either from a basic hub, or from a mobile phone or tablet.
- The goal would be to deliver a solution that is simple to (retro-) fit to existing UK housing stock with radiator-based central heating and which is:
 - Easy to fit (not needing a specialist)
 - Attractive, appealing and easy to use for the average person

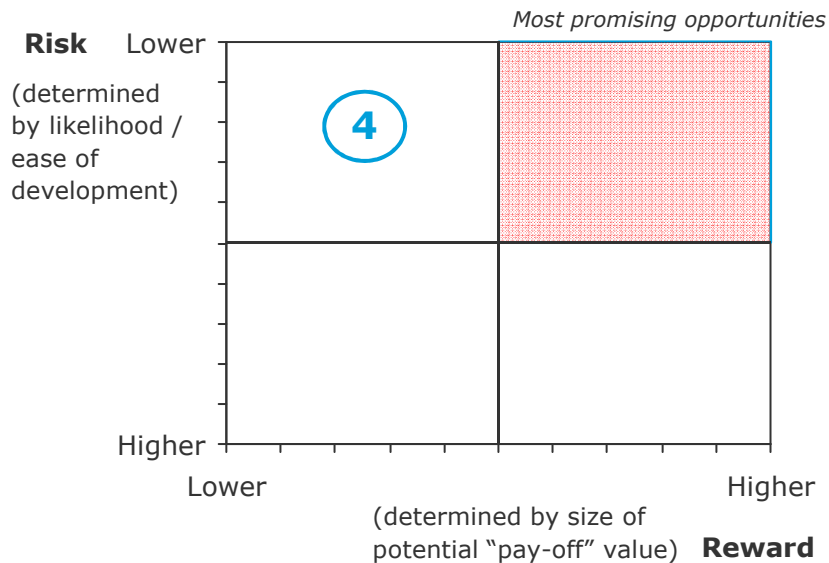
Gap being addressed

- The gap in this case lies in the fact that the focus of companies involved in this space is on the big prize of leading the market:
 - Energy focused companies involved in home control are focused on energy-led HEMS dealing with complex data for that purpose;
 - Non-energy companies (e.g. Google or Samsung) are thinking about the non-energy benefits from lifestyle enhancing control, collecting data and having a direct channel to customers.
- This opportunity looks at how energy can play an effective marginal role in a non-energy world where:
 - A smart home hub exists to communicate through;
 - But, this hub is not focused on processing complex energy data;
 - Customers are not primarily focused on energy benefits and therefore not prepared to spend time and effort on them (which is why it is so important that the products are very simple to install).
- The opportunity exists to offer a product that is simple, attractive, cheap and compelling.
 - Possible that this product could also exploit ongoing moves towards Open Energy protocols (e.g. opentrv.org.uk), to colonise the space via an ethical/viral agenda.

Non-Energy Opportunity 4: Wireless TRVs

In a world where home control systems are not focused on energy, wireless TRVs can offer energy benefits without complex data processing (2/3)

Risk & Reward matrix



Value from Opportunity

- Value comes from exploiting energy efficiency opportunities within the home through tailoring heating levels on a more granular room-by-room basis to avoid wastage.
- There are also benefits for customers around personalised comfort and an increased sense of control where different rooms in the home can be set according to personal preference rather than one setting for the whole home.
- In this opportunity value is restricted to heating related energy efficiency benefits.

Costs

- Wireless TRV's offer a neat, low-cost way of applying smart technology within the home to save energy in an economic, uncomplicated way.
- Ease of installation should reduce costs by allowing units to be supplied outside the traditional installer/merchant route, which major suppliers of traditional TRVs are locked into (the 'gilded cage').
- Development costs are primarily around design and engineering of the product, including technical integration & hub, and development of a new supply chain outside legacy merchant route.
 - Units are likely to be dearer than conventional units owing to connectivity, user interface and hub integration.
- Design and ease of use are both essential components of the finished product, which will impose an up front cost (most players in this space have a strong engineering orientation: i.e. products are functional but ugly, and not particularly user-friendly).
 - To differentiate from existing units a higher price point is likely to be required, which implies a necessary emphasis on design.

Risks and Barriers

- Less risks/barriers associated with this opportunity though there are important design issues around the link to the hub/platform regarding power management, range, security and compatibility.
 - Power management is linked to protocol choice and hence whether a physical in-home hub would be needed – e.g. Wifi supports directly-addressable IP addresses, thus making a soft hub (e.g. via smart devices) realistic – however, it may bring power usage issues with it, unlike certain other home automation protocols.
 - Reliance on open protocol standards being developed so that there is flexibility in terms of hubs the TRVs could operate with – if closed platforms dominate the market then partnerships would need to be formed with dominant providers.

In a world where home control systems are not focused on energy, wireless TRVs can offer energy benefits without complex data processing (3/3)

More detail on the opportunity

- In this case the HEMS is not part of the offering, instead it is connecting to an existing home control hub, whether this is:
 - A 'hard' physical hub in the home); or,
 - A 'soft' hub involving a smart device based app accessible via the cloud
- Protocol selection may determine whether or not a basic physical hub is needed, but it should be possible to avoid one entirely if the TRV is IP-addressable.

Data that the HEMS could measure

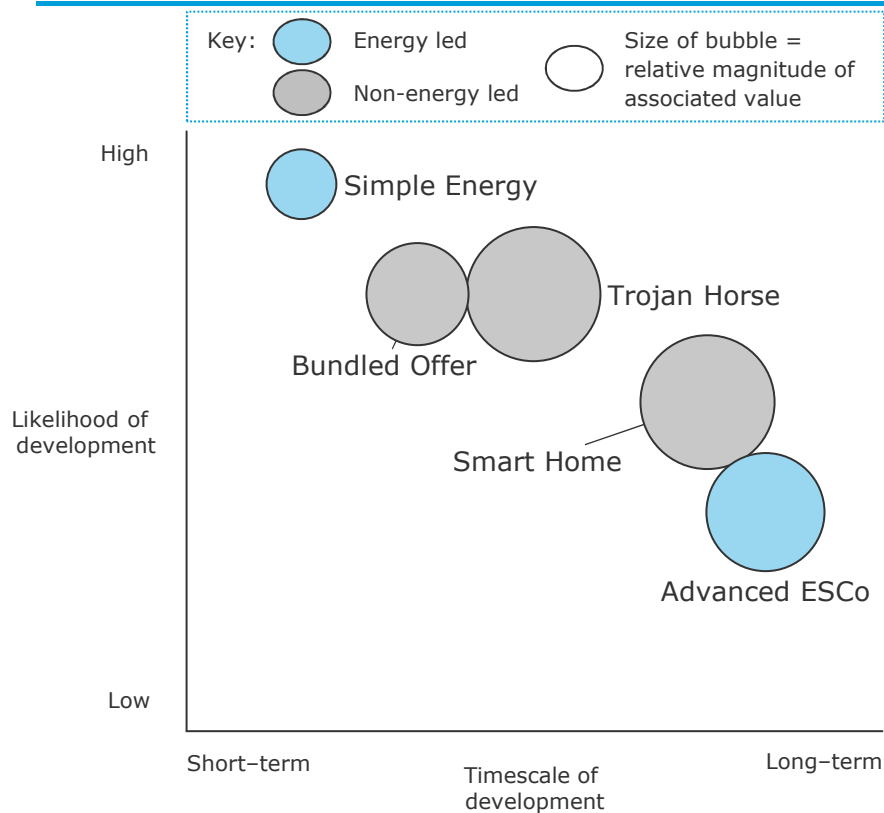
- The core functions of the TRV should merely be to measure room temperature and, if necessary, shut off the radiator.
- However, there are a number of additional features that may increase desirability:
 - Incorporate occupancy sensors (shut off radiators in empty rooms);
 - Respond to specified user lifestyle preferences & manual overrides;
 - Allow for flow temperatures, radiator thermal losses, and draughts;
 - Learn how room is used over time (build room usage profiles).

Section A

2. HEMS narrative scenario analysis

The five future scenarios for home control solutions have varying likelihoods and timescales; three involve energy-led development

Relative likelihood and potential of future scenarios



Discussion of relative scenarios

- Five main scenarios have been developed: 'Simple Energy', and 'Advanced ESCo' refer to energy taking a lead in the market for home control while 'Trojan Horse', 'Bundled Offer' and 'Smart Home' refer to non-energy leads.
- '**Simple Energy**' and '**Advanced ESCo**' scenarios illustrate the potentially binary nature of the energy-led examples. A simple energy proposition, while already happening, is unlikely to unlock significant value. To do so requires the opening up of new types of offers and business models, but if this is achieved then there are potentially large rewards available. Opportunities 1-3 relate to the Advanced ESCo scenario.
- The '**Trojan Horse**' scenario is interesting in that while energy takes a lead (e.g. Google using Nest to enter the home) the main aim is not necessarily to extract value from energy services but to establish the relationship and channel to the consumer so that data can be collected and used to make offerings. This value aspect also forms part of the 'Bundled Offer' and 'Smart Home' scenarios
- '**Bundled Offer**' and '**Smart Home**' scenarios illustrate the different non-energy approaches with the former taking a practical and iterative approach to offerings to make use of competitive advantages (of Telcos in particular), while the latter reflects a more visionary approach to developing control in the home centred around lifestyle and entertainment.

Scenario characterisation

Simple Energy: Energy companies dominate HEMS market with low-value offerings

Advanced ESCo: Development of Advanced ESCo models that utilise HEMS to unify energy services and supply

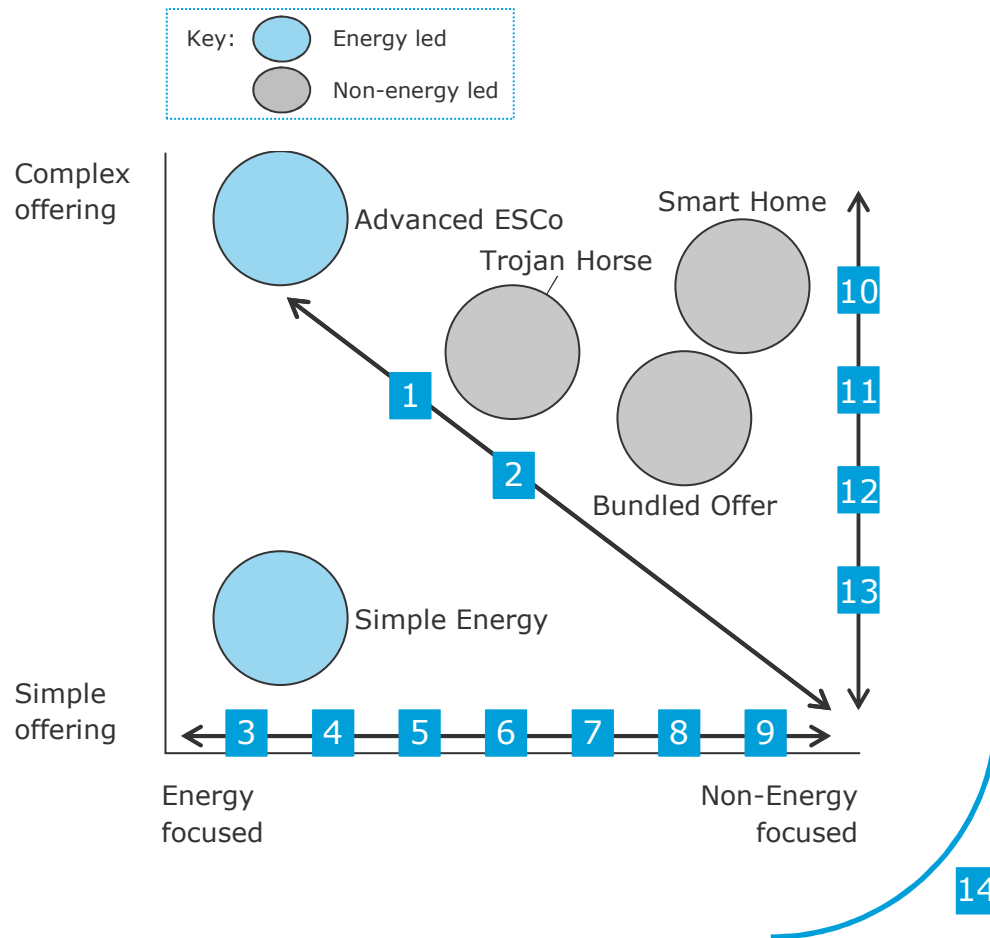
Trojan Horse: Data/ICT new entrants dominate using HEMS as an entry point to the 'Internet of Things'

Bundled Offer: Telcos lead the development of a platform in the home which is used to bundle communication linked propositions of which energy may be one

Smart Home: Non-energy appliances and entertainment lead visionary and purpose-built smart home offerings

Drivers impact on the future HEMS market direction in two main ways: how simple/complex the offering is and whether or not it takes an energy lead

Scenario type and key drivers



[Detail on driver definitions and analysis of likely development can be found in Section 4]

Explanation

Different narratives are dependent on different drivers to varying degrees

- Two drivers (**1 & 2**) tend to push towards more complex energy-led scenarios, these are:
 - Policy interventions or other developments that encourage demand shifting value to be exploited (1)
 - Step change in electrification through low carbon technology, such as electric vehicles (EVs) and heat pumps (HPs) (2)
- Some drivers (here labelled **3-9**) are primarily drivers of whether scenarios develop towards a more energy or non-energy led market for home control. These include:
 - Policy related drivers such as the impact of Smart Meter development (3) or potential reform of Energy Efficiency schemes to incorporate behaviour change / smart controls (4)
 - More economic related issues such as energy price development (relative to economic growth (5)) and energy retail competition (6)
 - Environmental impacts through more visible examples attributed to climate change and changing public attitudes (7)
 - Social attitudes through consumer trust and perception of energy companies (8)
 - Technology development in terms of reducing the reliance of HEMS on installers (9)
- Others (here labelled **10-13**) impact whether more simple or complex offers are likely to be made. These include:
 - Technology focused drivers such as penetration of smart devices / broadband in home (10) and the level of technology standardisation in the market (11)
 - As well as social/legal issues (12) such as changes in data privacy legislation or cultural norms and consumer trust and perception of HEMS / in-home devices (13)
- Finally driver **14** relates to economic growth which has a broader impact across scenarios

Scenario: SIMPLE ENERGY

Energy companies dominate HEMS market with low-value offerings

Simple Energy narrative description

Major energy suppliers drive to deepen customer relationships & reduce churn by bundling low-cost/free HEMS with supply

Type of offering:

- Energy-centric devices distributed by energy companies as part of supply contract
- Likely dominated by mediocre-to-fair quality offerings, but with 'something-for-nothing' pitch still ensuring mass market penetration – very low price or even free.
- Likely involve customer commitment to remain with supplier for a minimum contracted period
- Potential "freemium" model – basic package for free with paid-for add-ons.

Potential Winners & Losers:

- Market likely characterised by one brand per utility, with a 'much of a muchness' feel to most offerings
- **Winners** - A subset of utilities may dominate with slightly more desirable products & slickest supply chains
- Associated successful HEMS companies achieve significant per-unit price reductions
- **Losers** - Non-utility HEMS products are undermined, because selling for anything above an ultra-low price is no longer viable

Type of HEMS:

- Emphasis on ease of use & energy saving
- Limited footprint in the home, with wireless, clean look throughout – unlikely to include extensive add-ons for radiators, sensors, hubs, cables etc.
- Internet, mobile links essential
- Limited non-energy functionality

What would lead to this scenario?

- Rising prices increase customer desire to reduce and control their bills, while an increasingly competitive retail market with active customer switching means that suppliers look for ways to improve their customer trust and loyalty to reduce churn and improve customer acquisition. Helped by a relaxation on constraints around number of tariffs suppliers can offer HEMS as part of tariff scheme.
- Smart metering programme proceeds as planned with CAD plans allowing simple devices to interact in more complex ways and leverage the existing SM infrastructure for comms, leading to the potential to increase scope of data available to HEMS.
- Regulatory acceptance of HEMS as a carbon saving technology and inclusion within future energy company obligations & incentives. Greater environmental awareness from consumers.
- No major policy interventions to encourage demand-shifting and limited take-up of Electric Vehicles (EVs) & Heat Pumps (HPs) so reduced incentive to shift demand.
- Concern about the use of device data potentially preventing more complex HEMS offerings developing

What value could be exploited and when?

- Energy suppliers derive value via reduced churn & improved brand but this is relatively small.
- They are also able to exploit simple data captured by the HEMS to offer further tailored products or tariffs.
- Customers benefit from a degree of regained control over ever-rising bills though energy savings not shared by supplier.
- Possible value to meet ECO-type obligations
- Theoretically much of the value is available now but it is likely to increase over time as the drivers take effect, in particular increasing competition, regulatory acceptance and opening up an ECO value stream. Also, availability of energy-led HEMS products that are economically viable as 'free or cheap' within a supply package

Scenario: ADVANCED ESCO

Development of Advanced ESCo models that utilise HEMS to unify energy services and supply

Advanced ESCo narrative description

Energy Service Companies combine energy services and supply to provide pricing certainty via an advanced, HEMS-managed heating system

Type of offering:

- Better designed heating systems & monetizing flexibility allow for lower bills & performance guarantees.
- Heat engineering-led solutions (similar to those from Bosch, Viessmann today) with extensive emphasis on design & monitoring – tailored heat system design underpinning agreed energy supply commitments.
- Supply contract emphasizes comfort over energy sale, with performance guarantees so that suppliers focus on energy efficiency savings rather than energy sales.
- Demand shifting associated with operation of new electric devices (EVs & HPs).

Potential Winners & Losers:

Winners

- Boiler manufacturers/heat-led service companies moving into supply market.
- Possibly British Gas, should they choose to exploit their incumbent position as both leading installer & supplier.
- New supply entrants in possible JV with either heat system design & installers or EV manufacturers

- **Losers** - Other energy supply co.'s (unlikely to join in owing to capability gap & threat to legacy business model)

Type of HEMS:

- HEMS at heart of properly designed & sized domestic heating solutions that take account of thermal losses, insulation/building fabric, local weather forecast, return flow temps, occupancy, zoning, window & door sensors.
- Smart local demand forecasting to exploit ToU trading & DR.

What would lead to this scenario?

- Rising domestic energy bills, consumers' loss of trust in existing suppliers & public awareness that current domestic heating systems are oversized & inefficient.
- Policy interventions that encourage demand-shifting and focus of market reforms on energy services delivery, not competition (incentivises suppliers to promote energy efficiency & limit supply).
- Uptake of EVs and HPs that create demand shifting need and opportunities.
- The desire for more complex energy offering is bolstered by Smart metering roll-out success with positive customer engagement and introduction of ToU pricing / market structure for residential DR.
- Increasing technology standardisation and the sharing and use of energy data an accepted norm.

What value could be exploited and when?

- Value of energy efficiency savings in the home shared between customer and ESCo – energy service contracts provide subscription-type revenues for service providers & deeper customer relationships.
- Demand shifting value from providing flexibility through, for example, new heating / storage technologies (e.g. hybrids, HPs with thermal stores, M-CHP, EVs etc).
- Potential to also use exploit data and bundling opportunities though this would not be the primary purpose and may be difficult in the context of a formal energy supply relationship.
- Customers also gain peace of mind from price guarantees, & better quality heating from tailored design.
- Depends on a number of developments that push out the timescale for these values as per drivers above, in particular a market framework / regulation allowing exploitation of value of flexible demand, regulatory support for longer service-orientated offerings
- Also requires highly monitored/engineering-led HEMS (but packaged in an attractive way for the mass market) reaching a price point whereby costs can be amortised against a service contract

Scenario: TROJAN HORSE

Data/ICT new entrants dominate using HEMS as an entry point to the 'Internet of Things'

Trojan Horse narrative description

Data/ICT giants use HEMS offerings to penetrate the home to offer personalised control over energy with a view to gathering data & developing a channel to offer new needs & services

Type of offering:

- Energy-led with emphasis on personal comfort, control & lifestyle factors – energy makes sense as an entry point as it offers a 'golden thread' to other energy-using devices/appliances as well as already providing control in the home through the thermostat.
- Likely steps from energy into wider lifestyle and 'peace of mind' offerings (e.g. security, remote monitoring) using improved understanding of customer.
- Also potential to use channel to consumer to offer products and services from third parties.

Potential Winners & Losers:

- **Winners** - ICT and data companies (e.g. Google, Apple) dominate by linking information to other Big Data sources.
- Third party providers of specialist services such as healthcare find a new route to market, but remain dependent on data companies.
- **Losers** - Energy companies are vulnerable. Possibly they may still make some progress via HEMS sales, & play in this scenario via partnerships or acquisition of core skills.

Type of HEMS:

- HEMS sophisticated enough to allow collection of lifestyle information (e.g. temperature by zone/sensor, occupancy, appliance signature recognition).
- Capacity to store and analyse potentially huge amounts of data (or send centrally).
- Engineering-style capabilities, such as those in the Advanced ESCo scenario, are however not required

What would lead to this scenario?

- Energy prices continue rising, especially if combined with rising environmental awareness and concerns, so that energy makes sense as an entry point to the home - i.e. positioned as a quick win, but becomes a Trojan Horse with which to colonise the space
- Economic growth and rising disposable incomes that means consumers are better positioned to see energy as a lifestyle offering related to comfort, control and convenience rather than just cost.
- Race to 'own' the smart home amongst major ICT / data brands leads to significant marketing effort, that in turn produces customer desire for new smart home, data-driven offerings
- The use of energy and device data is accepted without major issues or complaint allowing data captured to become rich enough to support meaningful analysis (and associated data analytics investment) allowing cross-sell opportunities to be identified

What value could be exploited and when?

- Value primarily comes from the combination of data collected on consumers and the direct channel opened to them creating advertising/marketing revenue as well as the potential for highly tailored and targeted service offerings.
- New service-oriented markets emerge, with customers benefitting from tailored remote service provision directly into the home.
- Subscription-based models linked to lifestyle are likely to yield valuable, longer-term revenue streams.
- There could also be value from selling HEMS at a profit.
- Theoretically the value exists already but timescale to exploit it is uncertain, in particular depending on how consumers take it up and adapt to a different way of interacting with companies.
- Also, companies will need to learn how to make new types of service offering in new ways, as potentially this leads to whole new business models being developed.

Scenario: BUNDLED OFFER

Telcos lead the development of a platform in the home which is used to bundle communication linked propositions of which energy may be one

Bundled Offer narrative description

Telco leverage their infrastructure and brand strength, customer base and successful US examples to offer compelling 'peace of mind' offerings.

Type of offering:

- Led by telco giants (BT, Virgin, TalkTalk, Sky) with broadband offerings that can be utilised and the ability to exploit existing customer infrastructure.
- Broadband greater and greater bandwidth allowing new uses for it that Telcos are looking to uncover.
- Initial focus on security and 'peace of mind'.
- Route to market through add-ons to existing broadband & telco bundles.
- Likely to revolve around a platform that can capture / store data in the home (similar to "icontrol" at heart of ComCast offering).
- Heating controls could be a pull-through / add-on.

Potential Winners & Losers:

- **Winners** - Telcos win as a result of their large customer base and natural extension / brand-stretch from current offerings (as demonstrated in the US).
- Key platform partners (e.g. icontrol) are big winners.
- **Losers** - Energy and heating control companies are lower value add-ons, while utilities are largely irrelevant.

Type of HEMS:

- Advanced platform (not necessarily HEMS) in the home potentially with cameras, motion sensors, lighting & climate controls, to deliver security, video surveillance etc.
- High bandwidth requirements likely
- Simple communication between energy add-ons (thermostat, Thermostatic Radiator Valves (TRVs), smart plugs, lighting) and the platform.

What would lead to this scenario?

- Key driver is telco / broadband company thirst to go after 'peace of mind' market profit pools – following the example of AT&T, ComCast etc. in the US - uncertain as to whether or not this will materialize – quite binary.
- Success dependent upon positive customer reaction to 'peace of mind' offerings.
- Implicit assumption that other Energy-led offerings don't dominate the market which may link to their drivers being negative, e.g. a combination of falling consumer trust in energy market, limited environmental concerns and falling relative prices, as well as concern about the use of device data for more complex HEMS offering.

What value could be exploited and when?

- Value primarily relates to the bundling opportunity for Telcos and their ability to maximise efficiencies in their customer support functions and sweat assets, finding multiple functions for existing infrastructure.
- Possible future value from additional data analytics but this isn't necessarily driving today's strategy.
- Timing uncertain but Telcos could make moves at any time in the next few years – there is nothing preventing the exploitation of the value at stake.
- Exploitation likely to occur as Telco market becomes saturated and broadband coverage nears completion in the UK.
- With their large customer base and an offering that is relevant to most of the market, could grow quickly.
- Reliant upon telcos going after this prize and 'peace of mind' offerings being attractive to customers

Scenario: SMART HOME

Non-energy appliances and entertainment lead visionary and purpose-built smart home offerings

Smart Home narrative description

Smart Home space claimed by non-energy players with energy only added later as a secondary feature

Type of offering:

- Non-energy focused, with likely emphasis on one / some / all of:
 - entertainment
 - appliance management
 - home automation, profiling & control
 - access and security
 - "joy" & ease of use (smart watches, robot vacuum cleaners etc.)
- Energy a potential marginal pull-through

Potential Winners & Losers:

- **Winners** - Likely to be valuable brands, either domestic goods manufacturers (e.g. Samsung, Sony) and/or data specialists aiming to control the hub/cloud in the home (e.g. Microsoft, Google – link to Trojan Horse scenario).
- Potential for JVs between data /ICT companies and appliance manufacturers.
- **Losers** - Energy companies unable to compete on account of skills gaps and brand deficit.

Type of HEMS:

- High bandwidth (likely entertainment-based) hub (not necessarily HEMS) at the core of the smart home offering
- Potential for simple communication between energy add-ons (thermostat, TRVs, smart plugs, lighting) and the platform.
- Likely to require capacity to store and analyse huge amounts of data at a local level

What would lead to this scenario?

- In contrast to the Trojan Horse scenario where the channel to the home is explored through energy, here the starting point is not energy but lifestyle and multi-media (e.g. entertainment, control & 'coolness' factors).
- Energy therefore becomes a secondary consideration, added at a later stage as an optional extra
- Likelihood is increased by continued smart device penetration and acceptance from consumers of the linkage of different services via these devices.
- Also greater technology standardisation and ease with data privacy considerations would help smooth development.

What value could be exploited and when?

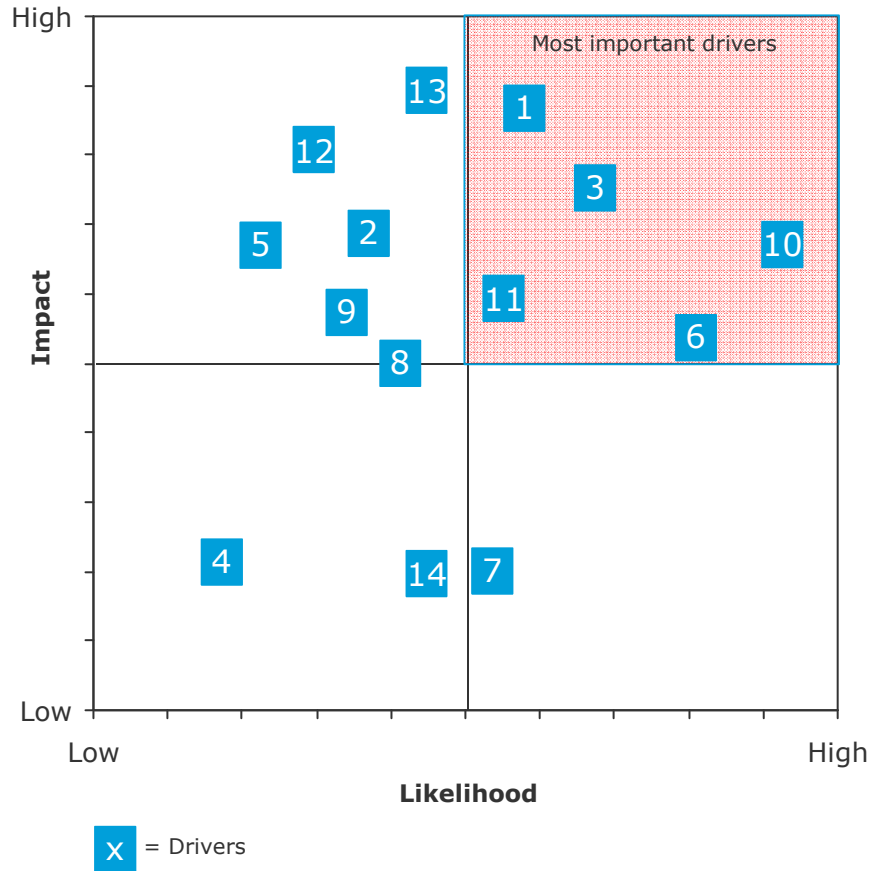
- As with the Trojan Horse scenario, value is primarily from the combination of data collected from consumers and the direct channel opened to them creating advertising/marketing revenue as well as the potential for highly tailored and targeted service offerings.
- New service-oriented markets emerge, with customers benefitting from tailored remote service provision directly into the home.
- Subscription-based models linked to lifestyle are likely to yield valuable, longer-term revenue streams.
- No specific trigger applies, with customer appetite for different potential offering types still unknown, for instance whether an energy-led or lifestyle & entertainment led offer will be most attractive to begin with.
- There is likely to be intense competition between different providers as the market shakes itself out, and associated standards wars, which may inhibit progress, as confused, hesitant consumers "wait and see".
- However, it seems inevitable that connectivity will eventually become a must-have, with an inevitable movement towards an 'internet of things' at some point.

Section A

3. Driver and Value Conclusions

Key drivers are: policy related, including ToU/DR and smart metering; energy market development; and technology related

Driver relevance mapping

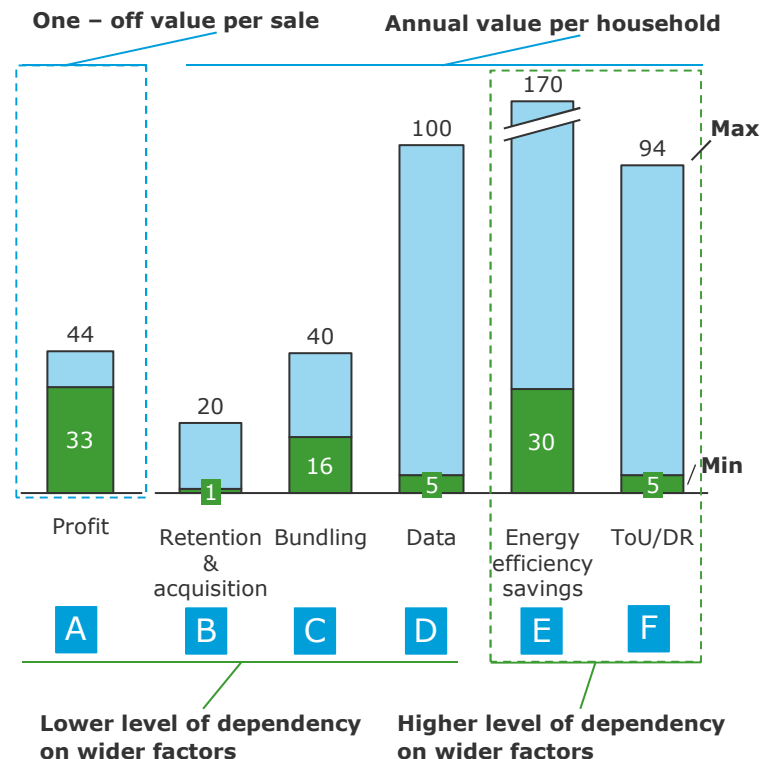


High level view of key drivers impact and likelihoods

- Five key drivers have a high potential impact on the future HEMS market and a high likelihood of materialising. These drivers represent a mix of different types:
 - Policy related drivers (1,3):**
 - (1) potential policy interventions or other developments facilitating access to the value of demand shifting; and
 - (3) developments around the functionality or customer experience with smart metering.
 - Technology related drivers (10, 11):**
 - (10) the penetration and use of smart devices/broadband in homes; and
 - (11) the level of technology standardisation.
 - Retail energy market driver (6):**
 - (6) the development of energy retail competition driving customer retention and acquisition strategies.
- A group of 6 drivers could have a high potential impact on the market, but a low to medium likelihood of manifestation. They include:
 - Drivers based on consumer attitudes and perception (8, 12,13):**
 - (8) changes in consumer trust and perception of energy companies; or in
 - (12) changes in data legislation or cultural norms; and
 - (13) changes in consumer trust and perception of HEMS and other IHDs.
 - Market drivers (2, 5):**
 - (2) a step change in electrification through low carbon technology like EVs and HPs; and
 - (5) development of household energy prices relative to economic growth;
 - Technology driver (9):**
 - (9) technology development to reduce the reliance of HEMS on installers.
- The remaining 3 drivers (4, 7, 14) could have a relatively low impact on the market, with varying degrees of likelihood:
 - (4) potential reform of energy efficiency schemes to incorporate behavioural change/smart controls is not at all certain and may only have a modest impact;
 - (7) changes in public attitudes or behaviour from climate change and
 - (14) economic growth driving willingness to spend on lifestyle or low-carbon products/services both have medium likelihood, and a comparatively low impact.

Potential values associated with HEMS & home platform solutions is in the £100s per year but some are more dependent on wider factors than others

Relative size of values per household (£)



Discussion of relative values

- Whilst most of the estimated values correspond to an annual value that HEMS can exploit (Values B,C,D,E,F), **profit** refers to a one-off value that occurs at the time of HEMS purchase
- **ToU & DR** value is more dependent on wider factors regarding the uptake of EVs and HPs, that cannot be easily influenced by the HEMS provider
- Similarly, **energy efficiency savings** depend in part on the customer's behaviour, which the HEMS (provider) may influence, and in part on the dwelling's energy efficiency rating, which the HEMS (provider) cannot control.
- In contrast, values A, B, C, D also depend on a set of wider factors that HEMS providers are better placed to influence directly.
- The highest value comes from **energy efficiency savings**, which could be as high as £170/year (depending on the customer's habits and the dwelling's energy efficiency) followed by **the value of data**, which could reach £100/year
- **ToU & DR** could account for a value of £5/year in 2015, up to £94/year by 2025. However, this value depends strongly on the uptake of low carbon technologies (EVs and HPs) and the removal of practical barriers for DR
- Taking advantage of cost savings and loyalty benefits that can be achieved through **bundling** could lead to a value of up to £40/year per complementary service whereas **retention and acquisition** could offer a relatively small benefit of up to £20/year to energy suppliers
- Lastly, there is a one-off value from **profits** per HEMS unit sold, which could reach up to £44 per sale

Value description

- Profit: Basic value proposition, in terms of profit per unit sold
- Retention & Acquisition: Value from customer retention and acquisition for energy suppliers
- Bundling: Bundling of complementary offerings (cost economies and margin pricing strategies in bundled offerings)
- Data: Value from customer relationship and associated data (data analytics and channel to consumers)
- Energy efficiency savings: Energy efficiency savings from improved control of energy use
- ToU & DR: Demand-shifting related value based on electricity load shifting

Section A

4. Supporting evidence on drivers of future HEMS

Drivers that push towards more complex energy led offerings tend to be policy related

Driver	Driver type	Logic of impact	Potential size of impact and likelihood
1 Policy interventions or other developments that encourage demand shifting value to be exploited	Policy	<ul style="list-style-type: none"> - Increased desire/ability to exploit value from demand shifting leads to greater scope to offer more complex and energy-led offerings - Type of intervention could include: move towards increased settlement based on actuals; increased pressure on DNOs to use D-shifting approaches; increased demand from D-side reserve from SO; changing regulation (e.g. DCUSA rules, or DNO ownership of storage) that enable value to be exploited at lower cost 	<ul style="list-style-type: none"> - The impact could be very large of significant changes in opening up possibilities for exploiting new value - It seems more likely that this will happen sooner through the supplier business model as smart metering develops, as there are significant challenges on the network side that may delay serious change in this area.
2 Step change in electrification through low carbon technology (EVs & HPs)	Policy & Technology	<ul style="list-style-type: none"> - A significant increase of EV and HP penetration will increase the amount of available flexible load during peak - Flexible loads provide the opportunity to be shifted to allow the more efficient operation of the system, unlocking this system value - More complex energy offerings can be developed to allow the efficient control of these loads 	<ul style="list-style-type: none"> - There are wide-ranging scenarios around the uptake of EVs and HPs, as the development of these technologies currently depends heavily on policy and subsidies

Driver **1**

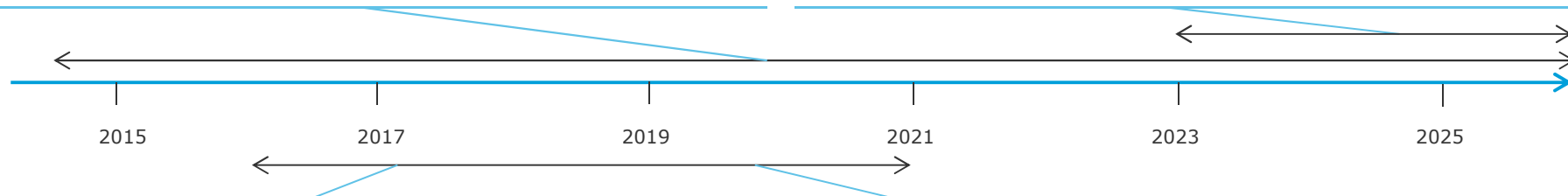
Demand shifting is more likely to be encouraged through suppliers than network operators

Increased demand for demand side services from SO

- Due to reduced capacity generation margins and the increased penetration of intermittent renewables, the electricity System Operator (SO) will look to procure more balancing services from the demand side
 - The SO has currently issued a new balancing service, the Demand Side Balancing Reserve for the period April 2014 – March 2016 to ensure system operation
- However, there are significant challenges for domestic demand shifting with regard to i) the verification, ii) the materialisation of the service, iii) the availability of flexible load that can be shifted due to the introduction of ToU tariffs

Increased pressure on DNOs to use demand side services

- DNOs investment plans have been already submitted for the period 2015-2023
- Whilst they are well incentivised to utilise demand side services to defer network investments under the current regulatory framework (RIIO), the uptake of such services will be very limited during this price control period
- Significant uptake of demand side services is only likely to happen during the next price control period 2023 – 2031 when DNOs will submit their new investment plans
- However, the challenges for demand side services to the SO are also applicable in this case



- Extensive industry discussions are ongoing regarding the move towards settlement on actuals for all customers to boost demand side
 - Ofgem is expected soon to issue a decision on mandating half-hourly settlement for customers in Profile Classes 5 – 8 (larger commercial customers). If positive, this could steer developments towards the adoption of HH settlement for all customers
 - Smaller suppliers that do not hold generation assets are likely to adopt settlement on actuals to optimise their wholesale costs

- The introduction of ToU tariffs will allow system wide benefits and thus it is seriously considered by regulators
- Italian regulator has mandated the introduction of ToU tariffs since 2010 and the Irish regulator is doing so as part of their smart metering programme. However, the introduction though of mandated ToU tariffs creates “winners & losers”
- Smaller suppliers that do not hold generation assets are likely to adopt ToU to optimise their wholesale costs

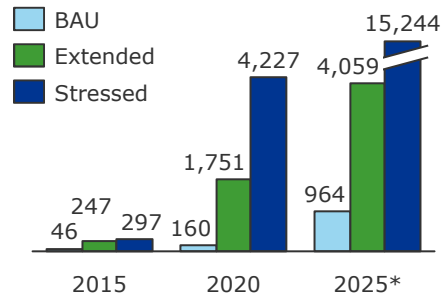
Move towards settlement on actuals for all domestic customers

Move towards ToU tariffs

Whilst the demand side services to SO and DNO seem less likely to materialise by 2025, the development of ToU tariffs and settlement on actuals seems very likely to happen by 2021, potentially driven by smaller innovative suppliers

Both EVs & HPs have potential for a step change in growth offering demand shifting opportunities but there is huge uncertainty around how these markets might develop

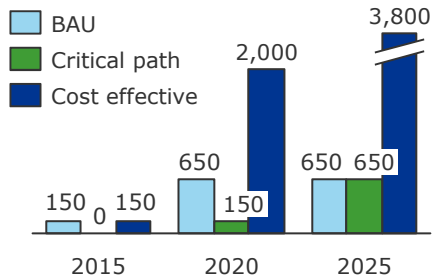
Example of study on total number of EVs in UK (000's)



*Data for 2025 derived through linear extrapolation of estimates between 2020 and 2030 (Element Energy 2010)

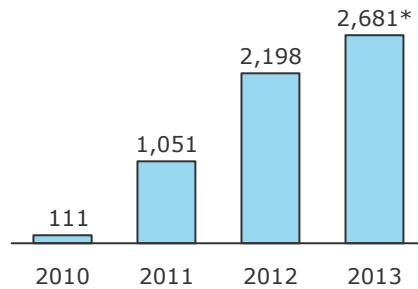
Extended scenario adopts Committee of Climate Change's estimations in order to meet emission targets and Stressed scenario is the absolute maximum due to constraints in supply chain

Example of study on total number of HPs in UK (000's)



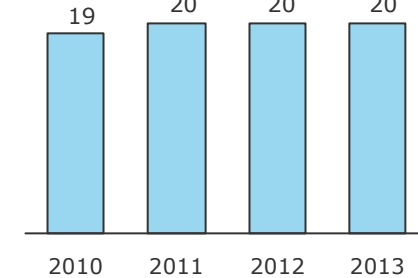
Critical path refers to the minimum level of HP uptake required to make meeting the 2050 carbon target possible. Cost-effective path is consistent with meeting the 2050 carbon targets at least cost (Element Energy/Frontier Economics 2013)

EV sales in UK



*Doesn't include Q4 (DfT 2014)

HP sales in UK (000's)



(BSRIA Worldwide Market Intelligence 2011, Element Energy/Frontier Economics 2013)

Potential for a step change in EV growth

- Different forecasts provide a wide range from around 100,000 to 1.7m for 2020
- Global and UK EV shares have doubled between 2011 and 2012, and doubled again in UK between the first half of 2012 and 2013
- Although, the past sales rates indicate that the BAU Scenario is about to materialise, in March 2014 1,200 EVs were sold compared with 270 in the same month last year
- Significant reduction in battery costs has been achieved: from \$1000 in 2008 to \$485 in 2012
- Major car manufactures are entering the EVs market (BMW, Nissan, Vauxhall, Renault, VW, Smart, Peugeot) - some of them follow also quite aggressive marketing campaigns (e.g. BMW i3)
- Tesla reached a market valuation of \$30bn in February 2014 providing an indication how promising EVs might be not necessarily relying on subsidies

Potential for a step change in HP growth

- Different forecasts have a massive range from around 150,000 to 2m for 2020
- Delta-EE estimates 2.8m HPs and 2m Hybrid HPs by 2025
- A significant number of HPs is expected to be deployed by 2020 under the current policy path (BAU scenario) that implies that policy support through subsidies will continue
- However, the deployment of HPs could be delayed without impacting the ability of UK to meet DECCs HPs targets for 2050

HPs are a proven technology and have already some scale in the market; EVs are still under development and gained significant traction during the last year. Whilst there is potential for a step change in both technologies, they still face potential pitfalls.

Whether the market for the connected home is led by energy players will be influenced by policy ... (1/3)

Driver	Driver type	Logic of impact	Potential size of impact and likelihood
3 Impacts dependent on Smart Meter development	Policy	<ul style="list-style-type: none"> - Level of functionality will impact on opportunities available in demand shifting based on what data can be gathered by, and which products can attach to, the smart metering infrastructure - Positive or negative customer experience with the programme will have an impact on customer engagement 	<ul style="list-style-type: none"> - There is potential for a reduction in smart metering programme functionality which could have a significant impact on the development of more simple and energy led offerings - It is very likely that customer engagement with smart metering will have a very significant impact on energy related offerings
4 Reform of Energy Efficiency schemes to incorporate behaviour change / smart controls	Policy	<ul style="list-style-type: none"> - More stringent environmental obligations could incentivise utilities to deploy HEMS to meet targets; - Availability of subsidies lowers the cost of HEMS to consumers; - Support through EE schemes would mainly benefit energy led HEMS offerings, non-energy led offerings may not be able to benefit due to cross-subsidisation of non-energy components 	<ul style="list-style-type: none"> - Favourable reform is unlikely to take place and would have a small impact: <ul style="list-style-type: none"> - current EE schemes do not support HEMS (ECO) or are ineffective (Green Deal) - although UK heating controls are known to be inefficient, there is no formal evidence that HEMS lead to EE savings or that market needs government intervention - policymakers face pressure to reduce policy cost impact on bills - even with reform, availability and consumer take-up of subsidies for HEMS is likely to be small

... and economic related factors... (2/3)

Driver	Driver type	Logic of impact	Potential size of impact and likelihood
5 Energy price development (relative to economic growth)	Economic & Policy	<ul style="list-style-type: none"> - growth in household energy bills is outpacing economic growth, increasing impact of the energy bill on household budget and raising consumer willingness to spend on HEMS, especially energy led HEMS; - economic growth outpacing growth in household energy bills deprioritises the need to reduce energy bills and can shift consumer focus on non-energy led HEMS 	<ul style="list-style-type: none"> - current forecasts of real GDP growth for the UK outpace growth in household energy bills as forecast by Ofgem/DECC, even when accounting for DECC's optimism regarding efficiency savings created by policies - this forecast suggests an increasing focus on non-energy led HEMS relative to energy led offerings
6 Energy retail competition	Economic	<ul style="list-style-type: none"> - A key ingredient of a competitive energy market is customer switching. As the level of switching increases, the incentives on suppliers to retain existing customers and acquire new customers becomes more acute. Consequently, suppliers will explore ways of improving service and developing innovative products, which drives energy led HEMS. 	<ul style="list-style-type: none"> - We expect retail competition to increase, which reflects: a sharper regulatory focus (e.g. Ofgem's retail market reform); deployment of technological innovations (e.g. HEMS); and continuing media interest raising consumer engagement. Big 6 suppliers are likely (at least initially) to develop a simple HEM offering that builds on existing in-house capabilities. New entrants will increasingly explore innovative offerings (based around HEMS) in order to compete with market incumbents.

... but also environmental and social concerns as well as technology development (3/3)

Driver	Driver type	Logic of impact	Potential size of impact and likelihood
7 Environmental impacts through more visible examples attributed to climate change and changing public attitudes	Social, Environmental & Policy	<ul style="list-style-type: none"> - More frequent and greater visible environmental impacts can increase social responsibility and lead to greater desire from consumers to reduce their carbon emissions - As a result consumers may be willing to change their energy demand habits and adopt low carbon technologies (EVs and HPs) - Government will also have pressure to take more action by promoting environmentally friendly technologies - Practically speaking, potential for changes in seasonal energy needs (e.g. air-conditioning in summer, heat management in winter) may have an impact on energy use 	<ul style="list-style-type: none"> - Extreme weather events (heat waves, extreme precipitation, and coastal flooding) are already increasing could continue on that trend, with 1°C additional warming expected by 2025 (IPCC 2014). - Heat waves are likely to increase in the UK (Northern Europe) (IPCC 2014) leading to potential uptake of air-condition units - Although the likelihood of these events is considerable it is not expected that this could have a significant impact on consumer and government behaviour in the short and mid-term
8 Consumer trust and perception of energy companies	Social	<ul style="list-style-type: none"> - The ability of energy suppliers to engage consumers in the retail market is important. If consumers lack trust in energy companies, then their willingness to take up new innovative offerings (e.g. HEMS) will be low. Further, if consumer switching remains low then incentives on existing energy companies to improve consumer offering may also be low. 	<ul style="list-style-type: none"> - The low level of trust in the energy companies is likely to continue and maybe compounded by further energy price rises. Which? Research (November 2013) revealed that only 15% of consumers trust energy companies to act in their best interests. Further, 59% of consumers said they lack trust in energy companies. New entrants to the market could provide competitive pressure by offering an improved service and innovative offering (e.g. HEMS).
9 Technology reduces reliance on installers	Technology	<ul style="list-style-type: none"> - Two potential scenarios could develop i.e. a plug and play installation or a device that requires installation. A plug and play installation would allow a rapid roll-out of HEMS at relatively low cost. An installer-led approach carries greater risk of poor installation (and negative publicity) and may slow the potential roll-out of HEMS. 	<ul style="list-style-type: none"> - A plug and play solution would have a high impact, but is dependent on technological breakthroughs.

Reduced functionality of the smart metering infrastructure can both directly create opportunities and eliminate others

Smart metering programme is delayed or postponed

- A delay of up to 6 months is a significant possibility but it is still expected that the gradual adoption of ToU tariffs and HH settlement based on actual data will happen
- Due to the complexity of the smart metering programme, there is a significant risk that testing requirements cause a 3-6 months delay (mass rollout currently planned to start at the end of 2015)
- A postponement of the programme for several years is unlikely
 - Given the general election is planned for 2015, any new government could potentially postpone the development of the smart metering programme, however this is seen as unlikely given the progress that is now being made.

3rd party access to services offered through the smart metering infrastructure is enhanced

- Enhanced 3rd party access is possible
 - Currently the functionality available to 3rd parties is quite restricted
- ✓ However, reduced regulatory barriers to participate in the smart metering programme coupled with access to a larger number of services would allow HEMS providers to make direct offerings to customers

Smart metering programme has a significant impact on customer engagement with energy related products

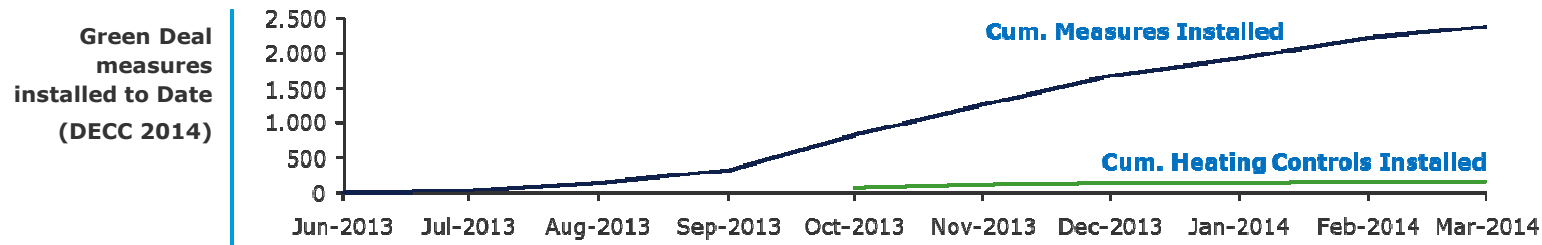
- The Programme will have a significant impact on customer engagement
 - ✓ A positive experience could potentially lead to improved acceptance of in-home technology, thus boosting HEMS sales.
 - ✗ A negative experience could threaten the potential uptake of HEMS

Smart metering programme functionality is reduced

- Reduced functionality is a possibility that should be accounted for
 - Due to the complexity of the smart metering programme, delays or difficulties in implementation could lead to reduced functionality - in short term or longer term - of components that are not fundamental
 - Some elements except for the electricity and gas meters, the comms hub and the IHD could be excluded: ALCSs and CADs fall under this category as they are additional to the core drivers of the programme
 - The longer the potential delays the greater the chance of reduced functionality
- ✓ An increased need for more sophisticated functionality of HEMS is likely to occur if ALCSs are removed as the ability for automated demand shifting through the smart metering programme will be restricted.
- ✗ Reduced amount of data (and thus reduced value from it) as well as less opportunity to attach new devices is likely if CADs are removed as the ability to connect devices and retrieve data through the smart metering programme will be restricted

Whilst any potential delays in the smart metering programme are not expected to have a significant impact, reduced functionality of the smart metering infrastructure can create opportunities in demand shifting and eliminate others based on data gathered by and products attached to the smart metering infrastructure

Reform of environmental obligations to include HEMS is currently unlikely and are likely to have a small impact even if they do take place



Current schemes do not support HEMS or are not effective

- **ECO** does not support HEMS or heating controls, i.e. energy suppliers cannot meet ECO targets by installing HEMS(-like) measures in homes
- ECO subsidies facilitate large home improvements (insulations) with a focus on (fuel) poor households;
- **Green Deal** does offer scope for heating controls but has so far proven ineffective in generating uptake of heating controls:
- Support for a specific measure under Green Deal requires recommendation through an independent home energy efficiency assessment
- A cashback scheme intended to kick-start uptake of Green Deal measures (running until 14) is largely unused to date: £3m of £125m fund spent almost exclusively on insulation
- Uptake of Green Deal financing for heating controls amounts to around 7% (170) of total measures installed (2400) – see graph above

Access to future subsidies is highly uncertain

- June 2014 availability of **Green Deal Home Improvement Fund** subsidies might offer support for HEMS in the future, but requires reform as heating controls are currently not eligible
- HEMS would have to compete with other measures for a set amount
- HEMS would have to be a recommended measure through independent assessment

Likelihood of future HEMS support

EE schemes could benefit energy-led HEMS offerings

- **Environmental obligations** could incentivise utilities to deploy HEMS to meet targets
- Would principally benefit energy-led HEMS
- Availability of **subsidies** lowers the cost of HEMS to consumers
- Would benefit both direct sales by HEMS providers (B2C) and HEMS taking the utility route to market
- Non-energy led HEMS may not be able to benefit due to cross-subsidisation of non-energy components (e.g. security)

Regulatory or policy support for HEMS is unlikely but not impossible

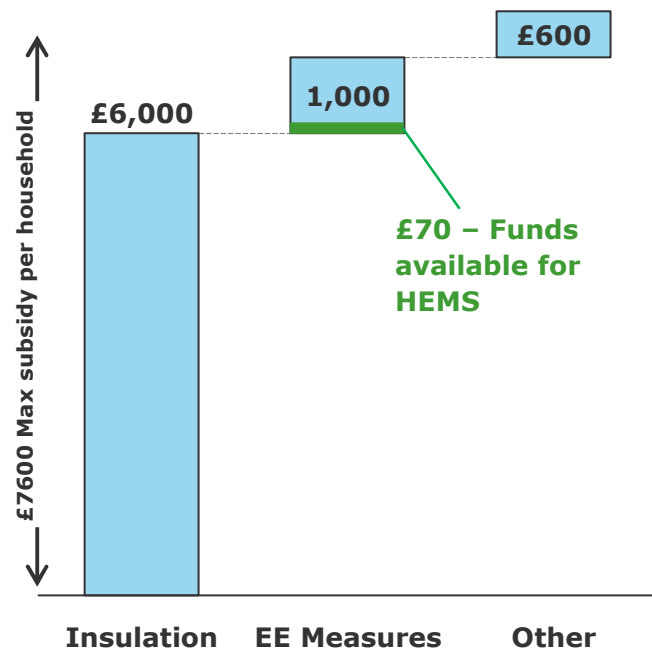
- Absent/ineffective support in current schemes and upcoming reforms;
- Difficulty in establishing the case for government intervention;
- Lack of evidence that HEMS (heating controls) improve home energy efficiency, although existing heating controls are known to be inefficient;
- Embryonic state of the HEMS market does not evidence need for government intervention if that were desirable;
- Political considerations are not favourable:
- Rising household energy bills put pressure on politicians and policymakers to reduce the impact of environmental regulations on bills;
- However this might lead to a shift towards general, socialised support (e.g. subsidies funded through taxation rather than the energy bill)

Future subsidies for HEMS are unlikely, and if they emerge, they are likely to be small at around £1.2m per annum

Green Deal Home Improvement Fund can provide a further boost to credibility of the GD, and potentially for HEMS:

- Demonstrates continued government willingness to subsidise home energy efficiency improvements and illustrates the move towards subsidies and away from formal regulations that impact the household energy bill;
- Overall fund is worth £120m in the first year, with up to £7,600 available for an individual household, of which £6,000 for insulation and £1,600 for a combination of other measures
- If HEMS/heating controls become eligible for subsidies in the future, they would have to compete with other measures for capped subsidy (£1,000) available for householders

Breakdown of Available Subsidies in £



- Based on 7% historic installation of heating controls using GD financing, householders might on average spend **£70** of available funds on HEMS;
- On this basis, overall subsidies used for the installation of HEMS would equate to 1% of the overall £1.2m fund, i.e. £1.2m.
- **Assuming continuation of the GDHIF at comparable funding levels, HEMS might benefit from £1.2m of subsidies per annum out to 2025.**

GDHIF eligible measures

Core offer

UP TO £1,000

TWO ENERGY SAVING IMPROVEMENTS

1

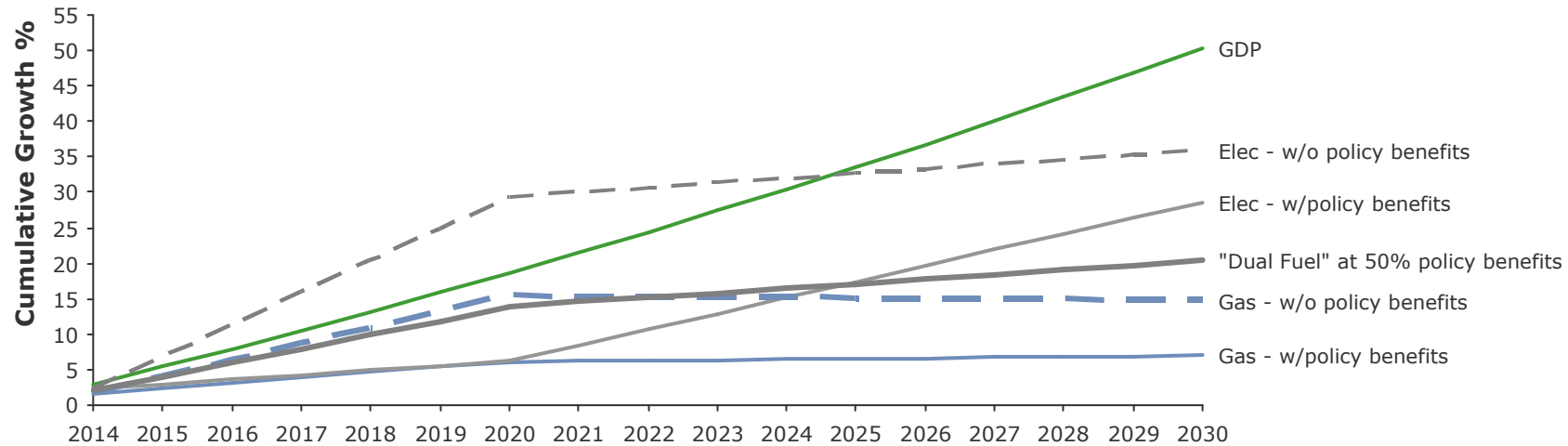
Up to £1,000 for installing two energy saving improvements from the list of 12 eligible measures below:

1 Condensing mains gas boiler	7 Flat roof insulation
2 Fan-assisted storage heaters	8 Floor insulation
3 Flue Gas Heat Recovery	9 Room-in-roof insulation
4 Replacement warm-air unit	10 Double/triple glazing (replacing single glazing)
5 Waste water heat recovery	11 Secondary glazing
6 Cavity wall insulation	12 Energy efficient replacement doors

DECC 2014

Current forecasts indicate UK long-term economic growth will outpace increases in energy bills, suggesting demand for HEMS could move towards non-energy offerings

Relative growth of GDP vs. electricity bills (%)



Energy prices affect different types of HEMS offerings

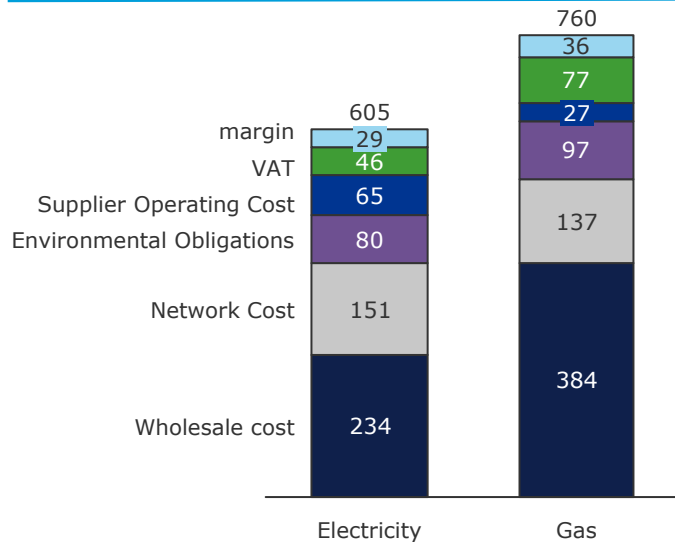
- Household energy bills **increase** relative to economic growth:
 - Increases the incidence of the energy bill on household budgets
 - Places greater importance for households on reducing energy bills
 - Increases consumers' willingness to pay for HEMS in general, but in particular energy-led HEMS
- Household energy bills **decrease** relative to economic growth:
 - Reduces the incidence of the energy bill on household budgets
 - Households deprioritise the need to reduce energy bills
 - Shifts consumers' willingness to pay towards non energy-led offerings with more gadget/luxury qualities and complementary services (e.g. security)

Bills should benefit from policies, but DECC's estimates are likely to be optimistic

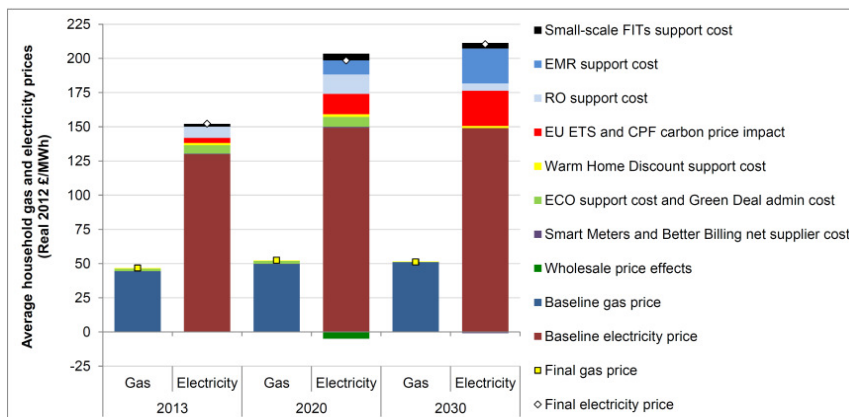
- ONS and IMF report long-term, real, year-on-year GDP growth for the UK of 2.4%
- DECC forecast changes in household energy bills out to 2030:
 - by 2020, efficiencies of environmental policies dampen the impact of cost increases on household gas and electricity bills
 - for household gas bills, DECC predicts policy benefits (ECO, boiler regulations) are sustainable out to 2030
 - household electricity bills increase sharply post-2020 due to the impact of EMR support costs (CfD FiT; CM) and the Carbon Price Floor (CPF)
- DECC's forecast policy efficiencies are likely to be optimistic:
 - Political pressure to justify policy decisions
 - Based on outdated consumption figures
 - Does not incorporate potential impact of EV or HP uptake

The development of household energy bills will greatly depend on the future costs and benefits of EMR and environmental policies

Ofgem breakdown of household energy bills (£/year per household)



DECC forecast of average retail gas and electricity prices

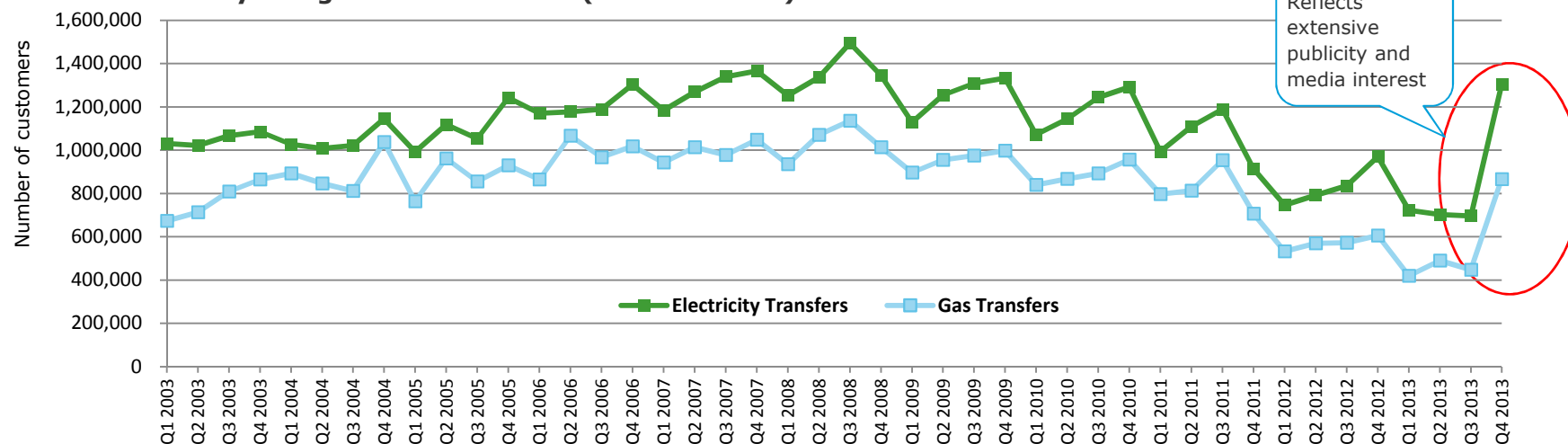


Explanation

- Ofgem’s April 2014 Supply Market Indicator estimates average annual household gas and electricity bills to be £760 and £605, respectively, based on standard consumption figures (15,000kWh for gas; 3,800kWh for electricity).
- This proportional breakdown is comparable with DECC’s estimate of household bill breakdown as at March 2013.
- DECC’s March 2013 analysis provides a forecast of household gas and electricity prices for 2020 and 2030 (but based on outdated standard consumption figures) based on a central case scenario forecast for fossil fuel prices, anticipated changes in the network costs and changes in the costs of environmental policies.
- The growing impact of EMR-related costs, including an increasing Carbon Price Floor impact and other costs in support of EMR policies (FiT CfD, Capacity market), is going to have an increasingly strong impact on electricity prices.
- We apply DECC’s assumptions for growth of cost components in household energy bills to the energy bill breakdown as estimated by Ofgem, assuming constant supply margins, to determine the impact of these costs.
- We developed forecasts of household energy bills with and without DECC’s assumed benefits of environmental policies (which are broadly based on lower or more efficient consumption stimulated by policies):
 - -11% for both gas and electricity by 2020
 - -13% for gas and +10% for electricity by 2030

Increased energy retail competition & customer switching will drive innovative customer retention & acquisition strategies increasing HEMS offerings and take-up

Domestic electricity and gas transfers in GB (no. customers)



We expect retail competition to increase by 2020. This primarily reflects a sharper regulatory focus (e.g. new tariff rules); deployment of technological innovations (e.g. HEMS); and continuing media interest raising consumer engagement

The development of more complex offerings is primarily related to the development of technology attitudes and perceptions... (1/2)

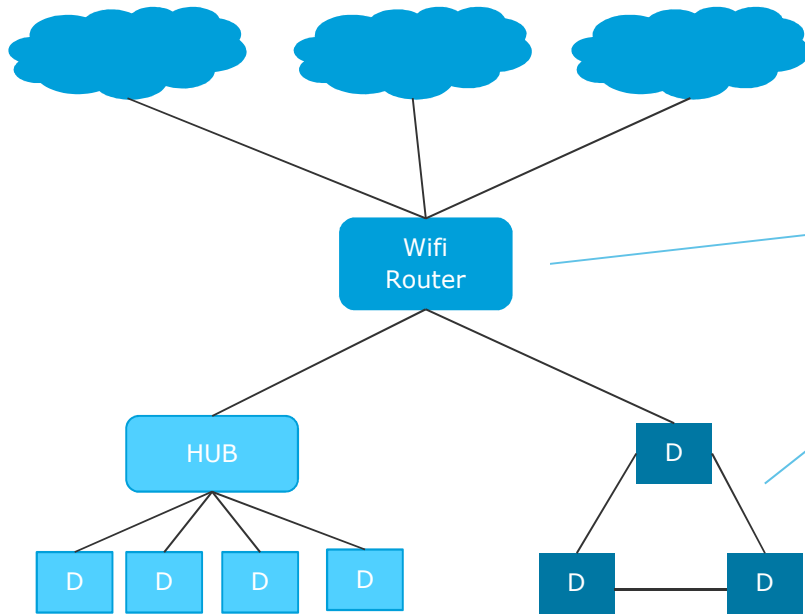
Driver	Driver type	Logic of impact	Potential size of impact and likelihood
10 Penetration of smart devices / broadband in home and use as a hub	Technology	<ul style="list-style-type: none"> - The higher the penetration of broadband and smart devices the easier it is to offer more complex and integrated solutions, based on increased availability of data to consumers around offerings not necessarily related to energy (e.g. health, automation) - The energy related offering becomes part of a wider smart home offering 	<ul style="list-style-type: none"> - It is very likely that every household in UK will have broadband in the short term and it is quite likely that smart devices will develop in the medium term - HEMS could function as add-ons to smart home offerings
11 Level of technology standardisation in the market	Technology	<ul style="list-style-type: none"> - Greater standardisation could accelerate the development of integrated and complex offerings as companies would be more confident to make investments in the area of smart devices - More advanced offerings around smart home potentially benefit from standardisation - Standardisation opens up the market to a larger number of companies, especially smaller companies rather than domination by a few 	<ul style="list-style-type: none"> - Technology standardisation is likely in the midterm but it is also very likely that large companies will lead the development of their own proprietary standards - If standards do not develop fast enough then larger companies may be more likely to dominate in the smart home arena

... and social attitudes and perceptions (2/2)

Driver	Driver type	Logic of impact	Potential size of impact and likelihood
12 Changes in data privacy legislation or cultural norms	Legal & Social	<ul style="list-style-type: none"> - More stringent legal or regulatory restrictions can limit companies' ability to share, or gain access to, HEMS user data and negatively affect the scope for HEMS offerings based on data/account control. - Similarly, changes in consumers' attitudes to privacy and/or data sharing can affect data/account-based HEMS offerings. 	<ul style="list-style-type: none"> - Although regulations are in place for the treatment of data in relation to smart meters, there is currently no evidence that general data/privacy laws will be reformed beyond current security requirements and permission-based access. - Although some signs of a change in attitude opposing data sharing are visible (e.g. going off the Facebook Grid, Google's recognition of the right to be forgotten) there is no evidence of a fundamental shift in attitude that outweighs consumers' perceived benefits of sharing data.
13 Consumer trust and perception of HEMS / in-home devices	Social	<ul style="list-style-type: none"> - General customer perception of the ease of use or installation of HEMS and the value delivered (convenience, monetary) is a crucial driver for the uptake of HEMS in general. - This is especially relevant for more complicated/sophisticated HEMS offerings. 	<ul style="list-style-type: none"> - User experience in the UK to date has been limited but broadly positive (particularly HIVE). User experience in the US from, for instance, NEST has been positive. - Very few outright negative experiences have surfaced so far, but a single, high-profile failure could have large consequences. - User experience with smart meters will provide an important benchmark.

Very high broadband penetration and the expansion of smart devices leads to faster development towards the Smart Home

The development of the home ecosystem where all devices are connected to the cloud is likely



Devices (D) can connect either:

through a HUB to the cloud via the Wifi router

or directly (if IP capable) to the cloud via the Wifi router

Explanation

- Multiple clouds are expected to keep different information from devices of the same household
- There could be an opportunity to consolidate data from a household via the consumer's smartphone device.
- Broadband penetration of both fixed and wireless is expected to reach almost 100% by 2017
- Transferring data to the cloud though broadband would be a default option, easy to implement
- Many smart devices are expected to become available on the market in the medium term future that will allow the development of new services related to energy, health, security and control

Market developments

- Major technology companies have plans and develop/acquire products that will allow them to develop the smart home market
- Google acquired Nest Labs that produce internet-connected thermostats and smoke alarms
- Samsung recently debuted its Smart Home range of refrigerators, washing machines and TVs that can be controlled from its smartphones and watches
- Apple is readying a new software platform that would turn the iPhone into a remote control for lights, security systems and other household appliances (FT 2014)

The developments in smart devices and broadband penetration makes it easier to offer more complex and integrated solutions to consumers, increases data collection and channel opportunities

In addition, overall economic growth will impact on the potential for all scenarios to develop

Driver	Driver type	Logic of impact	Potential size of impact and likelihood
14 Economic growth, prosperity and disposable income	Economic	<ul style="list-style-type: none"> - Changes in economic growth (and by extension in disposable income) determine consumers' ability and willingness to spend on lifestyle products and on products/services that reduce the carbon footprint. The rate of economic growth therefore affects demand for all types of HEMS products. - Relative demand for specific types of HEMS products, e.g. energy led vs. non-energy led, depends on the rate of change in economic growth relative to changes in household energy bills (Driver 4). 	<ul style="list-style-type: none"> - Current forecasts (ONS, IMF) predict a stable, year-on-year real economic growth rate of 2.4% indicative of a relaxation of household budgets and a positive growth in willingness to spend on HEMS.

Section A

5. Supporting evidence on value from future HEMS

Although currently there is large price range variation for HEMS depending on functionality, profit from selling a HEMS is estimated to be £33-£44

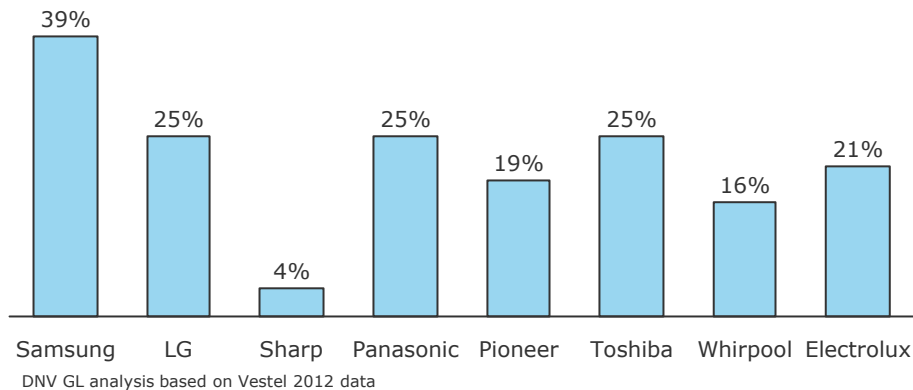
Potential Unit Gross Profit from selling a HEMS in UK (£)



Explanation

- The potential market value of HEMS products, is best captured by the gross profit metric as this captures how manufacturers place products similar to HEMS products in the market and the profits this product can attract, i.e. the price they can realise in the market over and above the cost of the good
- On the other hand net profits take account of a company's overhead (administration, marketing) other expenses (e.g. interest expenses) and taxes. This provides more insight into the profitability of a business as a whole, including the efficiency of its operations and how it is financed, and is less informative regarding profitability of a specific product
- The price range of the HEMS currently in the market depends heavily on its functionality and sophistication and can range between £100 - £1000 (WP1)
- Based on the price range of the successful products in the market today (NEST Thermostat & Hive) a feasible price range lies between £150-£200
- For the calculations we assume a 22% gross profit margin

Gross profit margin for major manufactures in white and black goods (2012, %)

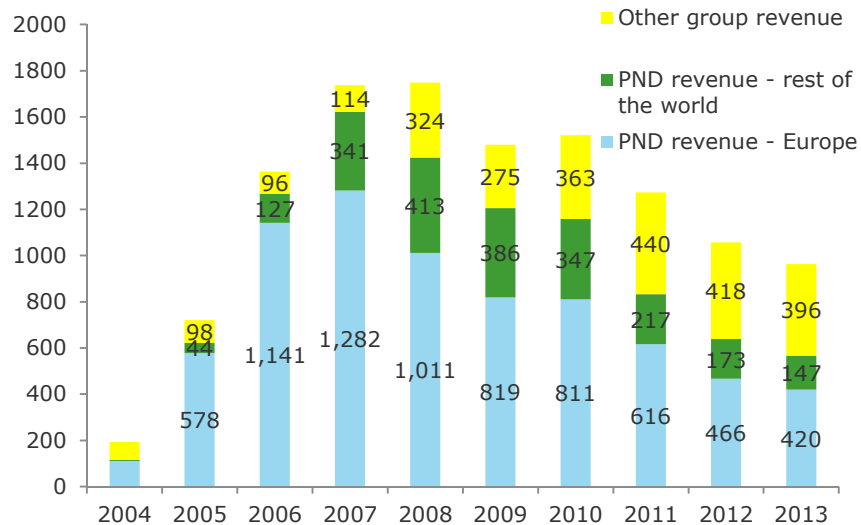


Explanation

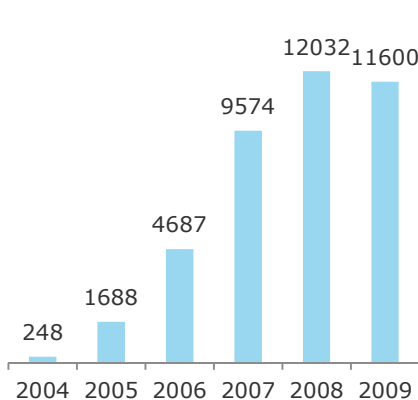
- As HEMS is a household device, it is expected that companies active in this area will be able to extract similar gross profit margins to the manufacturers of white and black goods
- The average gross profit margin for major manufacturers of white and black goods is estimated to be 22% (calculations based on 2012 data, excluding the outliers Samsung and Sharp)
- Samsung is probably able to extract higher margins due to its innovative products and the stronger brand name

Portable Navigation Device (PND) market provides some potential comparators on the life cycle of a HEMS market (Tom Tom case study)

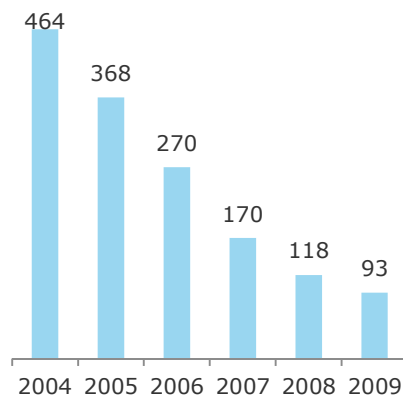
Portable Navigation Device revenue (direct to consumer) relative to total group revenue (in €millions)



Total number of units sold (in 000's)



Average selling price (in €'s)



PND market provides some potential insights into the development of a HEMS market

- **TomTom PND** – there are comparable characteristics between the SatNav and HEM markets
 - Functional product
 - Convenience factor
 - Can live without it
 - Gadget characteristic
 - Potential savings in terms of time (but not monetary)
- TomTom introduced the PND in 2004, when...
 - The market was under-penetrated in Western Europe
 - Only ~10% of the 200m cars on the road were equipped with PND's
- **TomTom product cycle**
 - PND unit sales rose by 573% from 2004 to 2008. However, a shift towards new offerings (e.g. navigation solutions on mobile phones and google maps) created a natural decline in PND sales from this point. From 2007 to 2013 total PND revenues decline by 94%
 - From 2006 to 2013 TomTom maintained a market share around 47% of the PND (direct to consumer) market in Europe
- TomTom's business strategy has been to diversify as the PND market declines. This is reflected in the relative increase of other group revenue (see yellow segment of top chart) from 2007 and includes selling navigation software and services for connected car; licensing (including location based applications for mobile device sellers); and fleet management (business solutions)

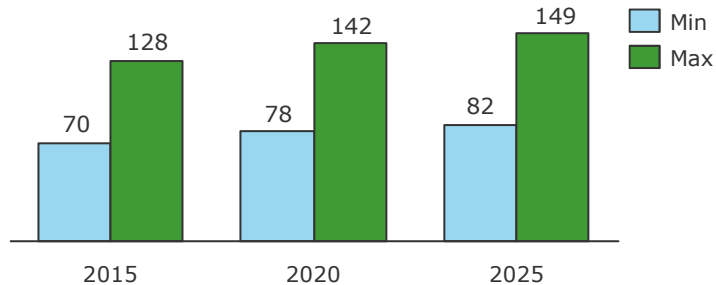
The HEM market could follow a similar product lifecycle....

- From 2004 to 2009, the total PND market penetration increased from 0.3% to 42% in the Western Europe market (assuming 200m cars). A similar period of rapid initial growth could be expected for the HEM market
- Similar to the PND market, there may be a shift away from simple physical HEM devices as the market matures and moves towards the 'smart home' offering

DNV GL analysis based on TomTom Annual Report data – segmental analysis and data availability varies over period. From 2010, when the PND market starts to decline, the number of PND units sold and the average selling price are not published.

Improvement in customer retention and acquisition could lead to a value of up to 20/yr per customer for the energy suppliers in UK

Value of an average dual fuel account to the energy supplier (£/year)

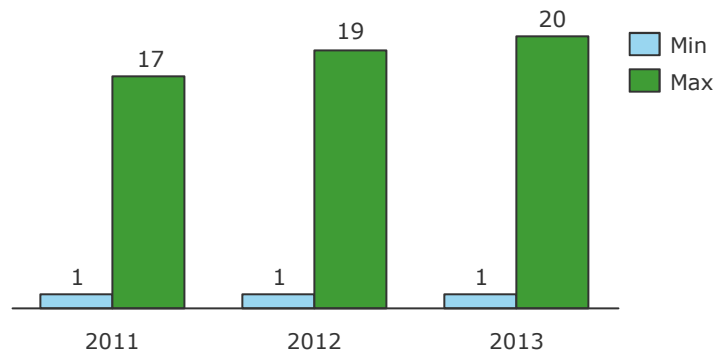


DNV GL analysis based on 3 year historic supply margins for gas (5-10%) and electricity (5-8%) and the DNV GL household energy bill analysis.



HEMS can improve customer retention and acquisition and thus create potential value for energy suppliers

Potential value of improved customer retention and acquisition due to HEMS (£/year per household)



Tariff arrangements for energy suppliers are deliberately restrictive allowing the development of only 4 tariffs and aim to avoid customer lock-in effects, but they do offer scope for HEM offerings (e.g. Npower)

Explanation

- Energy suppliers extract profits from their customers (value per account –top chart) and thus they have an incentive to retain them for as long as possible and also acquire new ones from their competitors
- In the UK on average, 13% of the customers switch suppliers each year. If this percentage is reduced then there is potential value to be unlocked for energy suppliers
- A HEMS provided by a supplier could reduce churn by 5% to 50%. Basic HEMS could reduce churn rates by 5% (assumption made based on improved customer satisfaction by 5%, Opower 2014) to 20% (Maingate Solutions, 2013) whereas more advanced HEMS is expected to further improve customer satisfaction and reduce churn rates by up to 50% based on industry sources
- We also assumed that customer acquisition is improved by the same percentage as churn rates

Market developments

Interestingly, utilities are currently investing in HEMS in order to build greater trust and improve customer relations

- EON offers the Opower enhanced bill reporting for free to all customers – cost for EON is estimated to be £1.8/customer per year (Opower’s revenue per account)
 - If we assume 1m customers for EON can apply the above assumptions the benefit from customer retention and acquisition for EON would be £0.91m-1.66m compared to a £1.8m cost
- Npower offers a Nest Learning Thermostat for £99 including standard installation worth £279
 - Npower’s subsidy accounts for £180 (or £60/customer per year to secure a benefit of £70-£128/year)

Calculations

Applying the range of 5%-50% reduction on the churn rate for the suppliers (5%x13% - 50%x13%), multiplying by 2 to account for improved customer acquisition, and multiplying with the ranges of the value per account we estimate the Min and Max potential value from customer retention and acquisition per household for the supplier’s customer base (e.g. in 2013: Min = 5%x13%x2x£82= approx. 1, Max = 50%x13%x2x£149 =approx. 20)

Tariff arrangements are restrictive and aim to avoid customer lock-in effects, but they do offer scope for HEM offerings

Potential examples for 4 core tariffs for smart meters

HEMS tariff

3 year fix, energy discount, early exit fee (£100)

2 year fix tariff

Early exit fee (£30)

1 year fix tariff

No early exit fee

Standard variable tariff

Enables auto rollover

Bundle options

Tied HEM bundle

- HEMS package which may contain different components e.g. HEM device, broadband device and phone
- But this offering has to be specific in terms of single price (£35/month) and product specifics.

Optional HEM bundle

- This bundle needs to be accessible to all core tariffs.
- Customer has choice to take or not take bundle
- May contain different elements e.g. choice of phone deal and entertainment package which is reflected in different price offers

Tariff regulations

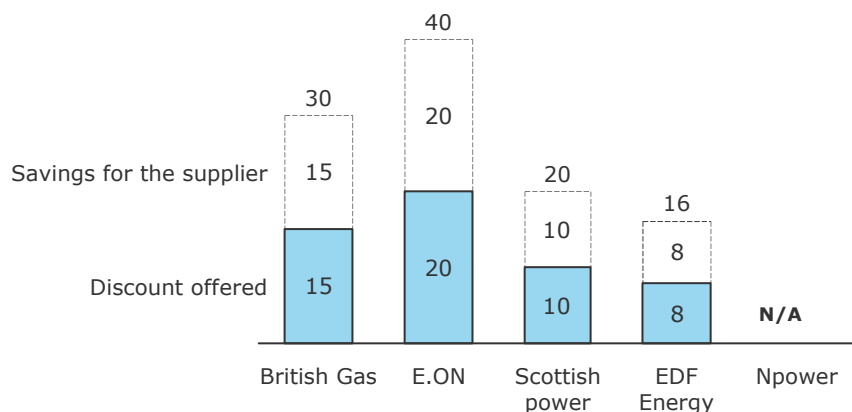
- Suppliers are limited to offering 4 core tariffs for smart meters
- **Ban on cash discounts**, except dual fuel, paperless and Warm Home Discount
- **Non-cash discounts are allowed** (bundles provided for free or at a discount) as long as it does not have a lock-in effect (i.e. consumers are not required to pay back the reward, and they do not lose the reward, or part of it, if they decide to terminate the contract earlier). For example, a supplier may offer a supermarket voucher after one year. However, if the customer left before one year, the supplier would be required to compensate them (in a proportionate and fair manner) i.e. the discount is continuously applied.
- **Non-cash contingent discounts (e.g. refer a friend) allowed** – but only if there is no access criteria
- Obtaining a derogation from these tariff rules is feasible but would require a novel approach and be subject to Ofgem review (including trial period)

These tariff rules are deliberately restrictive to avoid lock-in effects and deliver simpler tariff choices. Despite these restrictions, HEM tariff offerings are feasible. Indeed, this is evidenced by Npower's current 'Intelligent Fix - April 2017' tariff:

- Energy prices fixed until 30 April 2017; it comes with a Nest Learning Thermostat for £99 (includes installation worth £279); energy charges £1 per month higher when compared with the Standard charges (as at 15 May 2014) until 30 April 2017; £100 early exit fee; and pay by Direct Debit to receive a continuous discount through a reduction in your daily standing charge, worth £90 over each year

By leveraging a HEMS to offer a bundled service, value of £16-£40/year per household could be gained from cost savings

Big 6 discount on dual fuel accounts in £/year and their potential total savings (50% benefit share assumed)



DNV GL research of company websites. SSE provides no information on dual fuel discounts on the company website

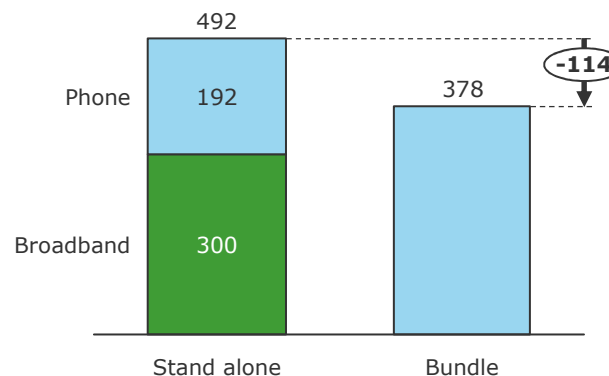
Big 6 Dual Fuel discounts may reflect economies of scale more closely

- Pure dual fuel discounts can be used to pass on cost savings related to administration, customer support, and billing costs to consumers
- Review of pricing information for the Big 6 supply companies shows that only 4 of the Big 6 currently specify a Dual Fuel Discount. Npower has discontinued explicit dual fuel discounts
- Discounts offered range from £8-20 per annum and reflect a combination of cost savings and strategic pricing (possible loyalty benefits) – lack of retail competition indicates a greater role for cost savings
- However, cost savings are specific to company’s operational model and thus it is difficult to generalise
- Assuming 50% of benefit to be shared with customers, total cost saving could amount to £16-£40 per household per annum

Telco’s apply a variety of strategic pricing strategies

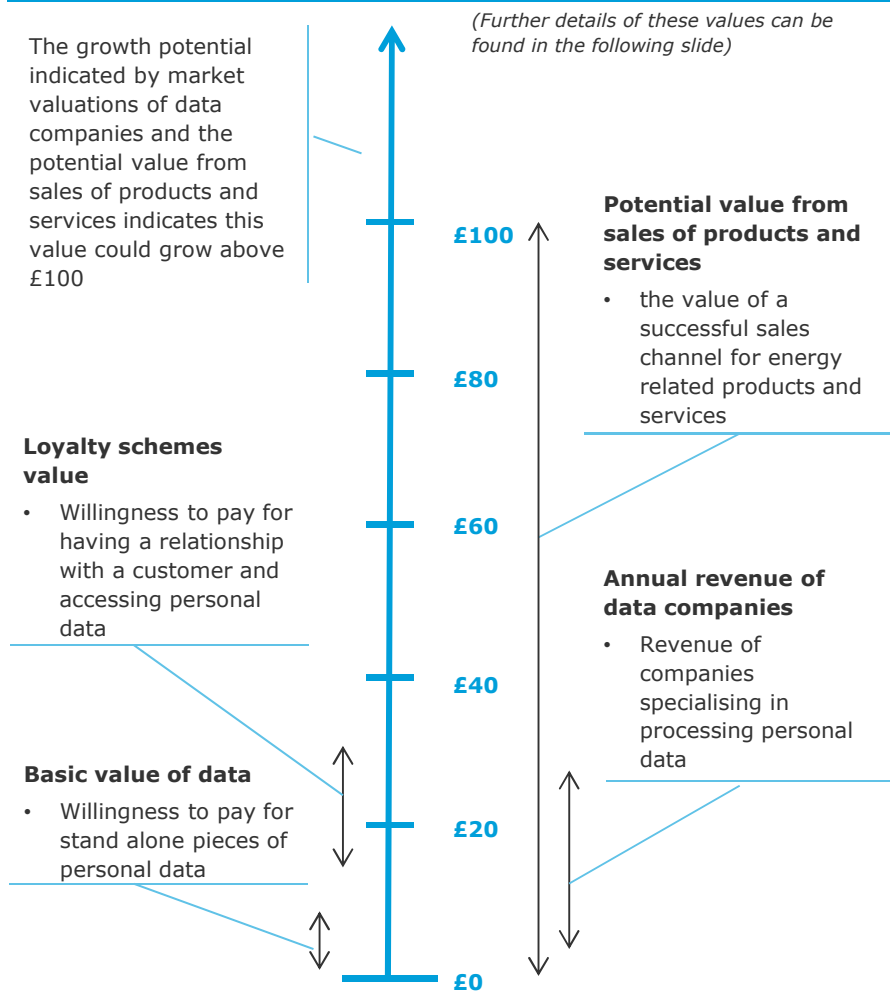
- In the UK, only VirginMedia applies an explicit discount to product bundles, i.e. the overall bundle price is less than the sum of its components
 - Virginmedia’s approach is primarily aimed at extracting consumer surplus, although it benefits from Economies of Scope
- BT and Sky follow a different pricing strategy where the sum of component prices equals the overall bundle price
- Comcast’s (US) strategy based on discount for a set period of time (e.g. first 21 months) rather than applying discount to bundles

Virgin Media basic bundle pricing strategy in £/year:



The value from data could stretch up to £100 per household per year and with a step change it could even exceed this

Current values indicate a range of £5-£100 for household related data



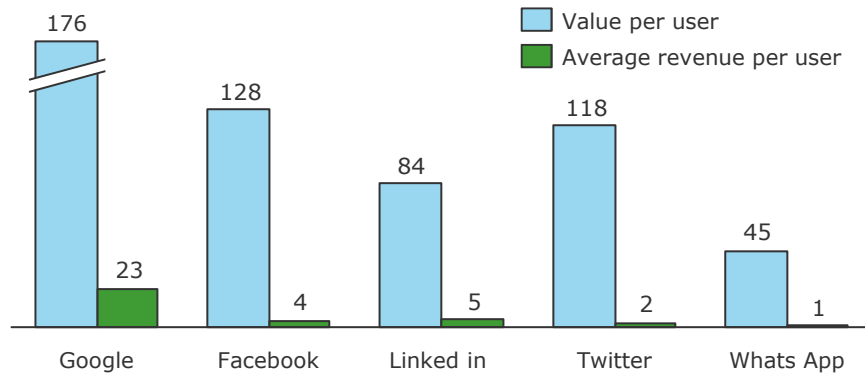
Explanation

- There is value associated with:
 - the data of a domestic energy user (e.g. energy consumption data, debit, tariff etc)
 - the account that a company holds for a customer (ability to establish contact and market / make offerings)
- Whilst some basic value can be captured already today by suppliers, there is an opportunity for HEMS providers to access even more value if they are able to acquire more detailed data and establish a trusted relationship with the client
- Whilst the value of stand alone personal data is relatively low and one off, the value set of personal account data controlled by data companies is significantly higher reaching up to £23/year based on average revenues per user currently reported by Google
 - Current stock market valuation evidences high market willingness to pay for shares at a multiple of current earnings, indicating strong potential for further growth of this value , especially for relatively young businesses
- Value of loyalty schemes include both the value from retaining a customer and the ability to make additional sales that is based on data processing and could reach up to £30/year
- However, the acquisition of data (including energy related) from the household could lead to a step change on the valuation of data as predictive analytics could be developed to enhance targeted marketing leading to increased value from added sales based on this data processing
 - This value could be as high as £100 but the data analytics that could be developed may lead to even more valuable business models
 - An indication of the value that household related data could have is the acquisition of Nest by Google, that cost approximately £2,000 per account

Value goes to the commercial entity but to extract it they will need convincing propositions that create value for their customers so that they allow their data to be collected and this channel to develop

Companies can extract value both from collecting useful data on their customers and having a direct channel to them

Annual average revenue and value per user for data oriented companies (2013, £)



DNV GL analysis based on Google Finance (2014,) Trefis (2013), This is money (2013), Forbes (2013) data.

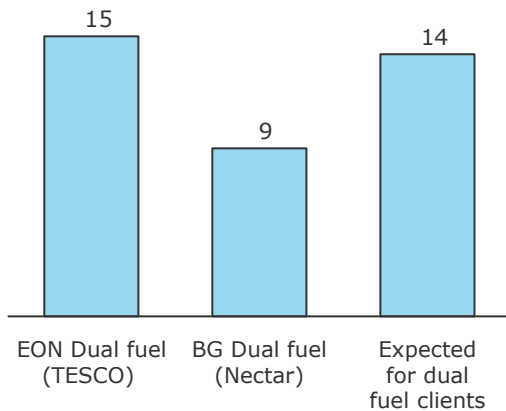
Explanation

- Google earned around £23 per user account from data in 2013 compared to a value per user of £176. its valuation reflects the strong growth potential as perceived in the market, confirmed by a price/earnings (p/e) ratio of 30.
- Other (younger) companies exhibit much lower ARPU, but an even higher relative valuation suggesting even higher growth potential perceived in the market:
 - Facebook's current p/e. ratio equals 81;
 - LinkedIn and Twitter's valuation exists despite negative earnings per share over 2013.

Value of a sales channel

- A commonly accepted rule of thumb is that business marketing/sales spend amounts to around 10% of revenues. (e.g Forbes (2012))
- An average household spends £970/year on energy appliances and services (ONS 2013) leading to a potential annual value of £100/household

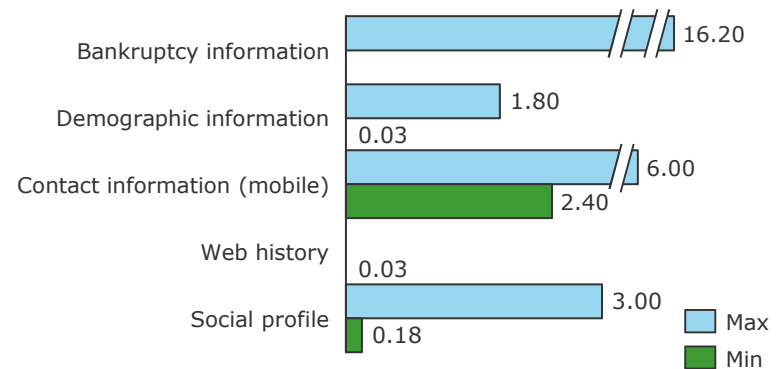
Loyalty programmes offer annual rewards (£)



- All major loyalty programmes offer 1% of rewards based on consumer's expenditure (Tesco, Nectar, Boots, BA/AMEX)
- The average annual dual fuel energy bill in UK is £1360
- It is assumed that half of the actual commercial value is shared with the customers

DNV GL analysis based on EON and BG data

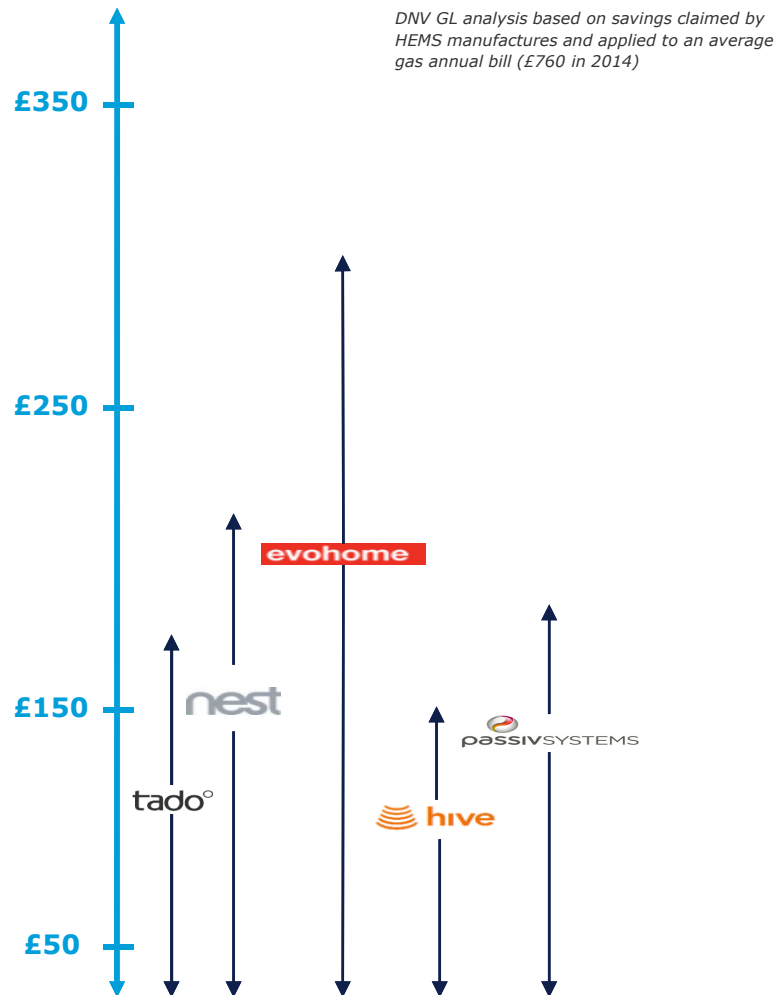
Value of personal data (£)



DNV GL analysis based on OECD, FT, Aricent and Frog Design

Energy efficiency gains from HEMS on average can be up to £170 per year but could be offset due to customers' behavioural change

Heating cost savings claimed to be achieved by HEMS manufactures today (£)

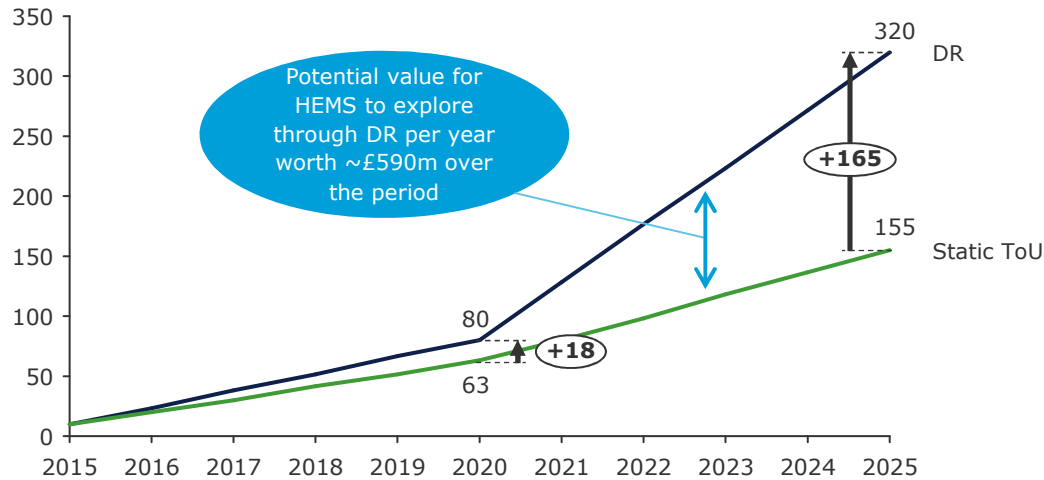


Explanation

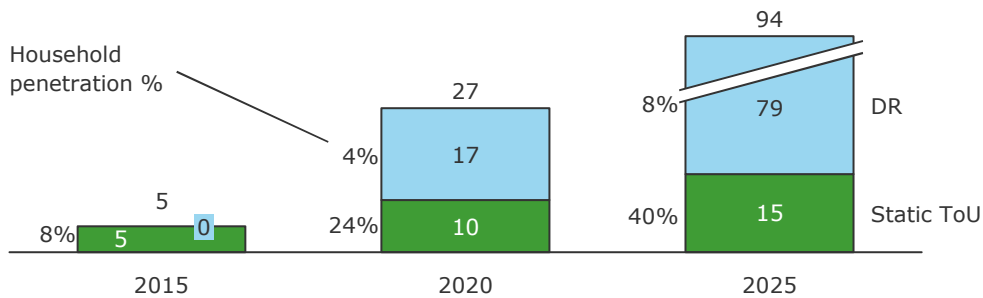
- Most of the HEMS manufactures today provide a range of potential heating cost savings that ranges between tens of pounds and £300 per year
- The majority of them claims a potential average saving of up to £170 per year (excluding the outlier Evohome)
- Heating cost savings depend largely on the user's house, climate, existing set point schedule and active features and can vary significantly
- High inefficient energy users are likely to see the largest heating cost savings that can be significantly higher than the average household savings
- The installation of in home display (IHD) that provides feedback on customer's consumption is expected to change how people consume energy. It can help to achieve energy efficiency gains of 8% on average (VaasaETT 2011) or £109 based on average dual fuel energy bill. These benefits could be also exploited through the smart metering programme that involves the installation of an IHD
- However, as with all energy efficiency measures there is the risk of the "rebound effect"
 - Behavioural responses to the introduction of HEMS (such as increased comfort through higher room temperature at the same cost) can offset the energy efficiency savings
- The impact of rebound effect needs to be further explored and this is an area that further investigation is needed

Value from shifting demand using HEMS could be up to £94 per household in 2025 depending on the availability of flexible loads

Available annual commercial value in the market that HEMS can exploit in high demand scenario (£m)



Available annual commercial value per household that HEMS can exploit in high demand scenario (£)



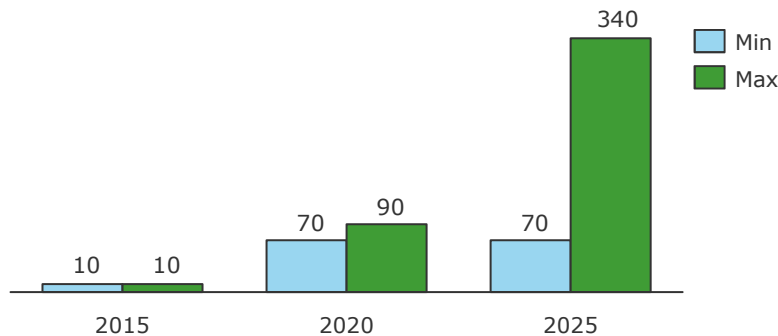
DNV GL analysis based on Baringa, Element Energy (2012) data based on the High demand scenario

Explanation

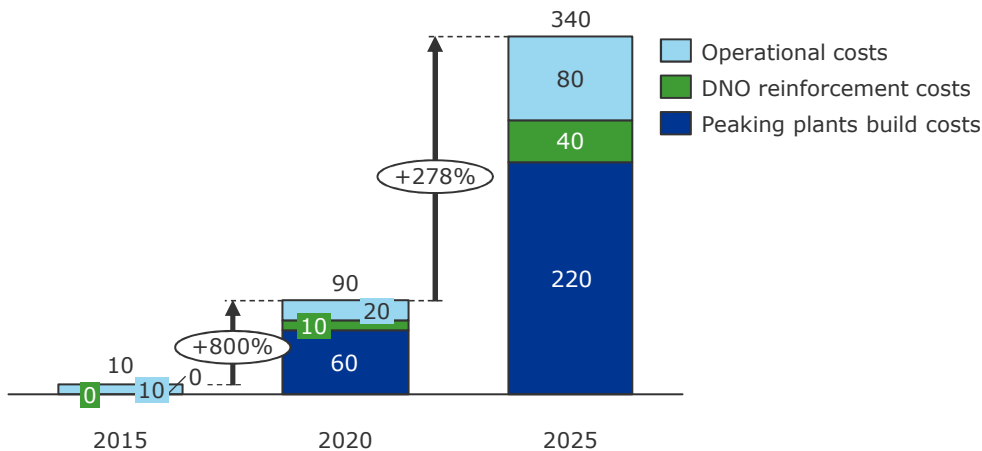
- Value from demand shifting can be split between:
 - that which can be accessed through simple Static Time of Use tariffs – this capability can be provided through Smart Metering infrastructure
 - that which requires Demand Response capability with remote load control through an incentive based mechanism
- SM functionality and rules will (at least initially) restrict load shifting to ALCS by energy suppliers, so 3rd parties would need to use separate HEMS to explore the total value from demand shifting.
- The total potential additional benefit from DR that HEMS could exploit between 2015-2025 is ~£590m (difference between Static ToU & DR benefits), significantly ramping up after 2020. [Different scenarios for future demand only available for 2025.]
- The potential demand shifting benefits increase over time due to the assumed increase in **flexible loads** and **consumer uptake of ToU and DR**
 - Assumptions around these two core parameters determine largely the overall potential benefits
- Nonetheless, value from demand response for HEMS comes with challenges:
 - it is not regarded by the SO, DNO's or by energy suppliers as being as firm a resource as backup generation
 - offers opportunity for fraud due to the challenges associated with base lining
- In the central demand scenario the available commercial value in 2025 is £235m leading to an available value of £53/household (£39 from DR and £14 from ToU)

Annual system value from domestic demand shifting could reach £340m in 2025

Annual demand shifting savings relative to the BAU baseline (£m)



Breakdown of maximum annual demand shifting savings, relative to the BAU baseline (£m)



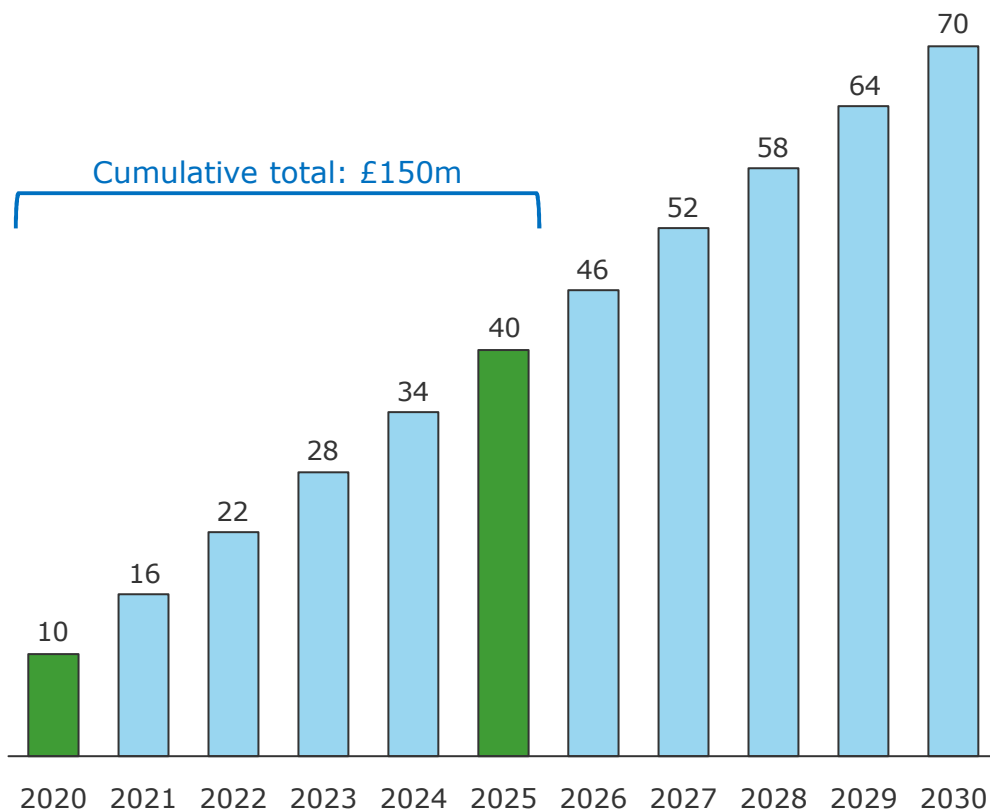
DNV GL analysis based on Baringa, Element Energy (2012) data

Explanation

- System value refers to potential benefit from increased efficiencies across the electricity system value chain. This system value is commercially available to be exploited except for a portion of the network savings as this is a regulated sector. In our calculations 50% of the networks savings are available to be commercially exploited
- System savings from domestic demand shifting are expected to gather pace around 2020 when significant numbers of EVs and HPs are expected to be present in the system
- As more automation is introduced to achieve demand shifting the higher the potential system savings are
- The system wider savings include:
 - Generation operational costs (includes CO2 costs)
 - Avoided new flexible generation(peaking plants) investment costs (OCGTs)
 - Avoided/ deferred DNO and TSO reinforcements (TSO savings not noticeable)
- The majority of future savings comes from reduced peaking plant built costs, followed by operational generation costs.
 - These benefits are captured through optimising demand against relative wholesale prices and through the TSO using demand as a balancing alternative to peak generation (see slides 67-68).
- DNO reinforcement cost savings are relatively low and it is expected to be difficult to exploit that value by using residential demand shifting to balance individual feeders

DNO saving from avoided/deferred network reinforcement due to domestic demand shifting are estimated to be £150m between 2020 and 2025 but the commercial value would only be up to £75m (Justification of Baringa, Element Energy 2012 study)

Maximum demand shifting DNO benefits relative to the BAU baseline approach (£m)



Explanation

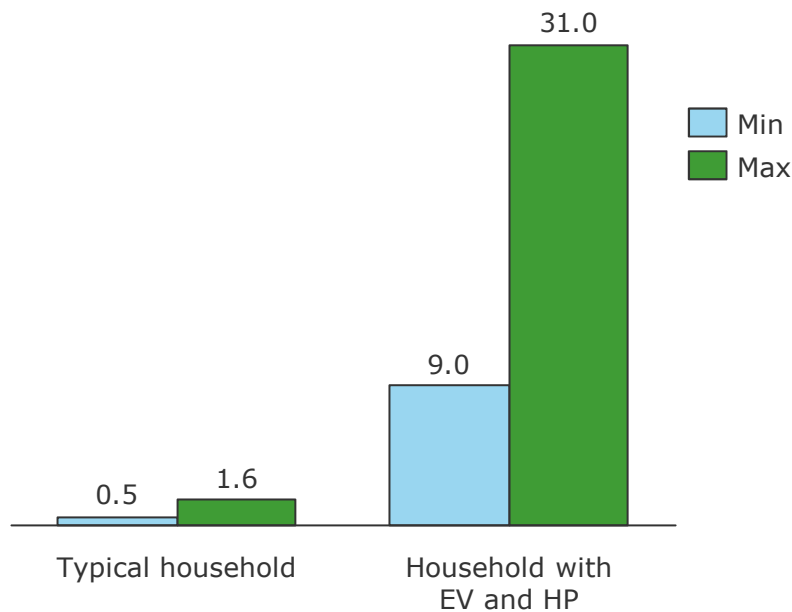
- Baringa’s (2012) study estimates approximately £440m DNO savings between 2020 -2030
- Study by Imperial College (2010) also estimates DNO benefits between £500m - £10bn between 2020 – 2030
 - The £500m estimation is aligned with Baringa’s calculations
 - The higher the penetration of EVs and HPs, the higher the potential benefits that are calculated
- However, as networks are a regulated industry only a proportion (45-50%) of this benefit can be exploited by DNOs under the current regulatory framework (DPRC5 and RIIO ED1)
 - The remaining benefit is returned to customers in the form of reduced Distribution Use of System (DUoS) Charges

DNV GL analysis based on linear extrapolation data from Baringa, Element Energy (2012)

Whilst today there is no significant wholesale cost saving for households without EVs and HPs, in the future these savings are expected to increase radically

Justification of Baringa, Element Energy 2012 study

Wholesale costs savings through demand shifting for a typical household a household that has EV and HP (£/year, 2012)

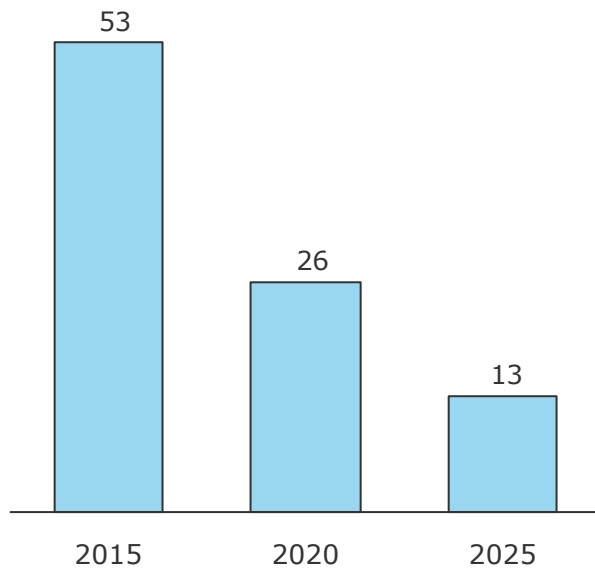


Explanation

- Today typical household's consumption during peak (4-8pm) is on average 900kWh/year (EST 2012)
- Wholesale cost difference between peak and off peak is on average 1.2p/kWh during the year (APX 2012 data)
- demand shifting is assumed between 5-15% during peak for typical household (Ofgem 2010) and 100% for EV and HP loads for these households (5.3-18kW)
- In the future, the wholesale cost difference between peak and off peak is expected to change radically if there is large penetration of renewables
 - This can be seen in Baringa's study
- Hybrid HPs and EVs provide significantly flexibility as they can switch to another fuel rather than having to rely on thermal or electric store respectively

Households with EV and HP could potentially achieve significant value from selling demand shifting services to the TSO today

Potential value of demand shifting services to the TSO from a household that has EV and HP (£/year)



Explanation

- Flexible demand in the household can be used to offer balancing services to the system operator (SO)
- In the future, the balancing needs for the SO are likely to increase due to high penetration of renewables
- However, as more flexible demand is in place, sources for demand shifting will be less scarce
- Moreover, the introduction of ToU tariffs will limit the load that will be available to be used for balancing services during peak
- For the calculations we assume:
 - a price of £0.25/KWh for demand shifting service in 2015 (National Grid 2014) and this price halves every 5 years due to twofold growth of EVs and HPs and the introduction of ToU
 - Offering a demand shifting service for 4 hours for 10 days/year
 - Ability to shift 5.3kW

Section B

Characterisation of the current market for HEMS and related ICT

Section B

1. Key messages, critical success factors and risks/issues

Key messages from the characterisation of the current market

1. HEMS is an embryonic market; HEMS players are actively trying to create a new market and in doing so are testing a variety of propositions and approaches; creating a compelling customer proposition, developing a strong brand, and finding a route to sell and deliver their products are their primary concerns.
2. There is a scattered range of product offerings; the most successful in the UK are simple and focused but they have the potential to broaden into wider and more complex offerings.
3. ICT platforms play a core role in enabling a broader HEMS offer that exploits more sophisticated value propositions; these platforms need to be cloud-based for advanced propositions such as remote control and value from 'big data'.
4. Current developed HEMS-focused ICT platforms are prepared for these sophisticated value propositions in terms of technology and infrastructure, software and data analytics will be the key to taking advantage of this.
5. Telcos are well placed to control this platform space in the future due to their positive customer perception, access to the home, and ownership of the key communications infrastructure both now and into the future (broadband).
6. It is currently uncertain whether open platforms, which could be more complex but potentially allow easier integration of multiple devices, or closed platforms will lead the way as there is no definitive advantage of one over the other; their relative success is likely to be driven by execution rather than any inherent strategic advantage.
7. The Smart Metering infrastructure enlarges the data available to HEMS providers and provides a realistic alternative option for a one-way data platform, but to offer added value services around demand control they would need to partner with Energy companies.
8. HEMS providers must strengthen their position to find a profitable and sustainable route to market that either avoids or more effectively manages their reliance on third parties such as Utilities and merchants.
9. Tackling customer perceptions and installation issues are two critical risks that create opportunities for potential new entrants to the HEMS market.

Critical success factors in the HEMS market are centred around principles of simplicity, practicality and focus on a compelling customer proposition

HEMS critical success factors

<p>✓ 1. Simple and easy technology</p> <ul style="list-style-type: none"> ➤ Basic ICT allowing quick and easy market entry and limited risk and reliance ➤ No (or simple) installation costs/process – potential for wastage if this is an onerous process ➤ Designed for easy customer use from the outset ➤ Utilisation of smart devices and leveraging existing ICT infrastructure to: <ul style="list-style-type: none"> ➤ limit costs ➤ gain from consumers' existing intuitive understanding of the smart interface ➤ enable faster penetration 	<p>✓ 2. Practical market approach</p> <ul style="list-style-type: none"> ➤ Practical and entrepreneurial approaches – tactical short term plays that can evolve into longer term strategies that can explore more complex propositions ➤ Focused and clear approach to market – focus on one value proposition and do it very well, then expand out to others ➤ Build / utilise a market channel and a large marketing budget ➤ 2 primary successful approaches to the market: <ul style="list-style-type: none"> ➤ Meet an existing commercial value proposition through tailored use of technology ➤ Creation of a new market through application of design to create a desirable consumer product ➤ Timing of offer to market to coincide with favourable legislation/regulation/market environment
<p>✓ 3. Customer focused offer</p> <ul style="list-style-type: none"> ➤ Consumer facing and attractive presentation (web 2.0 feel rather than energy/engineering approach) ➤ Emotional appeal to customers and simple customer-focused proposition ➤ Simplicity of the system ➤ Price point that's commensurate with the value proposition – currently 	<p>✓ 4. Access to funding</p> <ul style="list-style-type: none"> ➤ In creating a new market, significant funding is required both for development of compelling products and powerful marketing. This can be achieved through: <ul style="list-style-type: none"> ➤ Access to Venture Capital – depending on being in the right location to source this funding or having individual contacts and attraction (e.g. Opower) ➤ Development under the wing of a larger company or as a spin-off or joint venture (e.g. Quivicon) ➤ Self financing taking a more incremental approach – but very reliant on other's channel and marketing budget, or a niche play (e.g. EQ3) ➤ Partnering with a larger company that can act as a support and provide a guaranteed route to market (e.g. HIVE/AlertMe)

The X-factor – it is important to recognise that the most successful companies currently in the market also each have their own special circumstances or unique individuals leading them

Risks reflect the uncertainty and untested approach associated with an early developing market, but most also represent potential opportunities

HEMS risks and issues

✘ 1. Infrastructure and technology issues

- Lack of standardisation of technologies means there is a “step into the unknown” for companies, this especially impacts large companies who need more certainty to justify investment
- Smart Meter acts as a delay on development due to uncertainty on what will be rolled out and how it can be used (again affects large established companies more who are more likely to base their proposition around smart meters)
- Potential for communications interruptions to impact on service levels and reduce effectiveness and confidence
- Inability to provide comprehensive and quality installer coverage limiting the potential market

✘ 2. Market constraints

- Propositions are not compelling or attractive for customers
- Failure to ‘cross the chasm’ from early adopters to the mass market
- Free offerings from Utilities could commoditise the market and reduce price point for stand-alone offers
- Lack of market channels (typically heating channels unlikely to be suitable) and lack of marketing budgets
- Danger that the market is limited to being a short-lived or niche positioning that never achieves mainstream acceptance, and that in reality a simple more basic Smart Metering based offer dominates in the longer term

✘ 3. Negative customer perceptions

- Lack of customer awareness and understanding of what HEMS products are and what they offer
- Poor Energy company reputations impact customer perceptions of HEMS (especially if utility driven offering dominates)
- “Bad-news” stories can have a disproportionate impact due to sensitivity of heating/energy to people and the large potential impact they can have
- Poorly performing products tainting the rest of the market – in functionality or security of the system for example
- Customers unwilling to share data – eliminates an important future value stream

✘ 4. Regulatory barriers

- Regulation prevents the exploitation of more sophisticated value propositions such as demand shifting
- Inability to exploit value from data due to privacy/security rules and regulations
- HEMs cannot be used to meet (energy supplier) energy saving targets
- Energy supplier market reform reduces the value from using HEMs to build stickier customer relationships

Section B

2. The current HEMS market

a) Key messages

Key Messages – HEMS

1. Value that HEMS providers can capture is varied and goes well beyond simple unit profit, but to capture it they must create value for consumers.
2. HEMS market is still emerging, with a scattered but broadly incremental series of products tending to offer heating as a core component, then adding in cooling, power, microgen, and smart home automation as they become more sophisticated.
3. It is unclear whether 'simple and focused' or 'broad and multi-functional' offerings will win, or whether offers just evolve into more complex ones. Significant demand is still to be proven, outside design-led and high-tech market segments.
4. Developing a profitable position in an embryonic HEMS market requires a compelling proposition, strong brand, and finding a route to sell and deliver
5. Products are pairing off with energy companies to secure a route to market. The majority of the big utilities (4/6) have partnered with a start-up HEM offering, though several may just be buying insurance in case market takes off (i.e. followers not leaders). Other potential channels exist but are yet to be fully exploited.
6. Current market offerings do not allow customers to access all possible types of value so there is scope for the development of more sophisticated value propositions – e.g. time-of-use tariffs; advanced security offerings; preventative diagnostics; data exploitation.
7. Installation challenges and customer perception of early HEM offerings are critical and interdependent risks that will influence the success of the market.
8. There are possible opportunities for new entrants that feed from key risks but more value must be unlocked, and optimal customer journey & killer app(s) defined.

Value that HEMS providers can capture is varied and goes well beyond simple unit profit, but to capture it they must create value for consumers

Breakdown of potential HEMS values

Explanation

	Value to the HEMS provider	Value to the Consumer
Requires specific functionality or attributes	<p>Meeting environmental obligations (Green Deal 2.0?)</p> <p>Flexibility from shifting electricity demand</p> <p>Use of data collected for commercial purposes</p>	<p>Energy bill reduction savings</p> <p>Comfort, convenience & personalisation</p> <p>Control over usage</p> <p>Desirability</p> <p>Reduced billing risk & certainty</p> <p>Complementary offerings & services (e.g. security/health/media)</p>
Function of overall HEMS offer (does not require specific functionality)	<p>Profits from unit sales of HEMS products & services</p> <p>Support the selling of other services/products</p> <p>Reduce customer churn / increase new customers</p> <p>Operational gains (billing/credit management)</p>	<p>Satisfy environmental conscience</p> <p>Key: Energy specific value</p>

HEMS providers need to provide customers benefits in order to realise commercial value:

- Most current offers focus on either energy reduction benefits that result in financial savings or the provision of convenience or greater levels of personalised comfort. All have to consider their overall level of desirability as a nice-to-have product.
- In the future it is expected that complementary (non-energy) offerings will become more prominent as in the US where security offerings lead the way.

Value from the commercial perspective goes beyond a simple profit motive:

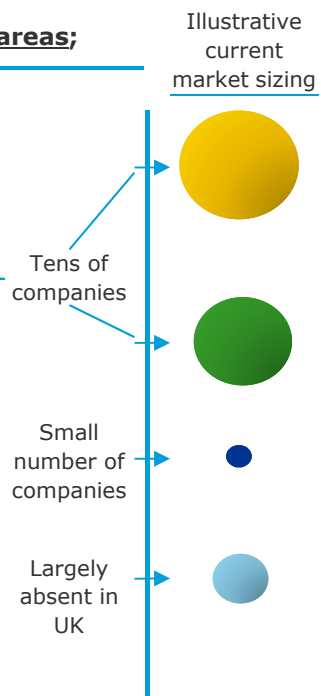
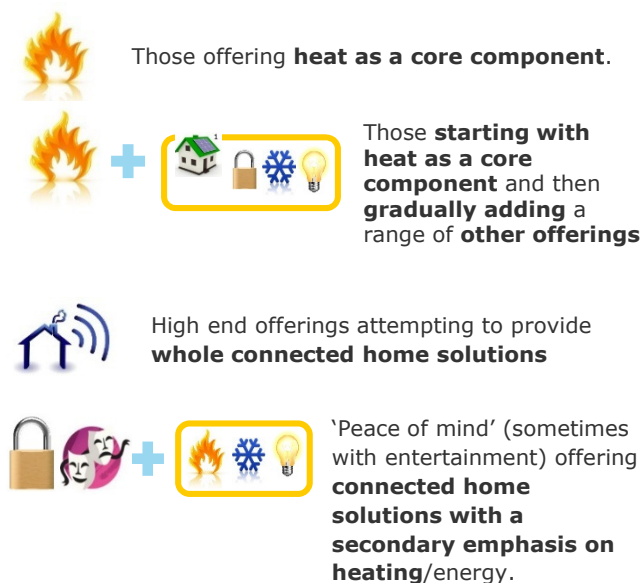
- HEMS offerings are currently used to directly support Utilities' operational goals such as customer retention, improved billing/credit management or helping to meet environmental obligations.
- However, in the longer term the major value from HEMS type offerings could come from:
 - being able to shift demand for the system/network benefit or to optimise against wholesale price
 - commercial value from detailed and sophisticated data on consumers that could be used to offer specific tailored services and targeted promotions.
 - Offering complimentary services as part of bundled offering

Customer propositions provide benefits in order to enable value to be captured by HEMS providers

The HEMs market is still emerging, with a scattered focus; there are many variations in offerings, many offer heating as a core component

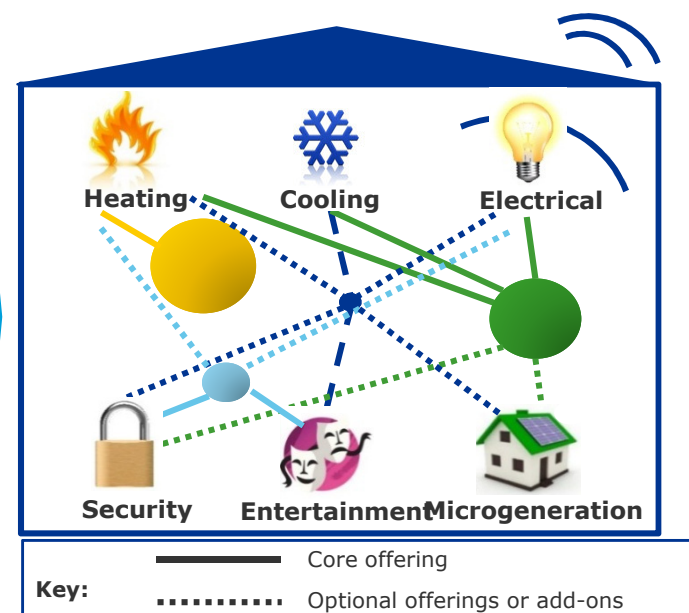
The existing market is very scattered, lacking a single USP. It can be categorised across many dimensions, but broadly can be segmented into offerings with heat at their core; and wider offerings built around whole house connected home solutions or 'peace of mind' solutions.

HEMs offerings can be roughly split into four focus areas;



Connected home

(illustrates the more popular combinations of offerings – but a whole host of other combinations exist)



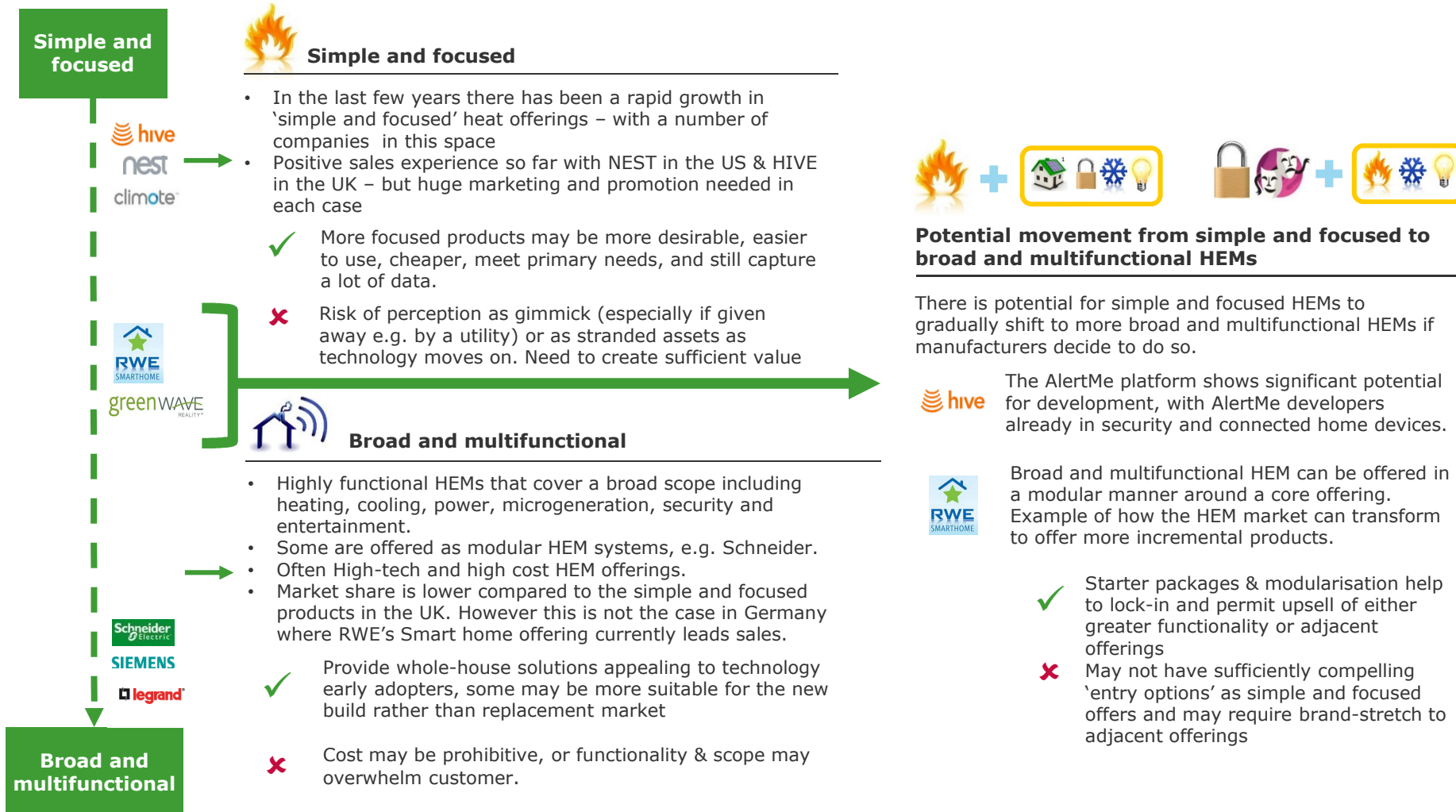
Scattered offerings are symptomatic of a wide range of companies feeling their way into the market from very different starting points

The HEMs market is attracting players from many different backgrounds, which helps to explain the many different approaches and entry points into the markets:

- Start-ups, who are experimenting with different tactics to get traction and sales
- Heating appliance manufacturers
- Web giants such as Google, Amazon
- Heating controls manufacturers such as Honeywell, Danfoss
- Home electrical / automation specialists such as Legrand
- White goods / electronic giants such as Samsung, LG

It is unclear whether 'simple and focused' or 'broad and multi-functional' offerings will win, or whether offers evolve into more complex ones

Potential movement for HEMs to become more broad and multifunctional as the market continues to grow



A few companies are gaining traction in the UK with simple/incremental offerings backed by large marketing spend and/or through utility channels

The UK HEMS market is embryonic, a few simple and focused offerings are demonstrating some traction– but sales numbers are very low and it is far to early to identify really success in the market:



UK current market leaders are simple and focused but will adopt an incremental approach backed by strong marketing.

The US market is further forward – with NEST demonstrating 10,000s sales per month with simple and focused, design-led product

US HEMS market ~0.5M per year

Nest dominating with 300,000 to 400,000 installations per year.

US market leader Nest is design-led simple and focused with exceptional marketing

Continental Europe provides a more mixed picture, with some simple & focused products selling 1,000s per month, and some wider (but sometimes modular) offerings also doing well.

EU HEMS market ~0.2M per year

A few players with 20,000 to 50,000 installations per year:

- Netherlands** – both through utility channels with strong promotion, focused / incremental offerings
- France** – primarily a compliance market for building regulations – broad and multi-functional.
- Germany** – incremental, modular offering built around heat – exceptionally strong utility marketing.

Quby **DELTA DORE** **RWE SMARTHOME**

EU market leaders mostly have a focused / incremental offering with strong channels and promotion

Developing a profitable position in an embryonic HEMS market requires a compelling proposition, strong brand, and finding a route to sell and deliver

Five forces analysis of the HEMS market

Buyers have strong power in the market because:

- No existing powerful end-user 'need' to meet, so HEMS players creating a new market
- Limited number of Utilities that currently hold the key to accessing consumers at scale, therefore hold great power and can dictate on price
- Utility HEMS offerings rely on their ability to support other business objectives (e.g. customer churn) and therefore offered at a discount or even free – not a core part of the Utility offering so limited dependency

HEMS players reliant on suppliers as:

- Most products currently require installation or distribution channels through 3rd party suppliers
- HEMS products not a priority for these suppliers due to low volumes and low margin
- Limited numbers of these installers and merchants

Therefore there is an advantage to companies that can avoid reliance on these suppliers as some of the most successful companies currently do

Potential for substitution is strong due to:

- Many HEMS offerings, so substitutes available and not easy for consumers to differentiate functionality (HEMS are already a substitute for basic controls) – there is a need to educate consumers
- Reliance on brand, visible design and price to differentiate and gain a footing with consumers

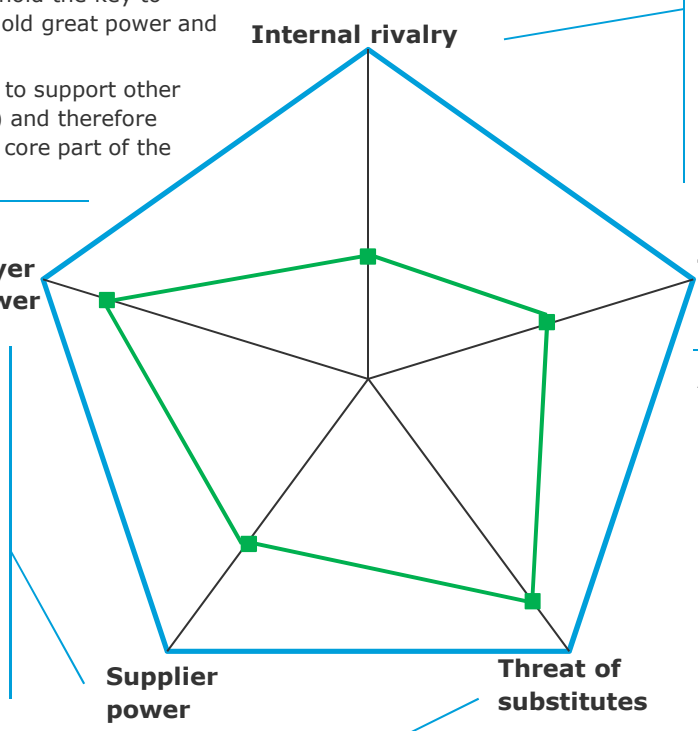
Internal competitiveness is diminished due to:

- Embryonic market with potential for fast growth and changing strategies
- Differentiation of products with significant cost differences and fluid prices
- Little brand recognition, currently players are more focused on getting the market recognised
- Difficulties in switching provider once installed due to physical barriers and significant size of investment

Threat of New entry

A mixed story with regards to new entry:

- Incumbents themselves learning about how to make offerings to customers
- Brands in early stages of being established - new entrants can enter the market if sufficient marketing power and right route to market
- Technology and know-how not a significant barrier, however access to distribution channels & marketing budgets is
- No specific regulatory barriers to entry but difficult / expensive to establish in the market without a partnership to build customer base



A sixth important force is ROLE OF COMPLEMENTS – future success will be influenced by how complementary applications and services can be built in and leveraged through HEMS offerings (e.g. multiple services in a home automation proposition)

Many HEMS providers are pairing with utilities to secure a route to market - other potential channels exist but are yet to be exploited

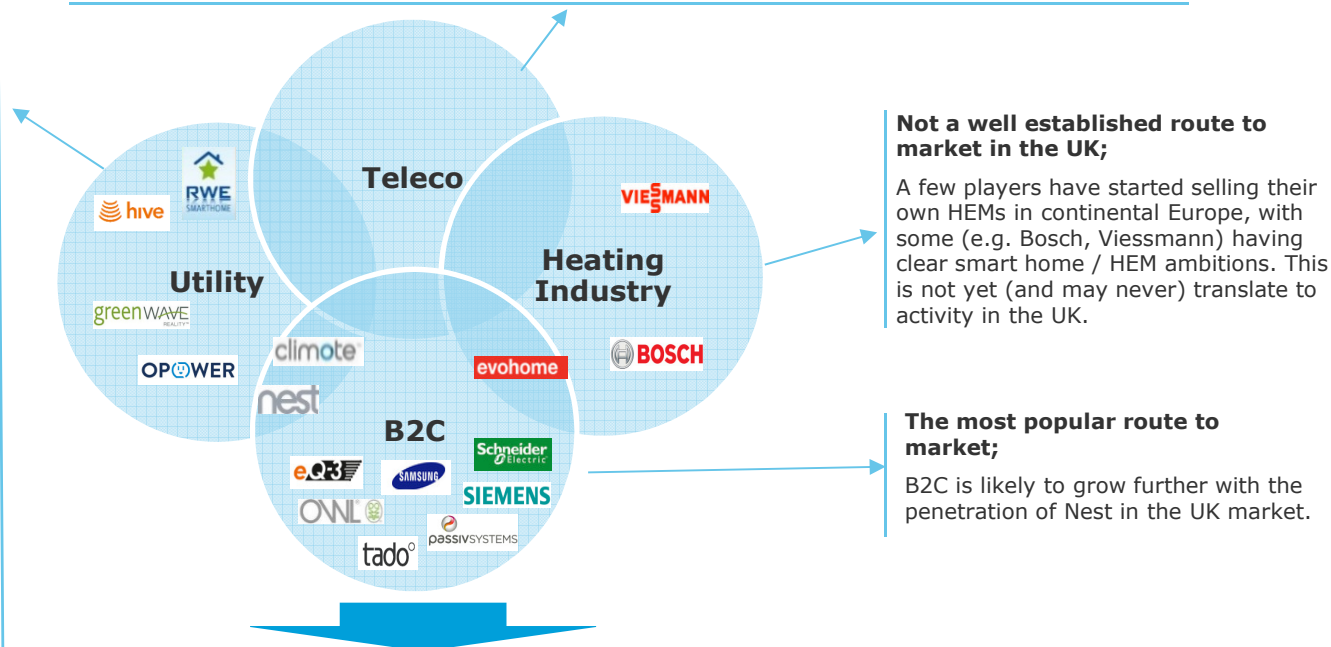
UK market leader, Hive provides the highest sales to date;

	+	<i>Movement into trialling HEM</i>
	+	<i>greenWAVE REALITY™</i>
	+	
	+	<i>Movement into developing HEM</i>
	+	
	+	
<i>Smaller/green utilities are getting involved;</i>		
	+	
	+	<i>Movement into developing HEM</i>

- The majority of the big utilities have partnered with a HEM company and have or plan to bring out an offering
- Some utilities are more serious about future development into connected homes than others – British Gas stand out.
- British Gas have large scope on the AlertMe platform for serious development into connected homes and a clear strategy move towards digital services / smart home leadership position.
- Followers in the market seem to be investing for insurance, with as yet no demonstrable ambition to establish a connected homes package. We are not convinced of their ability to drive HEMs market success.

Telco's are well positioned and have lots of power to develop a HEMs;

- They already have existing infrastructure and experience
- In the US telco's have captured a significant part of the 'peace of mind' smart home market increasingly with energy as a pull-through
- Penetration into the home is already complete, with most homes having a modem for an internet connection.



Not a well established route to market in the UK;

A few players have started selling their own HEMs in continental Europe, with some (e.g. Bosch, Viessmann) having clear smart home / HEM ambitions. This is not yet (and may never) translate to activity in the UK.

The most popular route to market;

B2C is likely to grow further with the penetration of Nest in the UK market.

Opportunities for a new route to market;

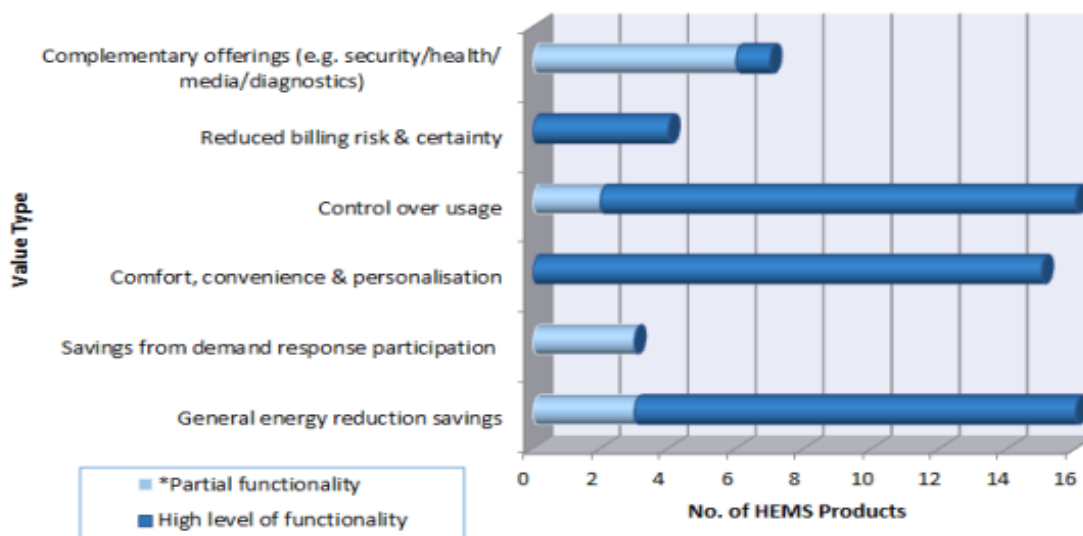
- B2C and utility routes to market are **emerging** – we believe they will **continue to be the main routes** to market in the near term.
- Alternative strategies yet to be exploited include Telecoms, heating industry, entertainment and security manufacturers.
- Some movement in this space includes Samsung's recent 'Smart Home' announcement – but very difficult to see how this will translate into HEMs activity in the UK.
- **Peace of mind offerings offer promise**– smart home security (and possibly entertainment) with an energy add-on.

Current market offerings don't allow customers to access all possible types of value so there is opportunity for more sophisticated value propositions

Certain types of value are widely offered to customers, whereas others are barely attempted:

- Our characterisation of the market, through the lens of 16 typical products, highlights that **demand response, reduced billing risk and certainty, and complementary offerings are only being offered in limited ways** within the current UK HEMS market.
- **The market has delivered most of what can be delivered within current constraints** imposed by technology, regulation and market arrangements.

Types of Value Delivered By Current HEMS Products



Current limitations

- ✗ Preventative diagnostics require refinement of appliance signature recognition routines to ensure accuracy. But boiler diagnostics being explored now by British Gas.
- ✗ Remote video surveillance / 'peace of mind' is theoretically possible, but may require additional bandwidth than is generally available.
- ✗ Time-of-use tariffs inhibited by absence of smart metering – thus domestic market operates on principle of settlement by profile class.
- ✗ Demand Response requires a completely new set of market arrangements, including definition of messaging and verification protocols.

Desirability / joy
An intangible customer value but critical to driving sales – clearly demonstrated by Nest, but less clearly by all other players.

***Partial functionality** denotes that capabilities are either externally constrained (e.g. DR-aware products cannot be exploited within UK energy environment) or only attempt a subset of what is possible (e.g. under 'complementary offerings', several products offer some security options but little else).

Installation challenges and customer perception of early HEM offerings are critical & interdependent risks that will influence the success of the market

Installer risks

Installers essential for many products where self-install is not possible (esp. owing to higher UK voltages).. **But..**

Quality risks

- Installers lack skills required for some HEMs products (esp. around IT & comms, but also in pre-sales and user training)
- Installer market highly fragmented (many small players) so quality risk

Channel risks

- Installers have a track record of conservatism re introducing new products (a factor in UK mandation of condensing boilers)
- Merchants influence installers (dominance of few major merchants constrains choice)

Quality and channel risks

- Installers influence customers (via personal bias or poor workmanship)
- Low margins may cause installers not to take HEMS seriously

Downward pressure on price/margin

Downward pressure on quality/perception

Customer/market perception

- Need to 'cross chasm' & create mass-market (non-geek) awareness/need, **But..**
- Best customer offer unclear - One-off sale? Starter bundle & modules? Subscription?
- Free/cheap offerings commoditise market with a "race to the bottom"?
- Risks from:
 - Energy company reputations
 - 'Big Brother in your home'
 - News of bad experiences (e.g. safety scare caused by poor install)
- Perception of gimmick and/or luxury purchase in a low-growth economy.

Possible solutions



- Designing for install' may help, effectively de-skilling the process by producing entirely repeatable installation journeys.
- However, pairing new technology with legacy devices may always present a challenge (there's a risk each visit ends up as a bespoke solution).



- Energy companies have an opportunity to combine HEMS & Smart Meter installs into a single visit, significantly reducing costs of sale, but regulatory resistance to this approach.



- Customer phone interviews prior to visiting can reduce surprises on arrival, but the benefits of this approach can be surprisingly small. Interviews with installers suggest householders are often poorly informed about what they already have in their homes.

The absence of a clear market leader leaves the field open for new entrants who can overcome barriers; the risks are in fact all opportunities

Barriers to Growth

Market development

- Skills gap & quality/cost risk where dependent on installer & merchant network
- Free/cheap offerings commoditise market
- Energy company reputations / Bad news / Big Brother in your home
- Perception of gimmick and/or luxury in low-growth economy
- Crossing the chasm / creating (non-geek) compelling need

Fundamental risks threatening the development of a mass market

Policy & regulation

- Inability to exploit data value due to privacy/security rules
- Energy system regulations stop value being extracted

Serious risks that may limit full value extraction

Technology

- Open v Closed Protocols / Need for Standardisation
- Smart Meter rollout uncertainty adds delay
- Comms coverage & reliability risk, esp. for high value services

Can and will be fixed over time

Market not owned by anyone yet...
So the risks all create opportunity



Major risks/issues	Opportunities
✗ Installer/ merchant risk	<ul style="list-style-type: none"> ✓ Simple products for self-install or professionalise an installer network ✓ Opportunity for strong brands e.g. British Gas's installer network or retailers such as John Lewis to drive sales
✗ Lack of consumer awareness	<ul style="list-style-type: none"> ✓ Impact of huge marketing budgets (e.g. Nest, Hive)
✗ Need to unlock more value	<ul style="list-style-type: none"> ✓ Open-source products to third-party developers to build added value products (cf. Philips & Hue hub; possibly British Gas & Hive opening up) ✓ Energy company start-up to offer ToU tariffs ✓ Telco's to offer Demand Response, exploiting messaging expertise ✓ Maybe energy isn't the right USP? Cf. success in US for security-led HEMS, with energy following later.
✗ Crossing the chasm/creating mass-market offering	<ul style="list-style-type: none"> ✓ New models for customer journey - e.g. "point & bundle" per US domestic security market. <ul style="list-style-type: none"> • Point = one-off payment for initial sale • Bundle = upsell to full package with optional subscription service as gold standard (e.g. video surveillance, which depends on bandwidth - telco).

Section B

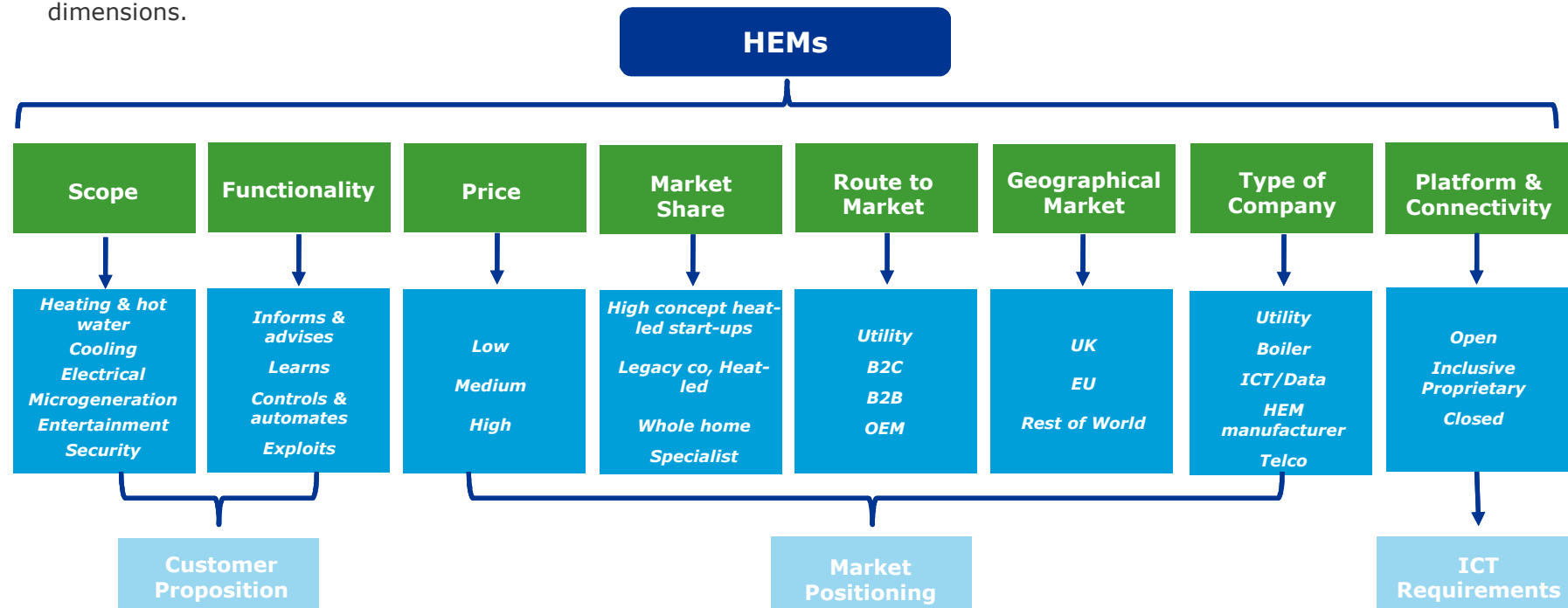
2. The current HEMS market

b) Back-up evidence

The market for HEM products is complex and scattered – we chose 8 dimensions to help characterise the market

No widely accepted definition and many dimensions to consider when characterising HEMs

- There is currently no industry-wide consensus on the definition of a HEM.
- For the purpose of this report a **HEM is defined as a product or service that controls, monitors and analyses energy and other supplementary home automation services, such as lighting, security or entertainment.**
- Using this definition the HEMs market can be characterised in many different ways – it is not possible to provide a simple two-dimensional characterisation of the market
- Therefore we developed a number of dimensions to fully characterise the scattered and emerging HEMs market.
- 16 companies were selected for further review - all of these companies cover the various sub levels within the 8 different dimensions.



Characterising 16 HEMs companies across a number of dimensions shows the range of offerings, but is a basis to identify a number of patterns

HEM	Product summary	Overall Functionality	Cost	Type of company	Scope	Route to Market	Market strength
nest	An attractive apple-like gadget with learning capabilities. Current market leader with significant financial backing.	●	££	HEM/Web Giant	🌐	U/B2C	★★★★
OPOWER	Specialist energy-only offering that has achieved a quick market win. Delivered via utility integration with minimal in-home footprint	●	n/a	HEM Start-Up	🌐	U/B2B	★★★★
greenWAVE REALITY	Wide-ranging, open platform that combines style and affordability	●	££	HEM Start-Up	🌐	U	★★★★
passivSYSTEMS	Simple occupancy based interface for customer control with high precision energy usage data, only installed by Passiv engineers.	●	££	HEM Start-Up	🌐	B2C	★★★★
hive	A simple thermostat yet the AlertMe platform shows significant development into connected homes products and services.	●	££	HEM Start-Up	🌐	U/B2C	★★★★
climote	A clock designed interface with a subscription offering for remote control. Started in Ireland, now paired with Scottish Power.	●	££	HEM Start-Up	🌐	U/B2C	★★★★
eQ3	Functional offering aimed at home managers more interested in capability than style. Modular design reduces initial entry price	●	£ - £££	Heat controls	🌐	B2C	★★★★
tado°	A sleek and simple designed thermostat with no display screen. Offer a rent monthly scheme and encourage self-install.	●	£	HEM Start-Up	🌐	B2C	★★★★
ONL	Lots of modular and expandable offerings covering energy. Self installed system that requires user inputs but gives lots of information about energy usage.	●	£	HEM Start-Up	🌐	B2C	★★★★
BOSCH	High-end heat-focused extension to Buderus boiler range, drawing on Bosch's experience of energy management & tuning	●	£££	Heat appliance manufacturer	🌐	OEM/B2C	★★★★
RWE	Wide-ranging utility package that goes beyond 'toe in the water'. Modular design allows for low-price starter kits & growth over time	●	£££	Utility/ Home automation	🌐	U	★★★★
VIESSMANN	Sophisticated home automation & energy management platform with hooks available for non-energy players to extend the product	●	£££	Heat appliance manufacturer	🌐	OEM/B2C	★★★★
evohome	Heating only offering with zonal control.	●	££	Heating controls	🌐	B2C	★★★★
Schneider Electric	A demand response ready, high-end, very smart but not sleek modular system that provides a smart home solution.	●	£££	Home automation	🌐	B2C	★★★★
SIEMENS	High-end lifestyle package from electronics giant, exploiting metering expertise, and offering multi-apartment management	●	£££	Electronics	🌐	B2C	★★★★
SAMSUNG	Home automation bid from high-brand manufacturer. Emphasis on appliance control & 'wow' factor rather than energy.	●	?	Electronics	🌐	B2C	★★★★

Scope 🌐 meets 1/6 – i.e. heating only, 🌐 meets 6/6 – i.e. heating + microgeneration + etc.

Functionality ● Low ● medium ● high

















Cost £ Low ££ Medium £££ High

Route to Market U Utility B2C sell direct to customer OEM original equipment manufacturer

Market Strength ★★☆☆ Low ★★☆☆ Medium ★★☆☆ High

Note: This focuses on the 8 dimensions on the previous slide (except for geography and type of company – left out for simplicity)

Scope varies but smart heat is at the core of HEMS. Products can be classified as simple and focused on heat, or broad and multi-functional

HEM	Scope					
	Heating	Cooling	Electrical	MicroGen	Entertain	Security
 hive	✓	✗	✗	✗	✗	✗
 climote™	✓	✗	✗	✗	✗	✗
 BOSCH	✓	✗	✗	✗	✗	✗
 tado°	✓	✓	✗	✗	✗	✗
 nest	✓	✓	✗	✗	✗	✗
 evohome	✓	✓	✗	✗	✗	✗
 ONL	✓	✗	✓	✓	✗	✗
 passivSYSTEMS	✓	✗	✓	✓	✗	✗
 OPOWER	✓	✓	✓	✗	✗	✗
 eQ3	✓	✗	✓	✗	✗	✓
 RWE	✓	✓	✓	✗	✗	✓
 SIEMENS	✓	✓	✓	✗	✗	✓
 SAMSUNG	✗	✓	✓	✗	✓	✓
 greenWAVE REALITY™	✓	✓	✓	✓	✗	✓
 VIESSMANN	✓	✓	✓	✓	✗	✓
 Schneider Electric	✓	✓	✓	✓	✓	✓

Simple and focused

HEMS products are defined fundamentally by heat

Broad and multi-functional

Technology generalists are attempting to provide whole-home solutions – or are adding incrementally onto heating solutions to offer multi-functional products

Characterising by smartness: there are a range of different types of offering but the majority are of low to medium smartness only

Characterising smartness

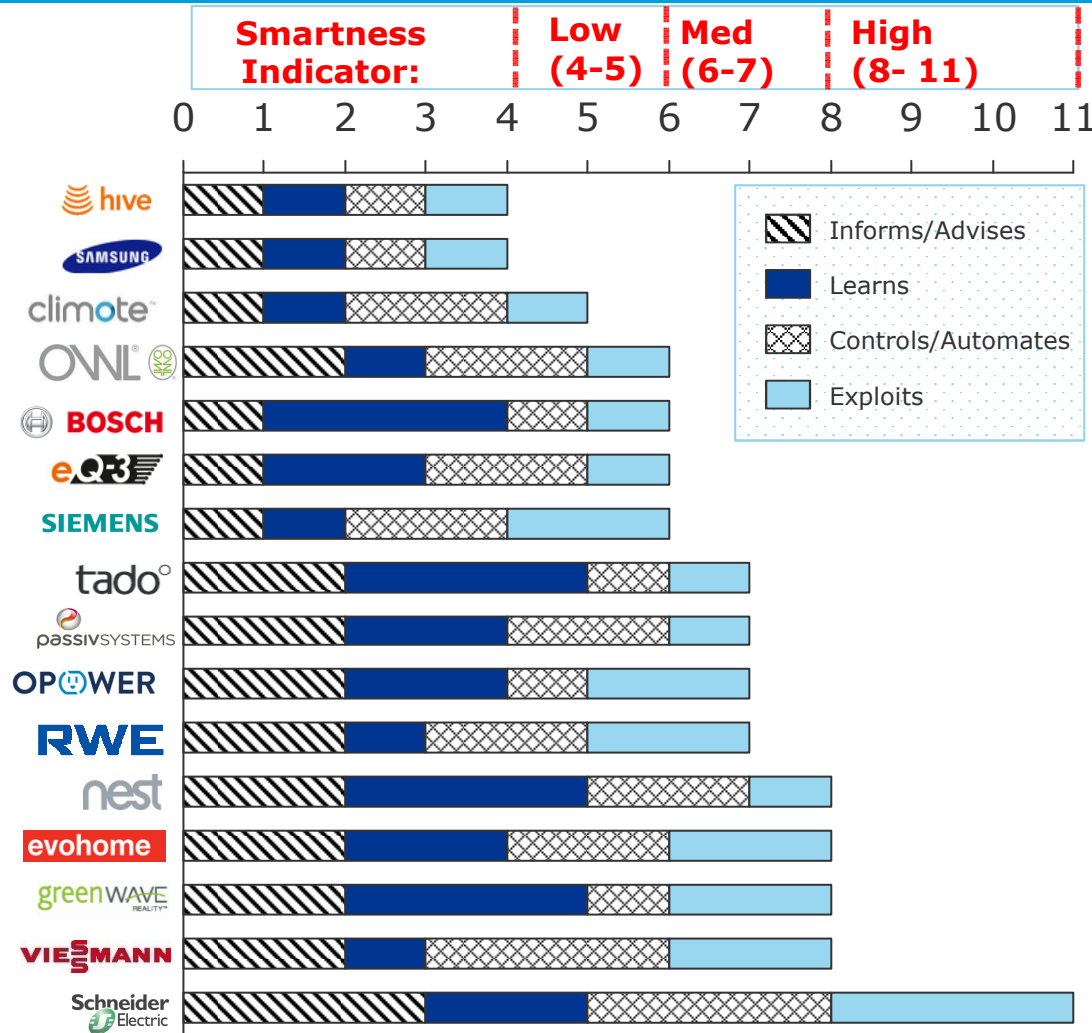
There is currently no structure in place to characterise the functionality of a HEM. The table below presents our method to characterising the functionality or 'smartness' of the HEM based on what it can do for the end user. We define four types of smartness – shown in the 4 columns below – before summing them up into three levels.

- **Low smartness** indicates that the HEM is merely a smarter and easier to use thermostat that has limited controllability, but more than a thermostat.
- **Medium smartness** refers to HEMs that have some really clever features like zonal control and simple manipulation of data and more detailed information to the end user.
- **High smartness** ultimately refers to a HEM that has a lot of scope, can learn and share data with the ability in the future to participate in demand response.

To define which HEM has a low, medium or high smartness a scoring system was established against the following criteria. Many combinations across this criteria were found, which further indicates the scattered approaches used for designing a HEM.

Smartness Indicator	Informs & Advises	Controls & Automates	Learns	Exploits
Low	Displays basic information , such as temperature and time. No detailed information or advice given.	In house and remote control of heating only for the whole house. Simple control of default or pre-set modes (up to 3 modes). No automation.	Pre-programmed - user input parameters.	Only controls heating. No data sharing with utility or manufacturer.
Medium	Displays more detailed information such as energy usage and cost and performs simple data analysis to display graphics. Basic pre-programmed advice given.	In house and remote control of all energy . Zonal control of heating in up to 4 zones and automation of 4+ modes, which can be pre-set or designed by the end user. Electrical appliances are controlled (either on/off) via smart plugs . Basic automation of presence (e.g. in/out of the house) is possible.	Decision making - reacting to data.	Data sharing - 1 way stream (e.g. sends data to utility or manufacturer).
High	As above plus displays more information and advice relating to real time data , such as energy savings, cost of energy consumed, CO2 produced. Capabilities for ToU - tariff picking.	Fully automated system which reacts to presence, anticipates your needs/comfort from its learnings and use of sensors. Has zonal control of all energy in 6+ zones . Can remotely control a variety of additional features such as electrical generation, security and entertainment in a more advanced way (e.g. dimming lights rather than on/off).	Learning - based on data, preferences and sensors.	Data sharing - 2 way stream (e.g. utility and demand response, or remote maintenance to manufacturer). Helps to exploit generation vs consumption vs tariffs.

HEMS Smartness – abilities vary, but there is a long way to go for most



Smartness v Scope

At the higher end of the smartness range, there is a broad correlation with scope. Thus, RWE, Greenwave, Viessmann and Schneider score relatively highly on both measures.

In contrast, there is an uncertain correlation between low smartness and low functionality, with only Hive and Climote scoring poorly on both.

Smartness v Market Share

It is difficult to argue that more smartness equals a larger market share (later slide).

Both RWE and Nest do score quite well in both dimensions, but UK market leader Hive and ultra-smart Schneider show limited correlation.

But Smartness isn't everything!

While level of smartness opens up opportunities for future value creation, it is not necessarily the most important HEMS attribute.

Smart devices may hold little desirability for customers if conceived, designed and implemented poorly.

Our value mapping shows there are several types of customer value that aren't yet being delivered

Product info		Value to consumer					
		General energy reduction savings	Savings from demand response participation	Comfort, convenience & personalisation	Control over usage	Reduced billing risk & certainty	Complementary offerings (e.g. security/health/media/diagnostics)
Product name							
NEST learning thermostat		✓	⊙	✓	✓	✗	✗
Opower Thermostat Management		✓	⊙	✗	⊙	✗	✗
GreenWave Reality		✓	✗	✓	✓	✓	⊙
PassivLiving Heat / PassivEnergy		✓	✗	✓	✓	✗	✗
HIVE		✓	✗	✓	✓	✗	⊙
Climote		✓	✗	✓	✓	✗	✗
EQ-3 MAX		⊙	✗	✓	⊙	✗	✗
Tado		✓	✗	✓	✓	✗	✗
Owl Intuition range		✓	✗	✓	✓	✓	✗
Easycontrol / Logamatic		⊙	✗	✓	✓	✗	✗
RWE Effizienz		✓	✗	✓	✓	✗	⊙
Vitohome		✓	✗	✓	✓	✗	⊙
Evohome		✓	✗	✓	✓	✗	✗
Wiser home management		✓	⊙	✓	✓	✓	⊙
Synco Living		✓	✗	✓	✓	✓	⊙
Samsung Smart Home		⊙	✗	✓	✓	✗	✓
	some functionality	3	3	0	2	0	6
	good level of functionality	13	0	15	14	4	1

Most of what *can* be delivered now *is* being delivered.

But advanced energy propositions, and sophisticated non-energy offerings (involving heavy data analytics or additional infrastructure) are generally unavailable.

KEY	
✓	Good level of functionality
⊙	Partial functionality
✗	No functionality


No clear winning pricing structure - a variety of structures are currently being used by the market leaders

Lots of market testing on price point

HEMs currently on the market range massively in price - the 16 typical HEM products give a view on the current price point. In general those offering heat as a core component are being sold at around £250, whereas those more comprehensive multifunctional systems are selling for over £500. This price often reflects functionality, but is not always the case for design-led HEMs.

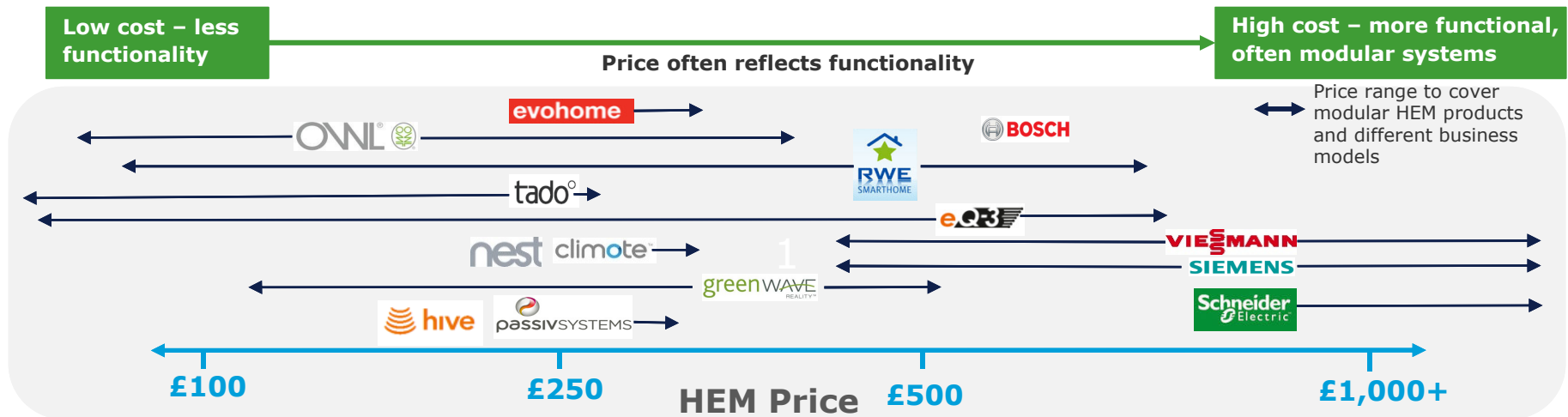
Current HEM price strategies

- 1. Modular HEM systems** – Generally high cost products, e.g. Schneider. Many others are using the modular system to hook customers in, e.g. Owl, Greenwave, RWE and EQ-3 which offer a cheap initial outlay, with a large cost for the complete package.
- 2. Buy out right and subscription on data** –has worked well for RWE in Germany. This helps to upsell more products by tying the customer into the subscription service, which is favourable to the utility for customer stickiness and revenue.
- 3. Free with utility with energy contract** – e.g. Hive. Attractive proposition for the customer who gets a free HEM, but also increases retention and revenue for British Gas. Could potential drill down the price point of HEMs.
- 4. Free but with subscription** – e.g. Climote offered as Connect through Scottish power for free with a monthly subscription charge. This monthly charge is lower if the customer chooses to pay a small amount upfront.
- 5. Point sales** – Most HEM start ups and high end HEMs are offering B2C, e.g. Passiv and Schneider.
- 6. Rent monthly** – Innovative 'rent-a-thermostat' approach taken by very few to decrease the upfront cost to the end user and ultimately create a new revenue stream once in the home, e.g. Tado.

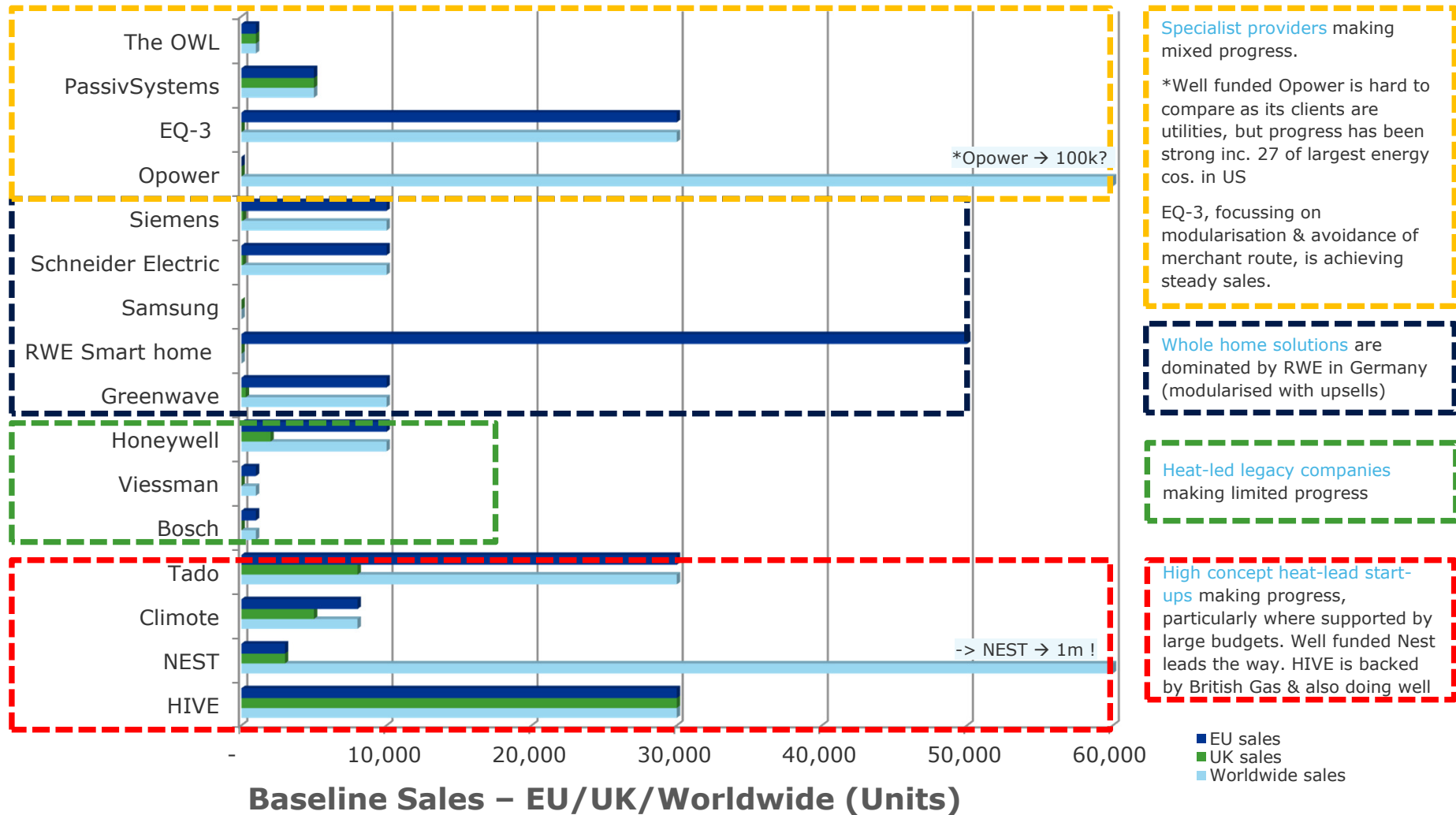
Offered for free with subscription


Option to pay monthly


Offered for free

Largest market share taken by high-concept, heat-led start-ups, with whole-home solutions also showing promise – modularised offerings *may* help in certain segments, but funding remains vital, from investors or partners



Financial analysis highlights the importance of adequate funding and careful partner selection

Very few companies are making profits, as they largely remain in the growth phase.

Growth will usually depend on significant funding being made available to

- build customer awareness and need
- complete market testing to work out most attractive propositions
- develop channels

The best placed companies will have access to very large investment pots, as shown in green opposite.

Corporate Profiling	Example	Level Of Funding	Likely growth rate	Risk profile	Outlook	Likelihood of leading market
Spinout ventures from corporates	Quivicon, spun from Deutsche Telekom	Good to Excellent	Medium to fast	Medium	Potential for market dominance but dependency on parent introduces risk	Possible to probable
VC funded start-ups	Opower	Excellent	Medium to fast	Medium	Has potential to grow quickly but likely to be under pressure to do so	Possible to probable
†Start-ups partnering with a 'rich uncle'	†Nest, AlertMe	Varies, depends on partner, can be excellent	Depends on partner appetite	Depends on partner appetite	Can produce explosive growth but partner selection is vital	Possible to probable
Large corporations	Siemens, Bosch, RWE	Depends on corporate appetite	Slow	Very low	Depends on central project funding, and likely to be heavily monitored	Unlikely
Privately owned medium-sized firms that are self-financing	EQ-3	Good	Slow to medium	Low	Steady but sure, however unlikely to grow quickly and lead.	Unlikely
*Start-ups without major partner	*Climote, Passiv	Possibly struggling?	Slow	Medium-High	Unlikely to grow in isolation. Will probably be overshadowed by richer competitors	Unlikely without more external support

*Small start-ups without a major partner are unlikely to succeed unless they can attract external support.

- Climote's total assets, less current liabilities, fell between 2011 and 2012 from +£120.665 to -£10,327. The value of equity shareholders' funds fell during the same period from -£29,335 to -£160,327. It has been declining since 2007 when it stood at +£1.3M
- Passiv is trading sideways:
 - 2012 - Turnover = £3.7M, gross profit = £1.1M.
 - 2013 - Turnover = £3.2M, gross profit = £1.4M.

... but expenses of over £5M in each year ensured significant net operating losses.

†Start-ups with a rich uncle (i.e. major investor(s) or a supportive, wealthy partner) have every chance of doing well.

- AlertMe appeared in third position in the Deloitte UK Fast 50 list of UK start-ups for 2013.
- It achieved turnover of £13.6M in 2012 and reported profits of £2.4M. Balance sheet improved from -£22.5M at end 2011 to -£7.9M at end 2012.
- Investors include British Gas amongst others, which brings benefits in terms of both funding and route to market – as well as attracting other investors.

US smart home peace of mind market – a novel way into HEMS?

Point solutions v bundles

- A **point solution** is a single product e.g. Google/Nest thermostat.
- A **bundle** of self monitored devices might include a video camera, some key fobs and a motion sensor with self-monitoring app/alerts and a thermostat.
- **Professionally monitored services** often contain similar ranges of sensors and applications as self-monitored but the hardware has to conform to security industry standards, must be professionally installed and uses a manned monitoring centre with police call-out

Bundles with recurring fees (plus up front fee)

- The traditional monitored home security market in the US was static at 21m homes, fragmented except for the leader ADT with 25% share. They sell through expensive dealer channels.
- With the entry of direct-to-user and platform operator Alarm.com, security companies started to offer **internet enabled professional monitoring** to lower their costs (eg replacing wired solutions with wireless) and to extend the range of services they could sell.
- The Broadband operators decided in the wake of their stagnating \$37bn profit pool on data and telcos they could attack the adjacent under penetrated security profit pools of \$7bn. **They quickly added video monitoring, partly as a differentiator and partly because it is synergistic with their broadband service.** The broadband operators believed the fragmented security market would find it difficult to retaliate and invested enormous marketing budgets to build market awareness. They also took cost out by using their call centres and physical shops to make the sales.
- **Security companies and Telcos have since launched a plethora of additional peace of mind services which are self-monitored with ongoing fees.** These include smoke detection, video monitoring of children or nannies, remote lock control and energy management. Video monitoring is one of the lead sales with **energy management one of the biggest pull-through sales often in a bundle.**
- Around 4m homes now have monitored and self-monitored internet security with a recurring fee. Adoption is growing fast at about 50% for 2014. Of the 4m, roughly 75% are from security companies and 25% from the broadband operators, mainly Comcast (merging with Time Warner Cable) and AT&T. The broadband operators are picking up a higher share of new adds. Smaller security companies include Frontpoint, Monotronics and Protect America. Smaller broadband players include Brighthouse and Cox & Rogers. Verizon recently withdrew its service which had been watched closely as it was price positioned lower than competitors and intended to be self-install with no professional monitoring

Point solutions and bundles with one-off fees

There is a battle between point solutions paid for on a one off fee vs the bundles sold by broadband operators and telcos on recurring fees. There are some 9m-10m homes with self monitored devices, the majority of which are point solutions.

As customers get used to point solutions, the telcos hope they will start to take bundles on service fees.

The market for one-off fee solutions has been fragmented with:

- OEMs such as Honeywell, Philips Hue, Belkin, Ingersoll Rand trying to reinvent their portfolio for an internet world, to get more margin and a customer relationship
- High end, high margin, low volume full home automation companies like Control4
- Retailers like Staples (on Zonoff) and Lowes (on AlertMe) want to gain new revenue and to build a customer relationship.
- Utilities selling thermostats to differentiate their core energy offering and improve net promoter score and trust. Sometimes they offer the thermostat as a one-off fee, sometimes on a rental and/or bundled with core energy

In the last few years some internet giants have entered:

- Nest had sold 1m thermostats and smoke detectors prior to its 2014 acquisition by Google and was growing at several hundred thousand homes a year. Since then Google has helped it strike big retail distribution deals and is subsidising hardware like the recent promotion of 2 for 1 smoke detectors at Home Depot.
- Amazon has recently launched a home automation store

Home automation products have been around for a long time, but recent moves by connected homes players appear to be changing the game at last

Connected home energy specialists are disruptive and consumer oriented.. Is this the way forward for the market?

Nest labs have shaken up the US energy market by being the main non-security offering to ship high volumes of products (300-400,000/year). They arrived in Europe this year and rapidly stimulated customer interest.

Other innovative companies like **Quby and Tado** are gaining traction through different routes to market and now have the challenge to manage growth and innovate further.

50+ companies are now in this market, most with either energy or peace of mind offerings.

Full home automation specialists have been in this market for quite some time, but failed to gain traction!

Early connected home energy specialists emerge around here

Climote and Alert-me launch in the UK – first move by British Gas and Scottish power. Still low customer interest and awareness. Low 1000s sales at max

15+ products available in the UK. Launch of Nest. Sales reach high 10,000s. Strong marketing from Hive and Nest. 4 of the big 6 offer products and the 2 others will soon

Heating appliance manufacturers start to look at this space

50+ connected home specialists in Europe

1980s ----- 2000s ----- 2007 2008 2009 2010 2011 2012 2013 2014

First utilities to get involved in this market (RWE, British Gas)

Many more utilities get involved across Europe

First telcos to be involved in this market

More telcos are getting involved

Basic Energy Monitors – Birth, Death & Rebirth?

There was a bubble of interest for energy monitor devices around 2008-2010, which came and went in a short period of time. Although trials indicated that energy bill savings of around 10% were achieved – improving for real time consumption feedback – the devices ended up in the “kitchen drawer” as end-users lost interest.

This type of device might yet reappear in the consumer’s property as part of the smart meter rollout or because of new build regulations. However, since ~2010, the industry has largely been pushing for more innovative heating controls, believing that these may deliver greater savings.

Costs of sale vary by channel, but usually several players are involved, which inevitably puts pressure on margins

Channel type 1a: Utilities

Tend to favour direct distribution of HEMS unit to customer (bypassing merchant) with installation out-sourced to third party. BG use their own staff.



Channel type 1b: Connected home specialist sale via third-party (e.g. John Lewis, Amazon) or own website (Nest, Evohome)

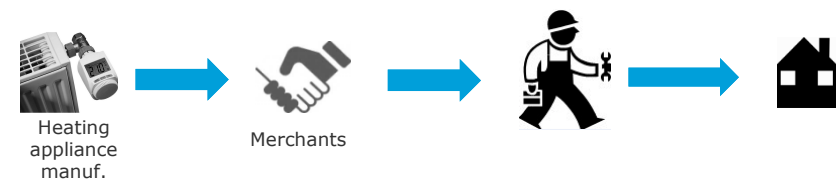
Similar to 1a, with customer using search engine to locate installer. Installation positioned as extra cost, not part of product. Aggressive marketing cost of 1a replaced by channel margin.

Each channel comes with its own cost challenges:

- Long supply chains put pressure on installer margins, encouraging them to combine HEMS installs with other jobs in same locality. This may delay delivery, and discourage impulse buyers.
- Sales and marketing costs in 1a & 1b are replaced by merchant's "gilded cage" in 2, where likelihood of promotion to the installer (who makes the sale) depends on merchant's incentives!
- Channel 3 may offer a good-value approach, particularly for new entrants like Greenwave, who hope to benefit from parallel ongoing utility sales & marketing efforts. However, only likely to be profitable if customers do upgrade from starter kits to full offering.

Channel type 2: Heating appliance manufacturer

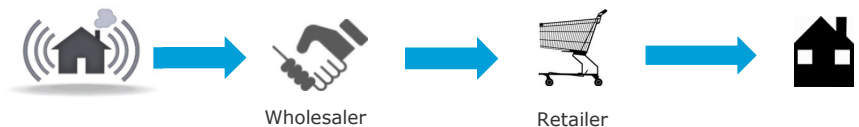
These companies have traditionally sold TRVs through the merchant channel, with high volumes and high margins for many years. Bypassing this route is not possible if they want to keep their core business safe (the 'gilded cage'). They therefore struggle to compete with disruptive competitors who are not locked into this channel.



Channel type 3: Building automation specialists

Companies like Schneider or Siemens who have many years of experience in building automation, including smart homes, usually offer many different types of products for the home. They often provide good-value "starter kits" with a few smart plugs and, for example, a security camera. The consumer can add other products to this at any time.

Emphasis is therefore on self-installation where possible, allowing distribution via retail outlets.



Section B

3. The current market for ICT related to HEMS

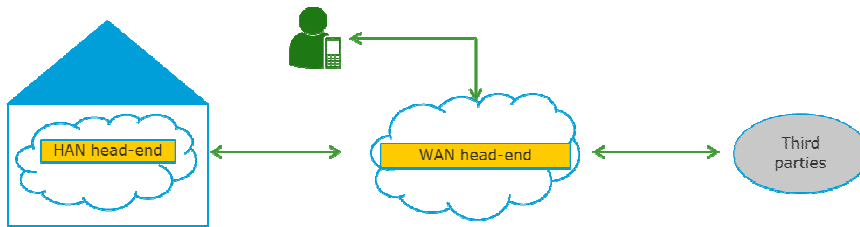
a) Key messages

Key messages – HEMS related ICT

1. ICT platforms being used and developed now should be able to support more sophisticated HEMS value propositions; the key will be the software and data analytics.
2. The move towards more sophisticated value propositions is centred around the provision of apps/remote control and the value from big data, which require cloud-based platforms.
3. There are new focused cloud-based HEMS platform offerings already entering the market but Telcos appear best positioned to control the space, while data specialists are also well placed if they can gain access to the customer's home.
4. To get maximum value from big data will require consolidation of different data from households but this doesn't necessarily require an open platform approach.
5. In the Smart Metering infrastructure, HEMS providers have options to operate alone and access a greater data set, or to partner with Energy companies to offer added value services
6. Through the CAD, a wealth of new data becomes available to HEMS providers, which allows the development of more sophisticated value propositions

ICT platforms being used and developed now should support more sophisticated HEMS value propositions; the key will be software and data analytics

Developing an ICT platform is the difficult part, ...



- An ICT platform needs to facilitate the secure data transmission and ensure interoperability on the application level between all different access points connected to it.
- The key difficulties lie on establishing the ICT platform in the first place as the implementation of communication and application protocol(s) standards is required to allow the interconnection of all devices both inside and outside the house.

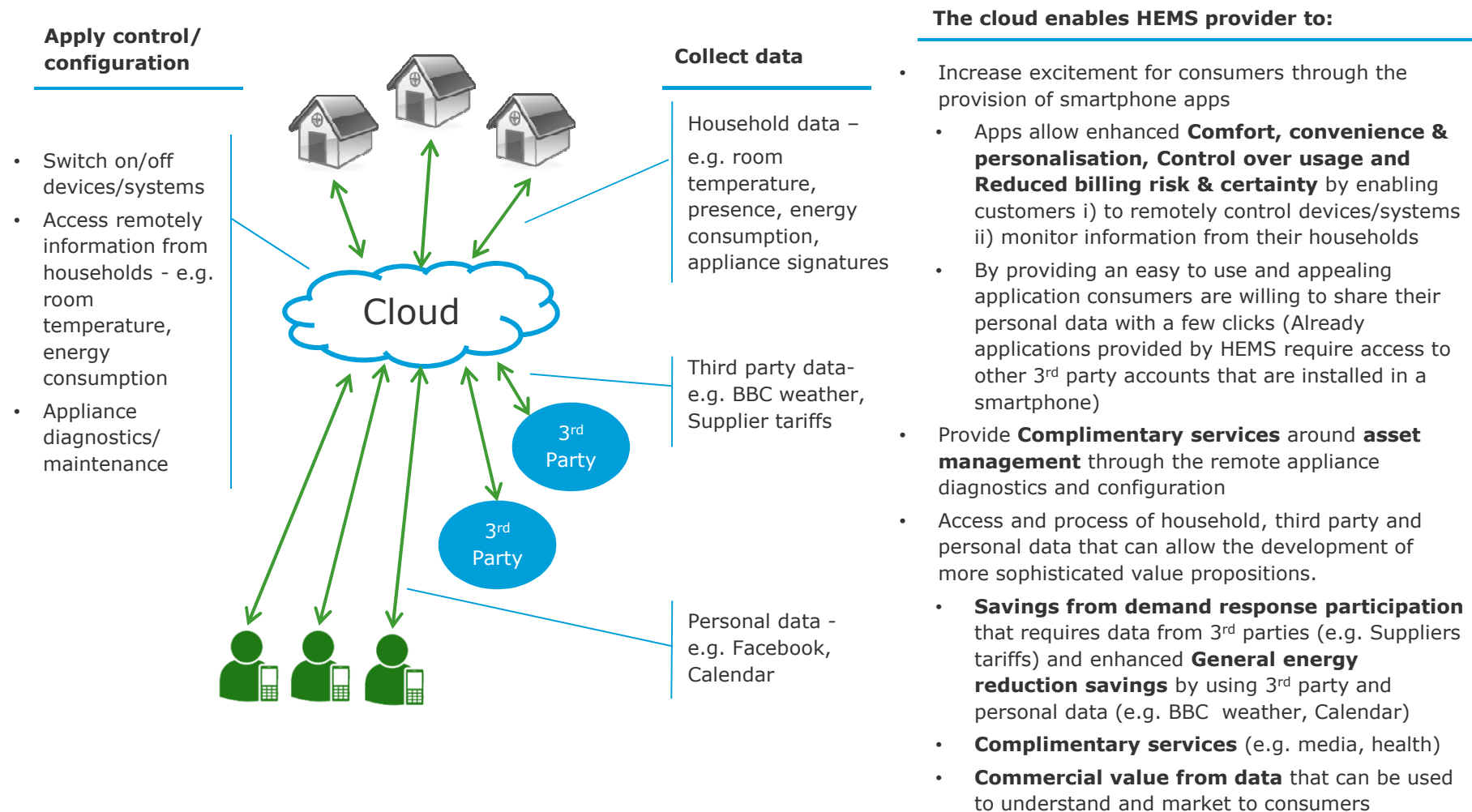
... scaling it up is less of an issue, with some exceptions:

- Once the ICT platform has been established, it can be scaled up (e.g. increased bandwidth, more connection points, larger data centres) fairly easily to allow more sophisticated value propositions
 - E.g. to allow enhanced remote control higher frequency of data from and to the household might be required and thus more bandwidth and data centres will be needed
- However, some value propositions might require extreme technical characteristics which will not be easily met by all ICT platforms
 - Frequency response will require a very low system latency of that is challenging to achieve

The development of more sophisticated value propositions is likely to require more advanced software and data analytics solutions

- The intelligence and subsequently the value proposition of a HEMS relies on the algorithms developed to interpret data and make decisions based on these.
- Improved algorithms can enhance the results of already available value propositions, however for the development of more sophisticated value propositions based on combined big data expertise from other sectors will be necessary.

More sophisticated value propositions are centred around provision of apps/remote control and the value from big data, which require cloud-based platforms



There are new focused cloud-based HEMS platform offerings already entering the market but Telcos appear best positioned to control the space

Comparison of different players against key factors for leading the home ecosystem space

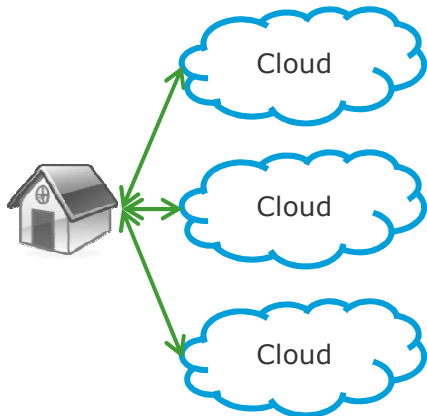
Type of player Example	New entrants HEMS Platform Hildebrand	Telcos fixed BT	Telcos wireless EE	Utilities Big 6 EON	Data specialists Facebook	Large "Black" Appliances Manufacturers Samsung	Large ICT providers IBM
Ability to built partnerships to develop standards	●	●	●	●	●	●	●
Broadband provision and reliability	●	●	●	●	●	●	●
Customer relationship	●	●	●	●	●	●	●
Access to household	●	●	●	●	●	●	●
Access to substantial funding	●	●	●	●	●	●	●
Ability to develop big data value propositions	●	●	●	●	●	●	●
Ability to built "great" functionality ICT platform	●	●	●	●	●	●	●

Data specialists in general lack access to the household, however Google has gained this access through the Nest acquisition and has plans to become a fibre optic broadband provider (already active in USA), thus positioning itself excellently.

To get maximum value from big data will require consolidation of different data from a household, but this doesn't necessarily require an open platform approach

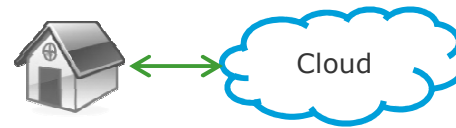
Today most the HEMS ICT platforms are closed

- Whilst most offerings adopt a common physical layer to transmit data they don't widely open up their application layer to allow integration with other devices
- As a result multiple clouds are expected to keep different information from the same household
 - The development of independent silo cloud based platforms have been used in the implementation of multiple Building Energy Management Systems (BEMS)

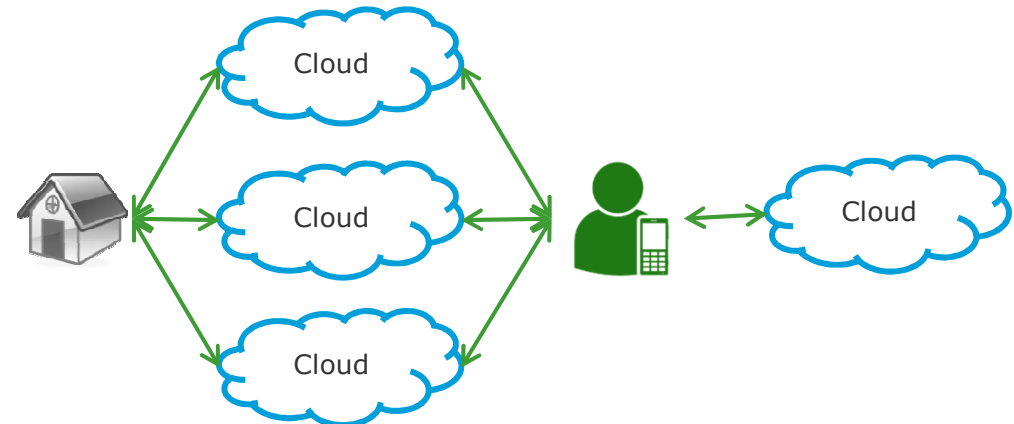


In the future, to fully exploit value from big data , data will need to be consolidated:

- To do this it might be expected that ICT platforms will adopt open standards to allow consolidation of data from a household in one cloud...

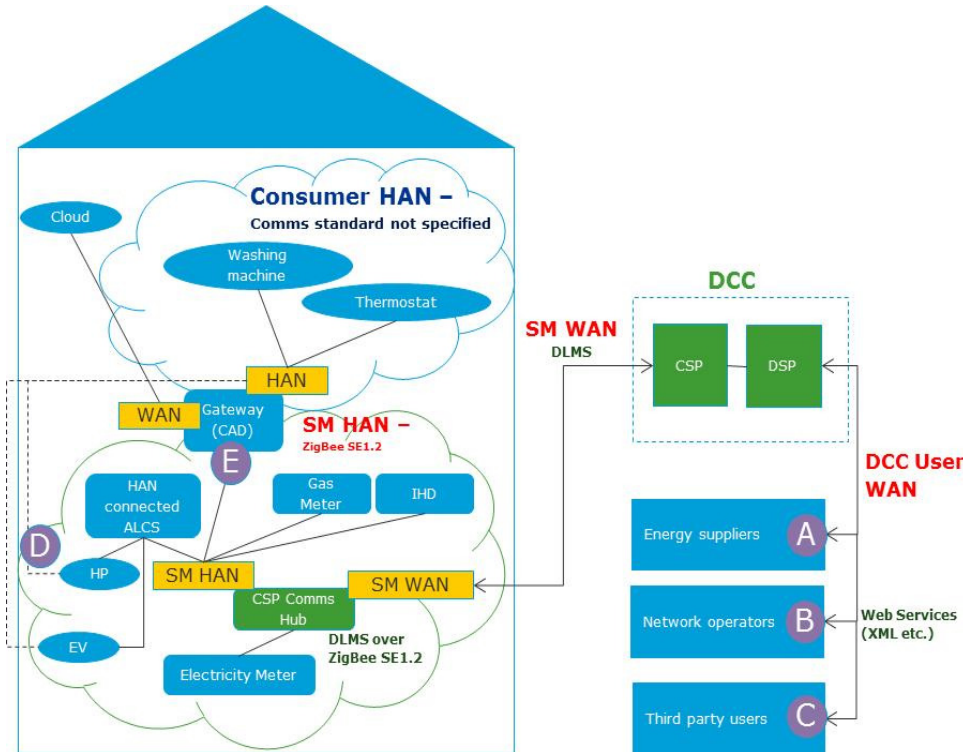


- ... but if they remain closed then there could be an opportunity to consolidate data from a household via the consumer's smartphone device.



In Smart Metering, HEMS providers can either operate alone and access a greater data set, or partner with Energy companies to offer added value services

Smart Metering infrastructure with HEMS entry points



Key: X HEMS provider entry points

Explanation

Operating alone, HEMS providers can benefit from a highly reliable, regulated infrastructure with multiple points of access..... C D E

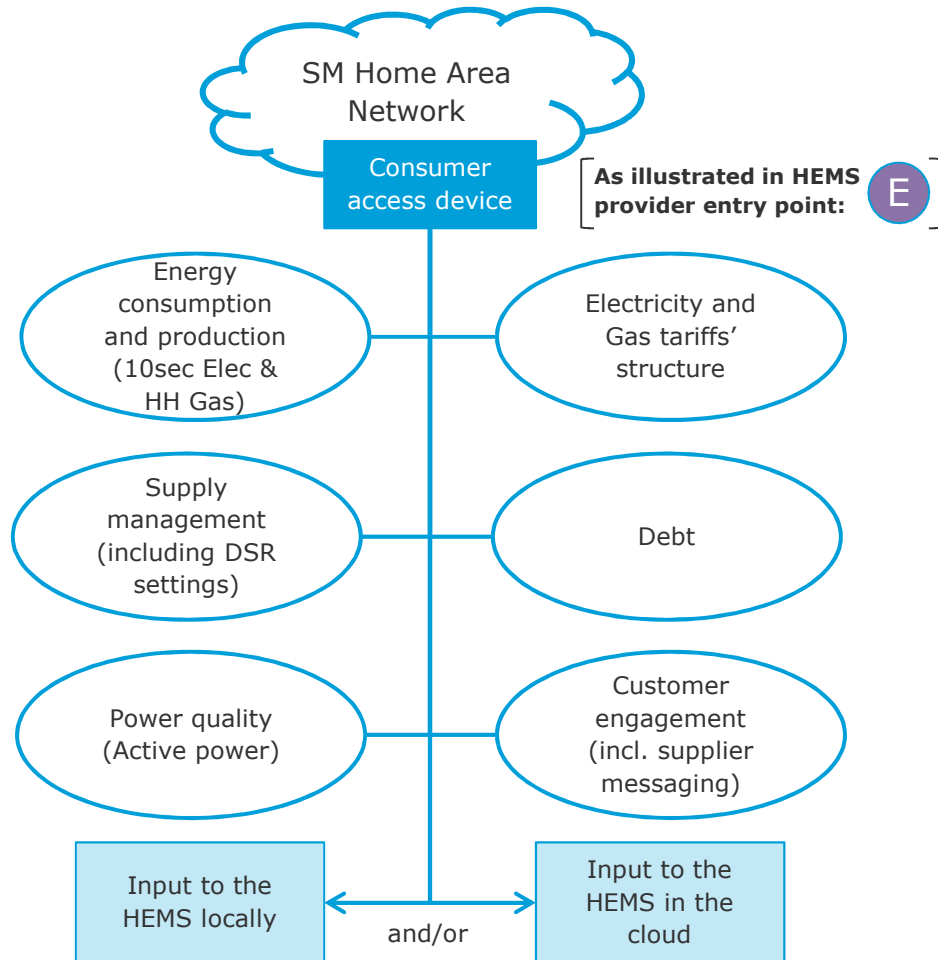
- Whilst the Consumer Access Device has its limitations (see slide 54), there is a plethora of data that could be collected from the home and merged with SM data.
 - This leaves the door ajar for a buoyant analytics market and an opportunity to develop the algorithms.
- HEMS providers seeking to use DCC's services should familiarise themselves with the Smart Energy Code and if seeking to influence, will be required to become a voting member.
 - SEC activities may be onerous and being a DCC User presents potential timing and compliance risks

Through partnership, HEMS providers may be better equipped to play a role in a wider market context (beyond the home) A B

- HEMS providers should proceed with care if attempting to get involved in the DSR market.
 - Only energy suppliers have access to ALCS and CADs cannot facilitate load control for the good of the system beyond the home.
 - Smaller loads could be controlled leveraging data from the CAD within the home (but these may have a limited role to play in local/national response).

Through the CAD, a wealth of new data becomes available to HEMS providers, which allows the development of more sophisticated value propositions

Data available through the CAD



CAD characteristics and capabilities

- CAD is expected to be easy to develop and install
 - CAD doesn't have to comply with any strict technical requirements or to be certified
 - CAD installation and connection to the SM system will be relatively simple and very low cost
- CAD can act as the hub for the HEMS
 - HEMS providers can develop a hub for their products that will be also able to connect to the SM infrastructure allowing them to have access to a much greater data set
- Data from SM infrastructure can be used for the development of more sophisticated value propositions
 - Once CAD is in place data could be accessed locally to inform the HEMS system and can also be transmitted to the cloud to take advantage of big data analytics.
 - New value propositions could be based around debt management, appliance signatures and power quality improvements.

The Consumer access device (CAD) is key to allow consumer to share data that are available through the SM programme with third parties

Section B

3. The current market for ICT related to HEMS

b) Back-up evidence

Communications functionality is the key ICT facilitator to support HEMS while data analytics offers opportunities for differentiation

There are four primary technology components for the ICT platform

Security is crucial to ensure data protection and prevent cyber attacks

- The security solution is typically integrated in the communication systems
- Security solutions adopted can have a significant impact on the hardware requirements

Communications is fundamental part of the ICT as it allows data to flow from A to B

- Communications between different devices of HEMS and the HEMS hub is required within the home (Home area network - HAN)
- Wider communications are required when data need to be transmitted outside the home (Wider area network - WAN)

Storage allows lagged processing of data

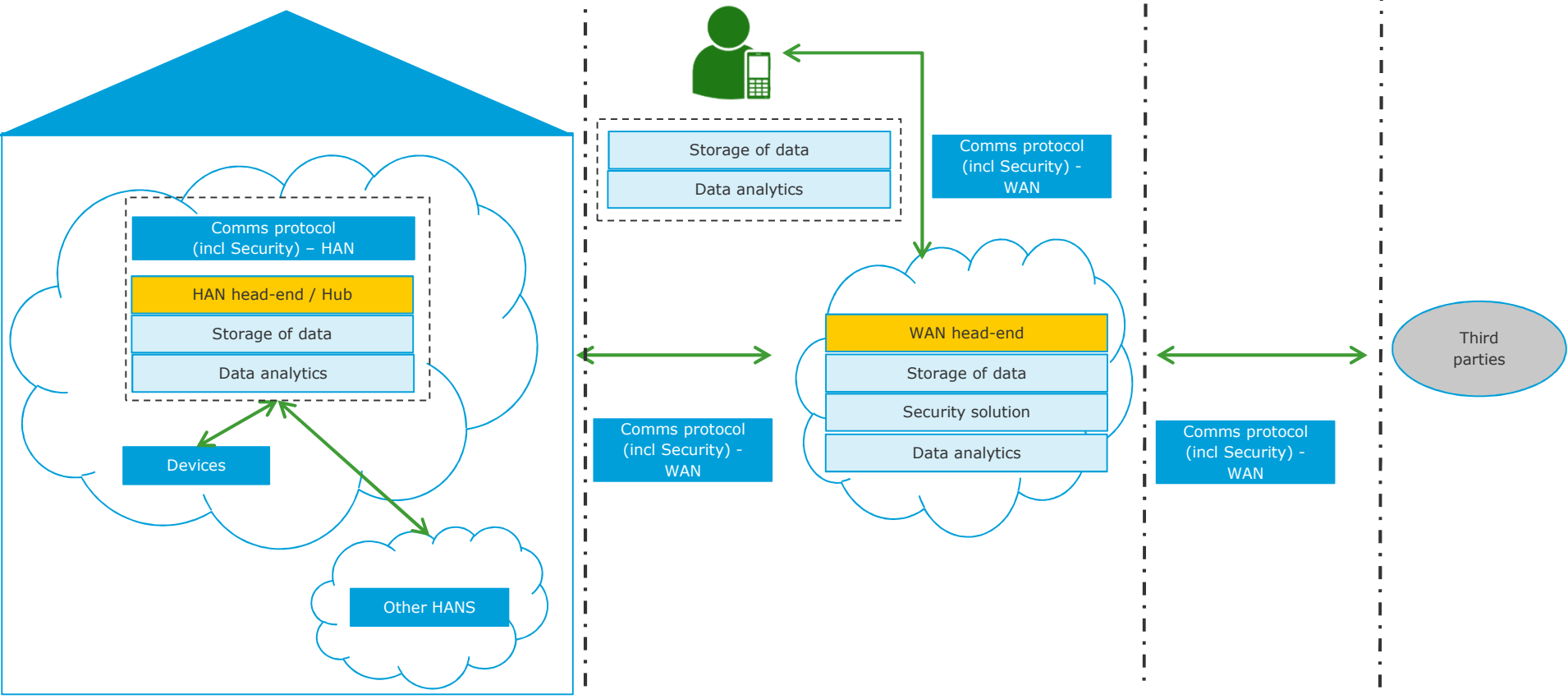
Data analytics allows lagged processing of data

- Data analytics sit at the heart of the HEMS value propositions
- Typically they are a "black box" and a key differentiator of HEMS capabilities

These functions can be provided either inside and/or outside the home depending on the HEMS value propositions requirements

There are three main platform types

- Fully integrated ICT platform that allows interaction with third parties
- Home and cloud based ICT Platform – No third party interaction
- Home only ICT Platform - No third party interaction



The HEMS value propositions have different demands of the communications infrastructure characteristics impacting which and where the ICT components are used

There are four key characteristics for the communication infrastructure

Reliability

- Reliability of communications is required to ensure the smooth operation of HEMS
- It can be improved with the use of storage and predictive data analytics

Latency

- Latency is important for VPs that require quick responses
- Very low latency is needed for a HEMS to provide frequency response

Data security

- High security standards are needed when private data are transmitted and remote control is allowed

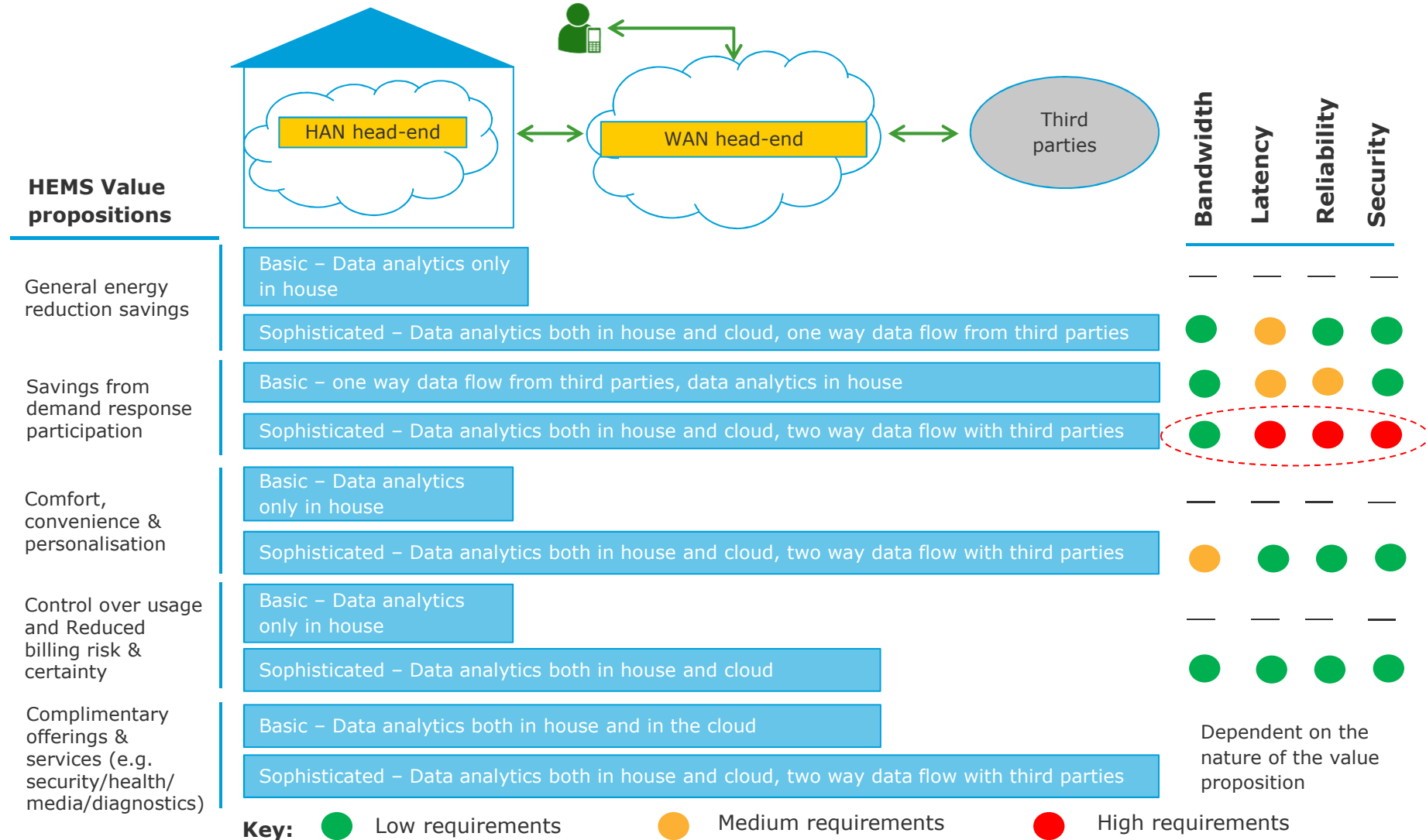
Bandwidth

- Bandwidth requirements for HEMS can be reduced significantly if data analytics take place locally

The greater these requirements the higher typically the cost and thus the communication solution should meet the required functionality at the minimum cost

In general it is more cost efficient to keep the intelligence at the lowest level possible (as set out in the Data Management project conducted as part of the SSH Programme in 2013)

Sophisticated demand response functionality has particularly high requirements from the ICT platform

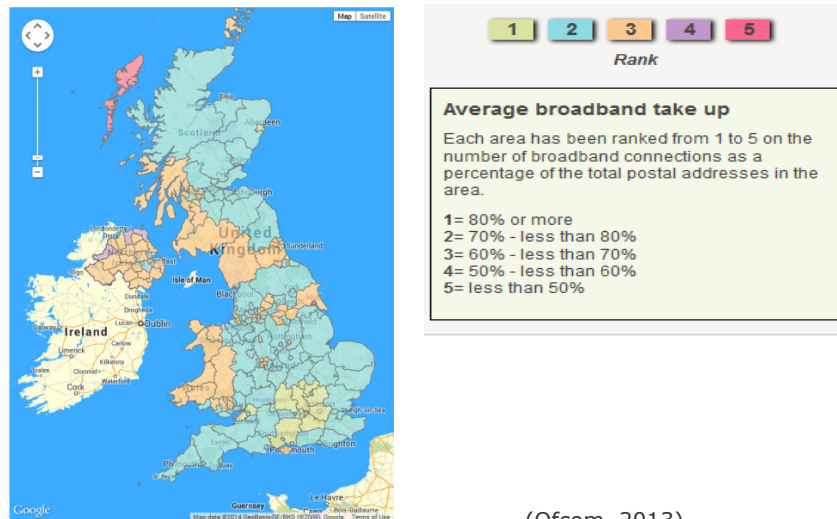


Offerings currently use fixed broadband because of its wide availability and zero additional cost for WAN communications; we expect it to dominate in the future

Currently the major HEMS providers use fixed broadband



UK penetration of fixed broadband is around 75% overall



(Ofcom, 2013)

Fixed broadband is dominant today because:

- **Penetration** - there is high penetration in UK
- **Speed** - it allows high speeds for data transfer
- **Cost** - it is already available and there is no added cost for using it
- **Target audience** - Customers for HEMS are likely to have broadband as they are more technology oriented

And in the future....

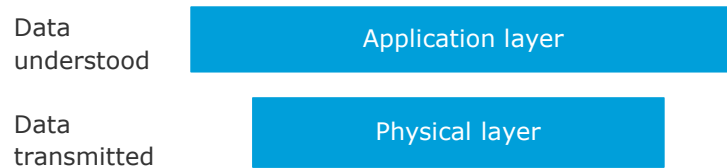
- The government is determined to achieve by **2017** :
 - **close to 100%** fixed broadband penetration of at least 2Mbps even to remote rural areas
 - 95% to have at least 24Mbps

But wireless broadband is fast catching up:

- New technologies 4G and 5G (2020) are expected to increase significantly wireless broadband speeds to tenths and potentially hundredths of Mbps
- Coverage of 4G is expected to reach close to 100% of population by 2017
- However, quality of signal will heavily depend on geographical locations

Currently most offerings are closed platforms but have the potential to open in future

A simplified communication model incorporates a physical and an application layer



To connect devices to the hub in a HAN, communication needs to be established in both physical and application layers

- To allow the interconnection of two devices these need to be able to physically transmit data to each other ("Physical layer") and being able to read and understand the data transmitted ("Application layer").
- Apart from the hardware needed to enable the "physical layer" communication there is a software element that is needed to allow the "application layer" communication.
- For both "physical and application layers" there are standards available either to everyone ("Open HAN") or to a few that get access once they have formed a commercial partnership ("Closed HAN").

"Physical layer" examples

Open	Zigbee SE 1.1	Schneider Electric
	Wifi	nest
	KNX	SIEMENS
Closed	Bespoke	Honeywell

"Application layer" examples

Open	Zigbee SE 1.1	Schneider Electric
	Bespoke	RWE SMARTHOME
Closed	Bespoke	RWE SMARTHOME

HEMS that adopt an open "physical layer" approach could adopt an open application layer as well in the future if they want to do so

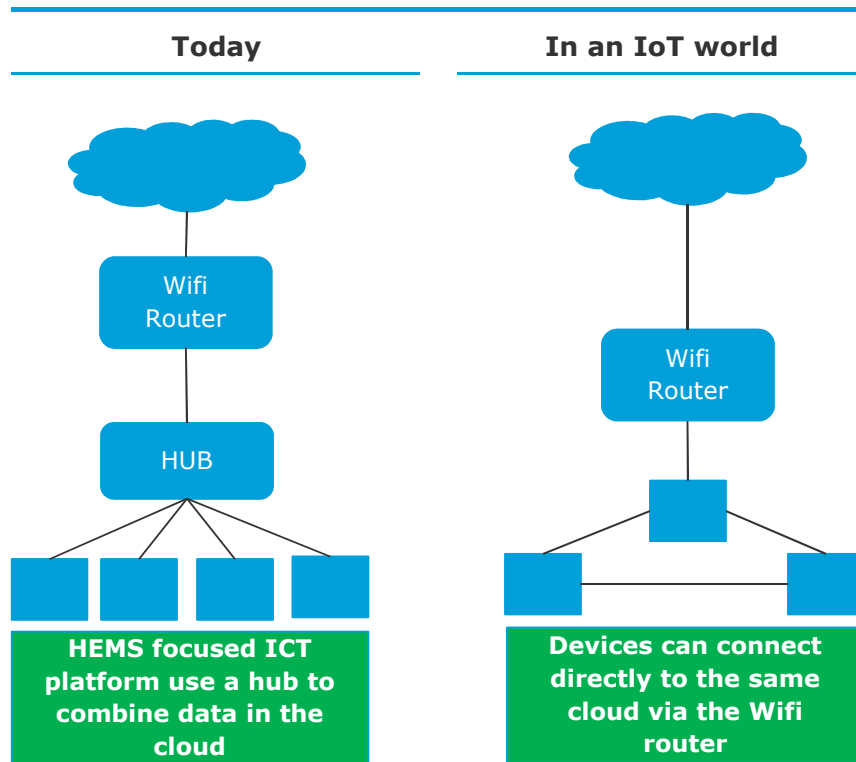
Advantages of open and closed approach

Closed	• Easier initial marketing and product loyalty Easy plug and play
	• More efficient
	• More secure
Open	• Integration of multiple devices
	• Increases certainty/competition

There is a strategic decision to be made with regard to the adoption of open or closed standards ("Microsoft VS Apple" approach)

The Internet of Things could pose a risk for HEMS focused platforms by allowing the operation of the Home ecosystem without the need for a hub

Connection to the cloud



The development of the home ecosystem where all devices are connected to the cloud is likely

- Today devices are connected either directly to the Wifi router or through a Hub.
 - Interestingly, Nest thermostat has a connection to the Wifi router and at the same time carries a Zigbee chipset (not enabled) that could allow other devices to be connected to it and to its cloud.
- In the future in an Internet of things (IoT) world all home devices could be IP addressable allowing them to connect to each other without a hub.
- This development provides the opportunity to a device that has established a connection to the Wifi router to become the point of connection to the cloud for that device.
- As a result a hub might not be needed in the future and the HEMS providers that have developed a wider ICT platform to facilitate the home ecosystem will find them redundant.

Driver for IoT & Home ecosystem

- Enabling new services to achieve market differentiation (rather than just improving operational efficiency/cost saving)



Possible massive uptake

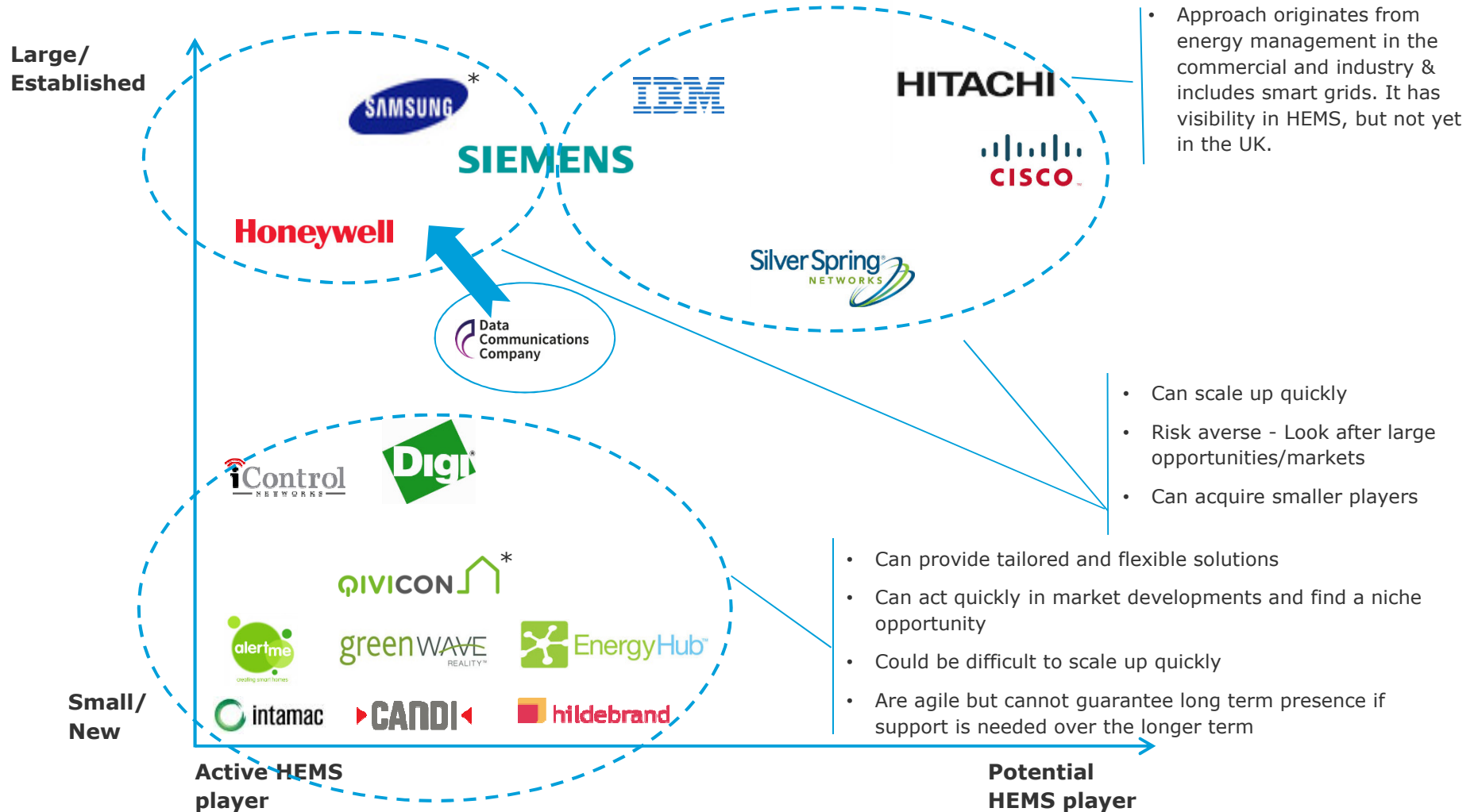
- 75% of companies from across industries are already exploring the IoT
- Consumers could soon be awash with IoT-based products and services (Economist 2013)



Impacts

- Data volumes transmitted are expected to grow substantially in future
- Increasing market for bridging technologies

Of companies with the capability for platform development, the active market is dominated by small focused players while larger companies are yet to demonstrate their potential



- Approach originates from energy management in the commercial and industry & includes smart grids. It has visibility in HEMS, but not yet in the UK.

- Can scale up quickly
- Risk averse - Look after large opportunities/markets
- Can acquire smaller players

- Can provide tailored and flexible solutions
- Can act quickly in market developments and find a niche opportunity
- Could be difficult to scale up quickly
- Are agile but cannot guarantee long term presence if support is needed over the longer term

*Samsung and Qivicon are examples of "Black" appliances and Telcos respectively that have developed an ICT platform that also includes HEMS

Larger companies tend to come to the market from a smart grid/city perspective while smaller are focusing on the home ecosystem

Larger companies

Insights



Has explored in 2013 opportunities to develop a platform for home ecosystem and HEMS in UK market



Keeps an eye on current developments of the SM programme in UK and will decide whether to make a bold move into the HEMS market. In parallel it seems to consider the development of a broader scope ICT platform.



Currently is only focused on potential services around smart grids and specifically DNOs



Sees the HEMS as one component of the wider smart grid infrastructure and currently is focused in providing components of the ICT platform rather the end to end solution.



Focuses on the development of smart grids and smart cities, and provides an ICT platform solution for their Synco living product.



Focuses on the provision of end to end M2M platform for the development of Smart cities solutions in UK.



Develops its own ICT platform that will allow the development of the Smart home ecosystem.



Aims to attract HEMS providers to use its platform, but also other services to maximise return for consumers

Smaller companies

Insights



Partners with major security and telecoms providers in USA that offer bundle services with security at the core of value propositions. Currently not very active in UK.



Partners with British Gas in UK to offer Hive. Sales in 2012 increased by 80% compared to 2011 reaching approx. £13 mil but lost £13mil the same year



A Danish company that takes advantage of low cost technologies that can be added on its platform. Partners with EON in UK.



Partners with Scottish power to offer HEMS solution and a broader range of connected devices, using their platform. They lost approx. £9mil and £10.5mil in 2011 and 2012 respectively.



A US company that offers a cloud based solution to improve interoperability.



A US company recently acquired by Alarm.com in 2013 but continues to operate independently at the moment.



A UK company that increased their profits by approx. 45% to £155K in 2012 compared to 2011



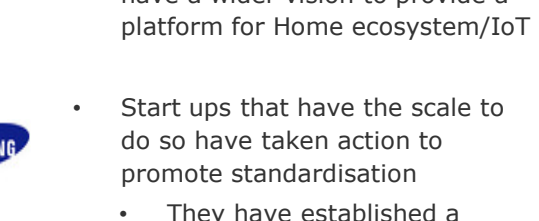


A US company, expert in M2M communications and Zigbee that provides the platform for the Schneider Electric's Wiser Home product



A spin off company from Deutsche Telecom aimed to develop a ICT platform that will facilitate the development of home ecosystem targeting consumers

Currently active HEMS platform offerings are taking different approaches to the market

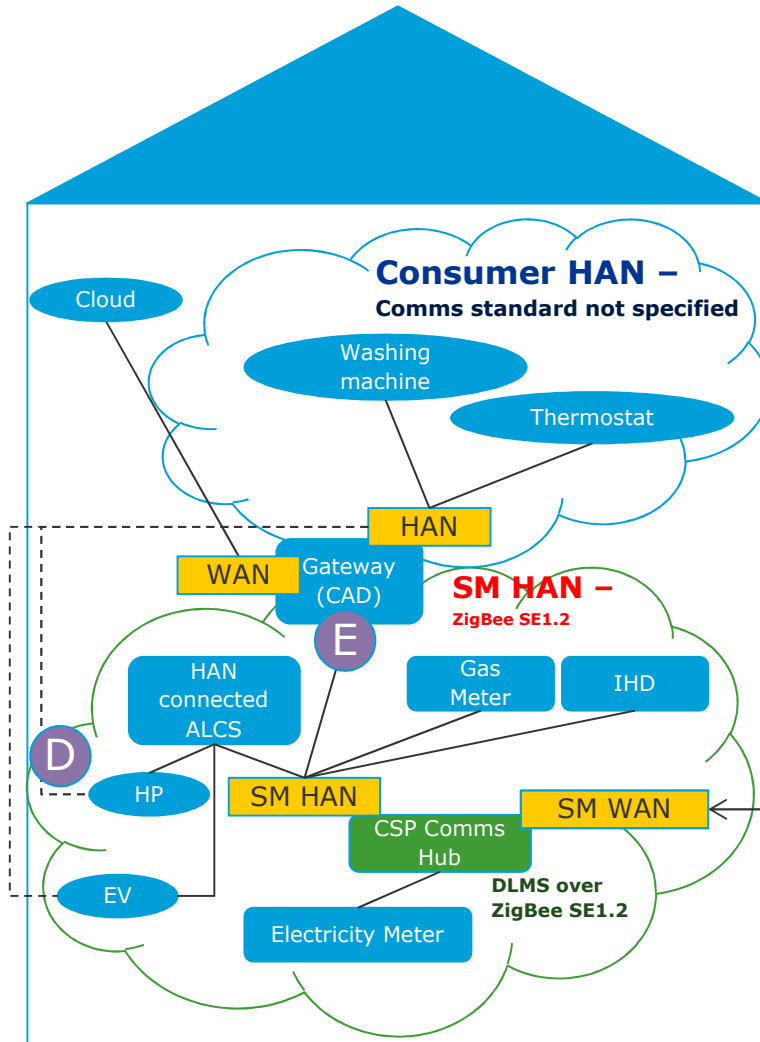
	Route to the market			Explanation
Route to the market	B2B	B2B & B2C	B2C	
Companies				<ul style="list-style-type: none"> Several start ups that offer HEMS have a wider vision to provide a platform for Home ecosystem/IoT Start ups that have the scale to do so have taken action to promote standardisation <ul style="list-style-type: none"> They have established a partner programme, where interested parties can participate in order to access software needed to produce compatible apps and products, as well as a certification programme for compatible products
Presentation of offering	<p>“White label” offering - Aiming primarily to work with other companies to help them deliver a service to the consumers</p>		<p>“Branded” offering- Aiming to develop a relationship directly with the consumers</p>	
Example of services offered	<p>E-shop for compatible products</p> <p>Consumer support</p> <p>Partner programme (Apps and hardware development)</p> <p>Product certification</p>			<ul style="list-style-type: none"> Whilst broadly the “white label” offerings have developed some traction in the market the “branded” ones need to prove their potential

Section B

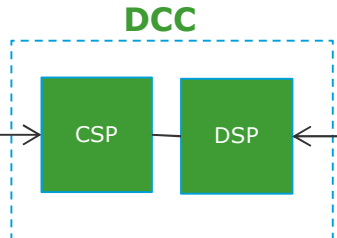
4. Specific Smart Metering implications for HEMS providers

HEMS providers have the potential to leverage the SM ICT infrastructure via the DCC's services or the SM HAN

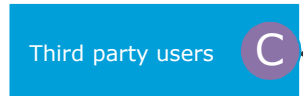
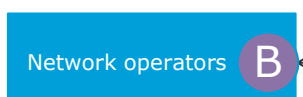
There are technical and/or regulatory issues to be considered for each 'entry point' – A to E



SM WAN
DLMS



DCC User
WAN



Web Services
(XML etc.)

Key:

HAN	Home Area Network
WAN	Wide Area Network
ALCS	Auxiliary Load Control Switch
HP	Heat Pump
EV	Electric Vehicle
SM	Smart Meter
IHD	In Home Display
DCC	Data and Communications Company
CSP	Communications Service Provider
DSP	Data Services Provider
CAD	Consumer Access Device

HEMS providers leveraging a direct relationship with Energy Suppliers avoid funding accession to, or representation on, the Smart Energy Code

Applies to entry points:



HEMS Provider requires role-based access to, and integration with, Energy Suppliers' IT Systems

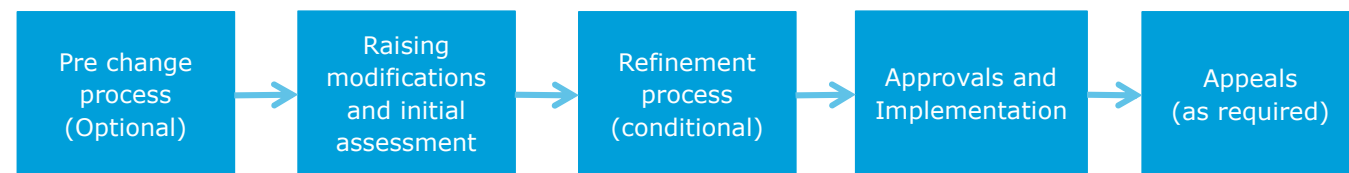
SEC activities may be onerous for potential HEMS providers

Smart Energy Code is administered by Gemserv



- Currently SEC is primarily developed by DECC until the Secretary of State deems otherwise but in the future the control will pass to the SEC members.
- During "Transition", variations to the SEC will be primarily introduced by the Secretary of State and only Urgent and Fast-Track Modifications may be raised by SEC parties and thus for a time, there is scope to lobby DECC for modifications without becoming a SEC party.
- Following Transition, change process will be akin to similar industry codes.
- SEC Parties include: Large Suppliers, Small Suppliers, Electricity and Gas Network Operators, a Consumer Member and a DCC (non-voting) representative.

Smart Energy Code will evolve/expand as SM mass roll-out progresses and there is a formalised process for its amendments



HEMS providers seeking to leverage DCC's services directly will have to become a SEC party and obtain one share if they require voting rights

Applies to entry points:



Access is via DCC User Gateway which is managed by the DSP

A HEMS provider seeking to become a DCC User with have to adhere to strict requirements, posing time and compliance risks.....

- Must undergo User Entry Process Testing – showing that systems capable of interfacing with DCC;
- Must meet applicable security requirements (will be subject to security audit);
- Must have appropriate privacy arrangements (will be subject to privacy audit);
- Must have robust process for gaining consumer consent and verifying that the person giving consent is the energy consumer

...but can benefit from a highly reliable regulated infrastructure.....

- Offering access to data from any UK household from just one access point (subject to customer consent).

....and is at liberty to suggest changes via SEC to amend DCC service arrangements

- to gain consent to access more data.
- on the basis of a new value proposition which has a positive NPV for UK plc.
 - e.g. DSR services leveraging (up to 5) ALCS.

What data?

- Limited DCC services available for third parties (this could evolve)
 - Tariff and Debt (read only)
 - Energy consumption and production (HH profile only, subject to customer consent).
 - Gas – 13 months, Electricity – 3 months
 - Max Demand Registers
 - Device management

Rules/Limitations

- Must comply with the SEC
- Must fund activities relating to SEC membership.
- Early SEC may limit the potential for SEC parties to exploit new functionality using the DCC services.
 - Services are mainly focused on supplier needs to start with.

To control loads using the SM ICT infrastructure, the HEMS provider may need to partner with the Network Operator or the Supplier as connecting to large devices via the HAN only enables receipt of information

Applies to entry points: **A** or **B** and **D**

Role-based access to Energy Supplier/Network Operator systems and gathering intelligence from other devices leveraging SM HAN

There is a risk to HEMS providers that ALCS might be one of the primary mechanisms for DSR...

- Access/control of ALCS is limited to Energy Suppliers at present and the ALCS has more stringent security criteria than the CAD
 - ALCS has to be CPA certified given the risks to critical national infrastructure of malicious activity.

...but clear opportunity for HEMS providers to collaborate with Energy Suppliers and/or Network Operators

- e.g. provision of valuable insights on device settings, history and performance prior to any participation in demand response activities

What data?

- A range of data sets could be collected in real-time from devices such as heat pumps and electric vehicles:
 - Alarm data
 - Battery life data
 - Condition data
 - Service data
 - Etc.

Rules/Limitations

- From a security perspective CAD is a type 2 device and does not require a Commercial Product Assurance stamp.
- CAD can only receive information about a device being using for load control (not command it).
- DNOs unlikely to pursue load control until RIIO-ED2 (2023 onwards)

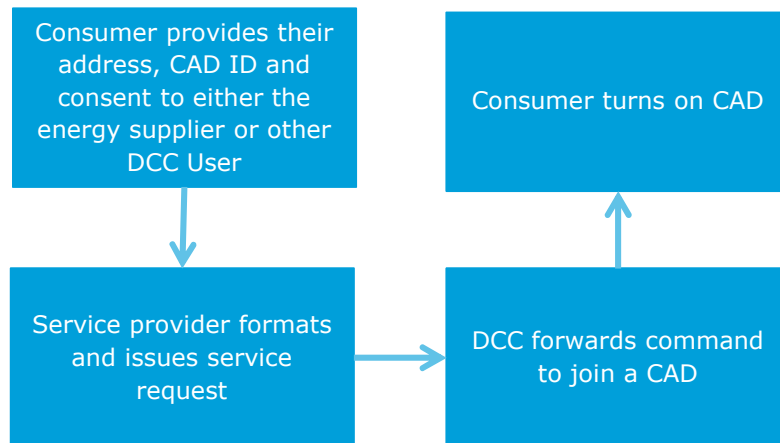
HEMS providers can access the SM HAN via a Consumer Access Device, but should be aware of the risks of constraining the value proposition that can be offered

Applies to entry points:



CAD connects to SM HAN using Zigbee SE1.2

Remote CAD pairing can be undertaken by an Energy Supplier or a 3rd Party



- When merged with data from other sensors in the home, HEMS providers will be able to conduct complex analytics without becoming a SEC party and conduct meaningful activities within the Consumer HAN and hence exploit big data propositions.

What data?

- CAD can access a range of data:
 - TOU Tariffs (up to 48 different time bands)
 - Block Tariffs
 - Debt
 - Energy Consumption and Production
 - Power Quality
 - Customer Engagement
 - Supply management
- One way – no control over devices in the SM HAN.
- 10s interval data for electricity and HH for gas.

Rules/Limitations

- SM HAN is not IP based (a limitation of Zigbee SE1.2).
 - As number of IoT devices increases in the home, CAD may need to support Zigbee SEP2.0 (IPv6 support) whilst retaining Zigbee SE1.2 for comms with SM HAN.
- Direct load control/frequency response cannot be instigated from CAD.
- CAD must be Zigbee compliant (no CPA required).
- Concerns around reliability of SM HAN.
 - Expected to provide coverage of 65-70% for Zigbee 2.4GHz but in the future Zigbee 868MHz will be adopted and is expected to provide 95% coverage.

More immediate impacts of the Smart Metering programme could also have a huge influence on the success of the HEMS market

Customer engagement could have a material impact on customers' willingness to embrace a HEMS proposition

- Risks include:
 - Lack of customer engagement could lead to obstacles to smart metering deployment or operation (e.g. people not allowing installers in, use of aluminum blankets to prevent data transmission), impacting negative the HEMS product associated with it.
 - Potential technical malfunctions or security issues are likely to be heavily criticised leading to a negative perception of home energy related products.
 - Concerns around health and data privacy.
 - Reduced willingness to invest in further assets related to energy products/services due to previous "mandatory" cost for SM.
- Central Delivery Body and SMICoP* in place to manage these risks. If successful, could bring benefits for HEMS:
 - Increased understand of energy consumption leading to positive reaction to HEMS propositions.
 - Overall message of customer engagement will be around "control" and "Technology to enable smarter living"

SM infrastructure will also impact on market opportunities

- It will technically enable the development of TOU tariffs (up to 48 different time bands) and block tariffs that can provide people with financial incentives to defer their energy consumption by using a HEMS
- Switching supplier will be much faster (possibly within a day) potentially allowing a HEMS to find and contract best available offers
- Emphasis in commercial partnerships with retailers and technology providers

*Smart Metering Installation Code of Practice