Department of Energy & Climate Change

# Smart Metering Early Learning Project: Synthesis report

Research conducted for DECC by the Environmental Change Institute, Oxford, the University of Ulster, and the Tavistock Institute

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The views expressed in this report are those of the authors, not necessarily those of the Department of Energy and Climate Change (nor do they reflect Government policy).

# Executive summary

Smart electricity and gas meters with the offer of an in-home display are due to be rolled out to all households in Great Britain by the end of 2020. DECC commissioned this synthesis research as part of its work to support a successful smart metering implementation programme (the Programme), to offer an initial analysis of progress to date and to learn how householders can best be engaged in order to benefit from the roll-out, in particular by saving energy. This report summarises and analyses evidence from a range of sources, including three new DECC research projects into how GB householders engage with smart metering, GB and international evidence on smart metering and energy feedback, and evidence from public health behaviour change programmes.

***Introduction to the Smart Metering Programme and the Early Learning Synthesis (see Chapters 1 and 2)***

The Government expects the roll-out of smart electricity and gas meters will deliver a range of benefits to householders, in particular assisting them to understand and reduce their energy usage, receive accurate bills and switch between suppliers more easily.

Energy suppliers are responsible for installing smart meters, engaging householders and providing in-home displays (IHDs). A new organisation, Smart Energy GB, has been launched to provide an independent central platform for consumer engagement activities, as set out in DECC's Consumer Engagement Strategy.[1] At present, the Programme is in the Foundation stage. This stage began in March 2011, with the aim of working with energy suppliers and other stakeholders (e.g. Ofgem, Smart Energy GB) to ensure all components of the system are in place to maximise benefits before energy suppliers start providing smart meters to most of their customers. A significant number of installations have now been carried out as part of the Foundation stage, giving the opportunity for early evaluation. DECC's objective was to use this stage as an opportunity for learning – to assess the framework in place and to guide the plans for consumer engagement being developed by Smart Energy GB and energy suppliers.

This synthesis report was commissioned by DECC to draw together and build on the DECC programme of Early Learning Project research carried out between 2012 and 2014, which is published in parallel. This research has involved a survey of 4,016 consumers, in-depth interviews with 169 households using both credit and prepayment meters, 12 focus groups and analysis of consumption data for over 10,000 households. It has provided a considerable body of new evidence about processes of change and customer outcomes from smart-type[2] residential meter installations. The synthesis report brings together the Early Learning Project research with GB and international evidence on smart metering and energy feedback, along with some evidence from public health behaviour change programmes. The aim has been to analyse progress to date, identify where further steps are likely to be effective in increasing consumer benefits, and inform future evaluation. The synthesis research aimed to assess not

[1] https://www.gov.uk/government/consultations/smart-meter-consumer-engagement-strategy

[2] Meters with smart functionality but which don't comply with DECC's regulatory specification

only *what* outcomes have been achieved to date, but also *how* they had been achieved, *for whom* and *in what circumstances*. The methodology is described in Chapter 2.

The GB roll-out is unique in terms of policy design and implementation arrangements. Evidence about the Programme and the effectiveness of different consumer engagement approaches will continue to build as roll-out progresses, and as the nature of energy demand and the energy system change. Hence further evaluation of different approaches to consumer engagement will be needed as the Programme develops.

### *Stages of behaviour change (see Chapter 3)*

In seeking to understand what works for whom in what context, the synthesis project has considered the stages of change a household may navigate following the introduction of a smart meter and in-home display (IHD). Introducing new technology into a household for everyday use and benefit is more than a purely technical process: it requires at least one household member to engage with it. Their level of engagement will be influenced by the value placed on the smart meter and in-home display (and the benefits they might yield), plus the householder's confidence, knowledge and skill in using the IHD and the data it provides. The research identified three 'transition points' that households may go through when adopting smart meters:

- engagement before and during the installation of the smart meter;
- engagement with information from the smart meter (in particular, from the IHD);
- making changes in energy consumption.

In order to reach the final stage of making (smart-meter-related) changes in energy consumption, they are likely to go through the two earlier stages. These transition points are described fully in Chapter 3 and have been used to structure the rest of the report. Each transition is important to the realisation of household benefits.

### *Engagement before and during the installation visit (see Chapter 4)*

#### Pre-installation engagement

The evidence synthesis shows that both public awareness-raising and detailed information for smart meter recipients before the installation have both been important in influencing whether householders were to engage effectively with smart metering. Informal word-of-mouth may also be significant. At this early (Foundation) stage, only a minority of households know anyone with a smart meter, although public awareness appears to be building gradually.

International experience suggests that maintaining a voluntary approach to installation will be important in presenting smart meters as a positive choice, rather than a fit-and-forget visit (as in routine replacement) or an imposition (mandatory roll-out). General information and community-level contacts can both offer an important introduction to the 'customer journey', influencing expectations and addressing concerns.

Implications for householder engagement include the value of:

- Smart Energy GB ensuring householders are given clear, reliable information that promotes realistic expectations;
- energy suppliers providing information and guiding expectations immediately prior to the installation visit;

- third parties (for example housing associations and NGOs) disseminating (general) information and providing more detailed advice and guidance, in co-ordination with Smart Energy GB and suppliers.

There is research evidence that neighbours, friends and family play an important role in shaping energy usage patterns and that social interactions are significant in helping people develop energy literacy. As the roll-out progresses, we can assume that there will be greater opportunities for households to learn about smart meters informally from neighbours, friends and family who have had them installed. This suggests that suppliers and Smart Energy GB might consider the extent to which customers most likely to respond positively could be targeted early on, as well as how to address any dissatisfaction that emerges.

**During the installation**

Installation itself is a significant occasion, in that a representative of the supplier is in a home to introduce new technology, along with some of the knowledge needed to understand and use it. Evidence from both installer and householder viewpoints showed how meter installers have a critical role in communicating with customers during an installation, encouraging them to use the IHD in ways that help them to manage their energy usage, providing relevant energy efficiency advice and indicating where further guidance can be found.

The Early Learning Project research discovered that some groups (households with low levels of literacy, long-term illness or disability) found it harder than others to operate the different functions on their IHD, and were likely to benefit from more face-to-face support during the installation visit. Prepayment customers were also found to benefit from more tailored support, given their specific requirements.

Implications for consumer engagement include the value of:

- suppliers ensuring that workforce incentives and outsourced contracts allow meter sufficient time to offer a positive installation experience, including demonstration of the IHD with an opportunity for discussion, and tailored energy efficiency advice;
- suppliers, with the support of Smart Energy GB, designing 'customer journeys', installer 'scripts' and supporting material to take account of differing customer needs and maximise the potential for long-term customer benefits.;
- energy suppliers collecting basic information about customers ahead of the installation, so that installers can tailor advice and guidance to suit the needs of individuals (including but not limited to the vulnerable);
- training for installers (whether in-house or contractors) in communication as well as technical skills, along with basic energy efficiency advice training.

***Engagement with information from the smart meter (see Chapter 5)***

The in-home display (IHD) was found to be the first and most visible element of smart metering for the customer. The IHDs provided to households covered by the Early Learning Project generally proved easy-to-use, with high levels of satisfaction and continued usage. 96% of consumers with an IHD had plugged it in at some point since the installation visit, and six in ten still had their IHD plugged in and in use when they were interviewed. These customers had their IHDs for between 6 months and over two years by the time they were interviewed, and those who had received them more recently were no more likely than those who had received them two years earlier to still have their IHD plugged in.

Householders who used IHDs to monitor trends and exceptions in their energy consumption over time (a 'monitoring approach') appeared more likely to be experiencing certain benefits

than those who used them simply to check on the power demand of different appliances (an 'information approach').

Implications for consumer engagement: the detailed Early Learning Project research confirms the value of:

- a well-designed IHD for helping increase energy awareness and understanding, and promoting reduced consumption;
- ensuring that the ambient 'traffic light' real-time feedback is suitably calibrated to the consumption range of individual households;
- particular emphasis on encouraging a 'monitoring approach' to the use of the IHD in installer explanations, Smart Energy GB advisory material and any follow-up support;
- taking particular care to promote a monitoring approach and appropriate design for prepayment customers to enable them to exploit the full potential of the IHD;
- additional face-to-face support for vulnerable and prepayment customers, during the installation visit and/or afterwards (when meter data can be used to identify particular needs or useful actions).

***Making changes to energy consumption (see Chapter 6)***

The research literature on residential energy use and consumption feedback shows that there is potential for smart metering to contribute to energy-saving through changes in routine behaviours and practices, and by encouraging the purchase of insulation and efficient appliances. These changes can be prompted and then supported, at least in part, by improved feedback from the IHD and more accurate and informative billing (see Chapter 6).

At this early stage of roll-out there was some evidence from the Early Learning Project of a shift in uptake of insulation and more efficient appliances, and improved knowledge about electricity use, but no general shift in routine energy-related behaviours and practices due to the installation of smart meters during Foundation.

Both purchasing and routine behaviours have the potential to contribute to the Programme's objectives, as well as wider energy goals. The Early Learning research identified progress on energy-saving from early Foundation deployments during 2011 (reductions of 2.3% in electricity consumption and 1.5% in gas compared to traditionally-metered customers).

There is scope to improve on this through effective consumer engagement, and it is realistic to expect durable energy savings of 3% based on evidence from the research literature and trials worldwide, the Early Learning Project findings and the potential improvements identified. Greater savings may be achievable over time: for example, the Foundation stage customers who had had their smart meters for longest were most likely to report changes in behaviour and decreased gas and electricity usage since installation. As noted in Chapter 6, these were not all 'early adopters': in fact, the smart-metered customers in the survey sample were less likely to appreciate having new gadgets in their homes than the GB population in general. Implications for consumer engagement include the value of:

- Smart Energy GB taking on roles in support of behaviour change and energy efficiency, for example
    - developing advisory and other supporting materials;
    - mobilising, supporting and coordinating local networks and partnerships;
    - acting as a facilitator for knowledge exchange;
- suppliers developing additional forms of feedback, such as Home Energy Reports, to complement IHD feedback.

- taking steps to develop synergies between general information, feedback, tailored advice and energy efficiency programmes;
- suppliers and Smart Energy GB paying special attention to the needs of households who are vulnerable, in fuel poverty or on low incomes, prepayment customers and those living in rented accommodation;
- building up institutional knowledge and know-how among a range of actors involved in implementing the roll-out.

The synthesis findings support the policy design and regulatory requirements introduced by the Government to date, including the central importance of the IHD.

The findings also make clear the extent to which the detailed approaches taken by suppliers and third parties will influence the outcomes for householders. Lack of preparation, taking a 'one size fits all' approach to installation support, and failing to engage third parties or provide households with advice and help will all tend to reduce positive outcomes for customers and have consequences for the Government's objectives.

On the other hand, with a well-designed and delivered roll-out, a 'virtuous spiral' is possible, with more satisfied and knowledgeable customers engaging further with innovative market offerings, and with a greater interest in future developments in low carbon and low-impact energy services.

**This research report is one of five which have been published concurrently[3], containing the findings of DECC's programme of 'early learning' smart meter research and small-scale trials. This was based on research with early recipients of smart and smart-type meters. It was aimed at extending the Government's and stakeholders' understanding of how best to deliver consumer benefits, and providing evidence from which to assess the need for any changes to the policy and regulatory framework.**

**A further Policy Conclusions report summarises DECC's view of the key findings, and sets them in the context of further progress, since the research was conducted, to establish the delivery framework for smart metering. This report also provides the Government's conclusions about future consumer engagement policy and delivery priorities, and the steps to implement them, working with Ofgem, Smart Energy GB, suppliers and other parties.**

[3] https://www.gov.uk/government/publications/smart-metering-early-learning-project-and-small-scale-behaviour-trials

# Chapter 1: Background and Introduction

The roll-out of smart electricity and gas meters to households and small businesses in Great Britain began in 2011 with the Foundation Stage. During the Foundation Stage the Government and delivery partners aim to learn from early activity about how consumer engagement can best be achieved, and feed lessons into planning for the next stage.

## Project aims and objectives

The aims of this synthesis have been to:

- bring together evidence relevant to engaging householders in Great Britain with a smart metering programme;

- offer an initial analysis of progress to date in enabling consumer benefits from smart metering, especially energy saving;

- identify where further steps are likely to be effective in increasing benefits from engaging householders in Great Britain with the smart metering programme – 'the Programme'; and

- provide pointers for evaluation of smart metering in the future.

The DECC monitoring and evaluation strategy for smart metering, published in May 2012[4], set out the Government's approach to tracking and evaluating the Programme. In line with this, they have completed a range of work during the Foundation stage to learn from early installations of smart meters, to help inform planning for the main installation stage.

This report summarises and analyses evidence from a range of sources, including three new DECC research projects into how GB householders engage with smart metering, carried out with co-operation from energy suppliers; GB and international evidence on smart metering and energy feedback; and some evidence from non-energy domains such as public health, where applicable to understanding behaviour change processes. It offers suggestions and considerations for the main installation stage, but the most recent findings, and those closest to home, are derived from the GB Foundation stage. Supplier strategies are still evolving, Smart Energy GB was launched as recently as July 2014, the market for smart energy services is immature, and many operational issues remain to be resolved. So new evidence will need to be gathered as the roll-out proceeds.

## Smart metering programme – aims and objectives

The Programme aims to roll out 53 million smart electricity and gas meters to all domestic properties and smart or advanced meters to smaller non-domestic sites in Great Britain by the end of 2020.

The Programme is being delivered in two phases. The Foundation stage began in March 2011 with the objective of working with stakeholders to ensure the necessary groundwork is completed before energy suppliers start the process of providing smart meters to most of their

[4] https://www.gov.uk/government/consultations/information-requirements-for-monitoring-and-evaluation-of-smart-meters

customers. Foundation will be followed by the main installation phase. Some customers are already receiving smart meters as their suppliers start up their programmes during Foundation stage.

The equipment installed by suppliers will normally consist of a smart electricity meter, a smart gas meter (where required) and a communications hub (which may be integrated in the meter). Suppliers will offer domestic customers a free in-home display (IHD) as part of the installation.

The IHD is a tool that can assist householders in understanding and reducing their consumption. Supplementary ways of enabling and encouraging demand reduction are (a) better indirect feedback from accurate, clear billing and (b) advice that is informed by accurate and high-resolution data.[5,6,7]

In addition to measuring consumption at fixed intervals, storing, transmitting and displaying data, the GB smart meter specification is intended to assist users in:

- accessing accurate and timely billing arrangements;
- accessing redefined smart prepayment arrangements, including remote switching between credit payment and prepayment;
- quicker and easier switching between suppliers;
- metering microgeneration, and any electricity exported from the site;
- linking further technology (e.g. smart appliances) into the platform provided[8].

During the Foundation stage of smart metering roll-out, the Programme is focussed on building the appropriate regulatory framework, processes, specifications and IT systems to deliver the expected benefits. Part of that regulatory framework is the establishment of the Smart Metering Installation Code of Practice (SMICoP) which recognises the opportunity for informing householders, involving them with the new technology, and signposting further advice - not simply putting new equipment into the home.[9] Regulatory requirements include the responsibility to offer an in-home display to all customers, to demonstrate use of the smart meter and IHD clearly and accurately, and to provide supporting material, taking account of any customer vulnerabilities or special needs[10].

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[5] e.g. Darby S (2010a) *Literature review for the Energy Demand Research Project*. Ofgem (Office of Gas and Electricity Markets), London

[6] Ehrhardt-Martinez, K., Donnelly, K.A., and Laitner, J.A. (2010) *Advanced metering initiatives and residential feedback programs: a meta-review for household electricity-saving opportunities*. American Council for an Energy-Efficient Economy, Washington DC

[7] VaasaETT (2011) *Empower Demand. The potential of smart meter enabled programs to increase energy and systems efficiency: a mass pilot comparison*. (Lead authors Strömbäck, K, Dromacque, C, and Yassin, MH). Report for the European Smart Metering Industry Group. Vaasa Energy Think Tank, Helsinki

[8] DECC (2011) Smart Metering Implementation Programme response to prospectus consultation. Functional Requirements Catalogue. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42737/1480-design-requirement-annex.pdf

[9] https://www.ofgem.gov.uk/ofgem-publications/57316/smartmeteringinstallationcodeofpractice.pdf

[10] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43042/7224-gov-resp-sm-consumer-engagement.pdf, p.4

## The roll-out

The GB roll-out is atypical in being supplier-led. Most roll-outs around the world are carried out by network operators, each in their own territory. Suppliers have flexibility to decide which customers to prioritise for installations and they are expected to do so on the basis of their own commercial incentives.

Suppliers are likely to plan their roll-outs to minimise costs; it is expected that they will aim to optimise customer acquisition and retention as well as using smart metering as a platform to increase the range of products and services they provide. Some co-ordination may occur for technical reasons, e.g. in large blocks of flats where many meters need to be installed in the same place and where metering communications may need individual architecture solutions. With the supplier-led nature of the GB roll-out, there will be uncertainty over individual supplier strategies relating to their timing profile for installations, such as replacing existing prepayment meters (PPMs). All suppliers and industry are however expected to be able to offer basic smart services by the beginning of the main installation stage.

The Programme Impact Assessment (IA) from January 2014[11] projects £4.3bn in direct consumer benefits for the domestic sector. This is based on valuing the central case scenario of energy saving reductions of 2.8% for electricity (both credit and PPM), 2% for gas credit and 0.5% for gas PPM. The IA also considers low and high energy savings scenarios and related monetary impacts.

## The Consumer Engagement Strategy

The Government's approach to the GB smart metering roll-out has been designed to enable the delivery of a range of consumer benefits, such as energy savings, accurate billing, improved prepayment experience and easier switching. There is growing evidence that energy savings in line with or higher than the IA's central estimate are achievable from smart metering and real time feedback (see Chapter 6), but precise levels of energy and money savings will depend on the extent to which the policy design, roll-out and customer experience enable and support changes in energy use.

Energy suppliers are mandated to deliver the roll-out and are subject to a number of requirements to promote consumer benefits and ensure consumer protection, such as the Smart Metering Installation Code of Practice (SMICoP)[12]. But it is assumed that these benefits can only be fully achieved if there is effective customer engagement during the roll-out.

DECC consulted on its Consumer Engagement Strategy (CES) for smart metering in 2012[13], which sets out aims and objectives, what constitutes effective consumer engagement, and delivery mechanisms. The aims of the CES are as follows:

- To build consumer support for the roll-out, by increasing confidence in the benefits of smart meters and by providing reassurance on areas of consumer concern;
- To facilitate the realisation of consumer benefits, by building acceptance of the installation of smart meters and by helping consumers to use smart metering to manage their energy consumption; and

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[11] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/276656/smart_meter_roll_out_for_the_domestic_and_small_and_medium_and_non_domestic_sectors.pdf

[12] https://www.ofgem.gov.uk/ofgem-publications/57316/smartmeteringinstallationcodeofpractice.pdf

[13] https://www.gov.uk/government/consultations/smart-meter-consumer-engagement-strategy

- To ensure that vulnerable, low income and prepayment consumers can benefit from the roll-out.

The Strategy states that suppliers will have the primary consumer engagement role as the main interface with the consumer pre-, during, and post-installation. However, following consultation, DECC concluded that supplier engagement would be supported by a programme of centralised engagement undertaken by a Central Delivery Body (CDB), now established as Smart Energy GB.

The role of trusted third parties is also acknowledged in the CES, *'such as charities, consumer groups, community organisations, local authorities and housing associations…The CDB will want to facilitate and coordinate this involvement of third parties, but Government will have a role in preparing these organisations for working with the CDB.'*[14]

Vulnerable households are singled out for special mention given the Programme's objective that all consumers should be enabled to benefit from the rollout.

## Structure of the report

The main body of the report consists of the following sections:

**Chapter 2: Methods and sources** – Summarises the research approach.

**Chapter 3: Household transition points** – Explains and sets in context the key stages in the smart metering customer journey. These are used to frame the analysis and findings throughout the report.

**Chapter 4: The installation visit** – Examines householders' engagement in the installation process and how this shapes their responses to the smart meter and IHD.

**Chapter 5: Engagement with smart meter information** – Analyses how consumers are using information provided by IHDs and other forms of feedback to make changes in their energy use.

**Chapter 6: Post-installation changes in energy use** – Examines the potential for longer-term changes in energy use, including the role for post-installation support in realising consumer benefits.

**Chapter 7: Conclusions** – draws out the key conclusions and implications of the analysis.

Across chapters 4-6, the report seeks to describe progress to date, what works in current approaches, and what further steps may be required to maximise householder benefits.

[14] pp.5-6 of https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43042/7224-gov-resp-sm-consumer-engagement.pdf

# Chapter 2: Methods and sources

This chapter summarises the research approach and key evidence sources used in the analysis. It also defines some of the methodological terms used throughout the report.

The Early Learning Synthesis was designed to build a comprehensive picture of customer engagement with smart meters and their role in energy saving, and to inform the next stages of the roll-out. This report brings together evidence and data from a range of sources, including:

- Findings from the Smart Metering Early Learning Project, which comprised
  - a survey of around 4,000 households, followed by in-depth qualitative interviews with 79 selected households[15]
  - qualitative research with prepayment customers[16]
  - Energy Consumption Analysis for over 10,000 households.
- Research literature on metering and energy use feedback in relation to customer benefits and changes in energy use, with some reference to the literature on public engagement in other domains, where relevant (Annex B).
- A short review of lessons from the public health sector (Annex C).
- Focus groups of smart meter installers from two GB energy retailers (Annex D) , and two installation teams from Northern Ireland Electricity.
- An expert workshop with academics, practitioners and policymakers to develop theory-of-change maps and examine how smart metering might be adopted by different householder segments (Annex E).

**Significance of the Northern Ireland Experience**

Note that the Northern Ireland rollout of keypad meters was one of the first roll-outs in which a domestic meter was accompanied by an in-home display. The display could show customers their remaining credit, costs over previous chosen time periods, unit rates and number of units used at each rate, current load, maximum demand, time, and total units. It was also significant

[15] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

[16] DECC (2015) Smart Metering Early Learning Project: Prepayment Qualitative Research

in offering a prepayment tariff with a discount of 2.5% on the standard credit tariff, rather than the usual extra charge. The initial trial, with 200 low-income prepayment customers who were also offered in-home energy advice, led to 10% electricity savings; a later trial with a broader customer base and without the advice found 3% savings.[17] Roughly 40% of NI customers now use a keypad meter.[18] The keypad system allowed for a trial introduction of the time-of-use Powershift tariff, although this was later discontinued except for existing customers.

The keypad meter roll-out differs from that in GB in two important respects. There was no competition in electricity supply in NI until 2010, so much of the initial roll-out could be carried out in monopoly conditions, making it easier to operate on an area basis and enrol some community-level support to address customer concerns. Second, the keypads are semi-smart: there is no direct communication with the utility and meters still have to be read manually, and there is no provision for recording own-generation or for a Home Area Network.

Two smart meter trials have also taken place in NI, and the second focus group involved engineers who had installed smart meters for one of these trials.'

A theory-based evaluation approach was used in the synthesis of these different sources of evidence, utilising realist evaluation and realist synthesis principles. These are described below.

## Theory-based evaluation

This project has used theory-based evaluation as a way of structuring and undertaking the analysis. Theory-based evaluation systematically develops and tests theories related to links between policy delivery and outcomes, and is particularly useful for evaluating complex interventions involving many actors.

Theory-based evaluation uses an explicit *theory of change* to draw conclusions about whether and how an intervention contributed to observed results. So, the first stage in undertaking this synthesis was to develop a *theory of change map.* This described the sequence of events and results (outputs, immediate outcomes, intermediate outcomes and ultimate outcomes) that are expected to occur during and following the introduction of a smart meter. This was developed using policy documents such as the Smart Metering Programme Vision, the Consumer Engagement Strategy and the Impact Assessment.

Ofgem and DECC had already carried out a great deal of consultation in order to map out the processes by which smart metering might lead to various outcomes, and this project did not attempt to carry out further formal stakeholder consultation, although it did draw on the contributions from an expert workshop (Annex E). From this, and from policy documents, the authors developed a series of Theory of Change maps (in Annex F) which represent stages in their thinking and guided the work presented here.

The next stage in the research process was to test the programme theory (described elsewhere in this report as policy design) against available evidence, reviewing assumptions of how and why change might happen as a result of the introduction of smart metering, and in what circumstances. This assisted in describing and explaining processes of change, and in

[17] Owen G and Ward J (2007) Smart meters in Great Britain: the next steps? Paper 6: case studies. Sustainability First, London
[18] http://quindiresearch.com/northern-irelands-keypad-prepayment-success-story/

identifying contextual factors that support or hinder achievement of the outcomes originally intended by policymakers.

## Realist evaluation and synthesis

Realist evaluation is a specific type of theory-based evaluation[19], and we sought to apply some of the key principles in this project. A central consideration is whether 'mechanisms of change' differ depending on specific contexts. A mechanism of change, in realist evaluation terms, is the process by which an intervention brings about change. This might be different when the same intervention operates within a different section of the population, or in different circumstances.

Examples of mechanisms of change in relation to smart metering include:

- feedback on household energy consumption in the short to medium term, which might stimulate changes in behaviour and understanding;
- introduction of new technology into the home, which will be adopted and adapted in various ways, with impacts on their energy use;
- development of formal knowledge and practical know-how about energy use and energy systems through formal/official channels and informal social networks – a process of learning and sense-making over time.

Rather than starting from the usual evaluation question of *Does this intervention work?* Realist evaluation asks the question *'what works for whom, in what circumstances, in what respects, and how?'* It thus explores how mechanisms of change may vary in different circumstances for different groups in the population.

This project provides a synthesis of available evidence and data. Realist synthesis is an approach to synthesising research evidence based on the same principles as realist evaluation. With its focus on understanding underlying processes of change, realist synthesis tends to draw on a wide range of different types of evidence, including experimental trials, process evaluations, surveys, government documents, qualitative interviews and opinion polls.

A full realist synthesis requires the availability of a substantial body of material that reviews 'what works for whom, in what circumstances'. This was not available: much of the literature on smart metering is concerned with average responses to interventions, and does little to distinguish mechanisms, contexts and interventions for different groups (though we have noted where this not is the case).

For these reasons, we describe this particular synthesis as 'realist-informed' rather than 'realist'.

Based on the steps outlined in a paper by Pawson et al. (2004)[20], the synthesis carried out followed an iterative process. Questions and hypotheses generated in the early stages were revisited as the review progressed and new learning came to light, as shown in the box below.

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[19] Pawson R and Tilley N (1997) *Realistic evaluation*. Sage, London

[20] Pawson R, Greenhalgh T, Harvey G and Walshe K (2004) Realist synthesis: an introduction. ESRC research methods programme, 2/2004. http://www.ccsr.ac.uk/methods/publications/documents/RMPmethods2.pdf

**Step one: defining the scope of the synthesis**

An initial literature search sought to identify evidence and theories eg behavioural economics, that could help to analyse and explain responses to smart metering. (See Annex A for a list of the main theoretical framings that offered ways of analysing processes and outcomes.)

This evidence and theoretical explanations were used to

a) define the evaluation questions

b) generate hypotheses concerning different 'mechanisms' that might be operating in the customer journey from smart meter installation through to making changes in energy-related behaviour;

c) set out the 'programme theory'.

Early thinking was explored and tested in a workshop with policymakers, experts and practitioners in household energy demand and smart metering (Annex E). The workshop tested the programme theory and informed thinking on how the process of change might vary for different types of household.

**Step two: searching and appraising the evidence**

Guided by the evaluation questions and hypotheses, the project sought to bring together past evidence and current data. These included:

- further research literature, e.g. earlier reviews relating to feedback on residential energy use, papers from academic journals and conferences[21], 'grey' literature including DECC policy papers, influential general papers on social interventions and householder behaviour in general, and on energy-using practices in particular. The literature review can be found at Annex B.

- recent evidence, including data from the Smart Metering Early Learning Project.

- focus groups with smart meter installers from two major GB energy retailers (Annex D) and Power NI (formerly NIE Energy).

**Step three: extracting and synthesising results**

The outcomes from the literature review were brought together with the analysis of Early Learning Project data and focus group material. They were summarised and used to derive implications for policy and to generate questions for further research and evaluation. Steps two and three can, of course, be repeated indefinitely, but we have had to draw a line after a relatively short period of time.

**Step four: drawing conclusions and recommendations**

Findings from the synthesis are set out in the following chapters and summarised in Chapter 7. The process of drawing conclusions, like earlier stages was iterative, involving regular discussions between the authors, the DECC team responsible for this project, and an external advisor.

[21] Primarily *Energy Policy, Building Research and Information* and *Energy Efficiency,* with the Proceedings of summer studies held by the American and European Councils for an Energy-Efficient Economy

A full description of the methodology is provided in Annex A.

During the theory of change mapping exercise, we identified three transition points likely to occur if households adopt smart meters and use them to assist in making energy savings. We drew up questions and hypotheses for each, related to the household and delivery levels. As an introduction to the core chapters 4-6, Chapter 3 sets out these transition points.

# Chapter 3: Household transition points

This chapter provides some context from the wider literature to preface the findings in the later chapters. It also introduces the 'customer journey' and 'household transition points' that frame the analysis and conclusions presented in the report.

## Introduction and context

The literature on residential energy use shows that energy consumption patterns are also patterns of daily life.[22] Energy use is not an action or practice in itself – we do not set out to burn gas or use electricity simply for the sake of clocking up kWh. Rather, electricity or fuel consumption are among the measurable outcomes when people heat or cool buildings, or perform the many activities woven into daily life.

From this, we can hypothesise that the impact of a new technology such as a smart meter will be affected by many factors: the nature of that technology, how it is introduced, the knowledge and expectations of those who adopt it, the nature of their daily lives, and their 'infrastructures of demand' (buildings, heating systems, appliances). Some of the more generic research literature on technology adoption also shows that introducing new technology into a household is not simply a technical issue, but a socio-technical one involving trust, confidence, skills, and communication.[23]

This hypothesis has shaped the synthesis. So has the assumption that there is a pace at which technology adoption 'naturally' moves, so that innovations gradually work their way into the fabric of a society through social networks, influencing future decisions and developments.[24,25].

Given that the policy design assumes some process of learning by consumers – learning how to use the IHD, learning how to understand and apply energy use data, etc. - education theory is another useful discipline. The concept of social learning has taken hold in relation to technology adoption and resource management, showing some of the potential for user involvement.[26] The

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[22] See Annex B for the literature review. Two useful sources for this, as examples, are Shove E (2009) Beyond the ABC: climate change policy and theories of social change. *Environment and Planning A* **42** (6), 262-264; Gram-Hanssen K (2013) Efficient technologies or user behaviour, which is the more important when reducing households' energy consumption? *Energy Efficiency* **6**, 447-457

[23] For example, in relation to internet adoption, see Lu J, Chun-Sheng Yu, Chang Liu, James E. Yao, (2003) "Technology acceptance model for wireless Internet", Internet Research, Vol. 13 Iss: 3, pp.206 - 222

[24] Everett Rogers is the best-known exponent of this view; his book 'Diffusion of Innovations' is now in its fourth edition (2010)

[25] Hughes TP (1983) *Networks of Power: electrification in western society, 1880-1930*. Johns Hopkins University Press, Baltimore.

[26] e.g, Ornetzeder M and Rohracher H (2006) User-led innovations and participation processes: lessons from sustainable energy technologies. *Energy Policy* **34**, 138-150 who discuss the possible role of user groups (similar to self-build housing groups) in developing their own smart technology applications and what might be done to promote this; also Blackmore C (2007) What kinds of knowledge, knowing and learning are required for addressing

term ‘customer journey’ or ‘consumer journey’ is also being adopted in relation to smart metering.[27]

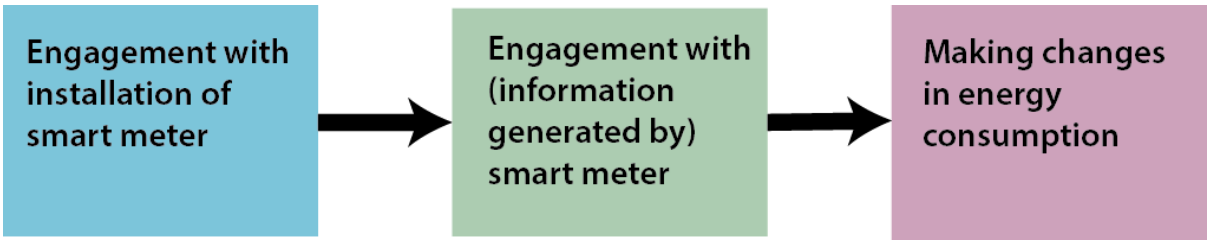
### Energy saving, usage and demand

One further theoretical note: it is important to distinguish between ‘energy saving’, ‘low usage’ and ‘low demand’: the dynamics of each are different.[28] For example, the term ‘usage’ is related to averages and trends over time, while ‘demand’ has particular meanings in relation to overall *capacity* for usage, the *power rating* of particular end-uses, and *timing* (particularly in relation to peak demand). ‘Saving’, unlike usage or demand, is a relative term: it is possible to achieve substantial savings and still have high usage. The concept of savings is more related to specific motivations and capabilities than the concept of usage, which relates more to broad lifestyle choices, economic imperatives, and the infrastructure of demand, which includes buildings, appliances and controls.

The introduction of smart meters marks a shift in the way that gas and electricity data are dealt with by network operators, retailers and customers, and also unlocks a potential market for third party service providers who can capitalise on this data, where customers consent to this. This synthesis deals primarily with opportunities and challenges to customers that relate to smart meter adoption. Given that smart meters and IHDs are being introduced to a wide range of households, in different types of buildings, by installers working under different conditions at different times and with differing levels of customer support, we can expect diverse processes and outcomes for different consumers.

## Introducing the Transition Points

During the Theory of Change mapping exercise described in Chapter 2, we identified three stages that customers may go through starting with the installation visit, each of which is independently important in producing lasting changes to energy behaviour.




Two points worth noting:

- We recognise that there is a preceding stage, which relates to consumers’ exposure to general awareness-raising activities, and this early stage is discussed in Chapter 4.

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resource dilemmas? A theoretical overview. *Environmental Science and Policy* **10** (6), 512–525; Verbong G, Beemsterboer S and Sengers F (2013). "Smart grids or smart users? Involving users in developing a low carbon electricity economy." Energy Policy **52**: 117-125

[27] e.g. Honebein, P.C.(2010) "We got a new digital electric meter. Our usage went up 123%. Our bill went up 65%." *The Electricity Journal* 23 **(**2), 76-82; Lewis PE, Dromacque C, Brennan S, Stromback J and Kennedy D (2012) *Empower Demand 2: energy efficiency through information and communication technology: best practice examples and guidance*. VaasaETT.report for ESMIG

[28] Klopfert F and Wallenborn G (2012) Empowering consumers through smart metering. Report for BEUC

- This is a theoretical framework and not every consumer will follow such a simple, linear journey. Additionally, not everyone is present in the home when their smart meter is installed. Some will move into dwellings that already have a smart meter; others will simply not be there at installation. They may be able to enter the customer journey at the second transition point.

The theory of change mapping suggested that in order to achieve change in energy use attributable to smart meter adoption, the two earlier 'transition points' (engagement in the installation and then with smart meter information) would ideally be navigated. Literature from the public health field supports the notion that individuals must go through different stages prior to making long lasting changes in their behaviour.

We identified three levels[29] at which these transition points would need to be considered:

- the household level, at which the 'customer journey' takes place;

- the delivery level: organisations with a direct relationship with households as part of the smart meter roll-out, for example, suppliers, Smart Energy GB, housing providers, local authorities, NGOs;

- the wider system: where no direct relationship with households is necessarily involved, for example, DECC, Distribution Network Operators (DNOs), Ofgem, meter manufacturers.[30]

These are significant for the analysis because specific processes are involved at each level, with implications for policy design and operational considerations. For example, engagement with smart meter information (transition point 2) is something that happens at household level. But it relies on effective supplier back-office arrangements and on a well-designed, well-functioning meter and display technology provided by delivery-level actors; it may also be influenced by advice and support from local authorities or NGOs, and on supplementary information from Smart Energy GB. The wider system level will in turn set the framework within which delivery-level organisations work, and the rules and codes that govern their procedures.

We can expect implications, at each transition point, for actors operating at the delivery level and these are discussed in later chapters.

## Complexity and the delivery level

Energy systems are complex and changes in one element of the system affect the others. For example, changes in regulation and market structure alter the nature of some energy services, and alter relationships between consumers and producers[31]; the old 'hub and spoke' centralised electricity systems are giving way to networks of more distributed supply.[32] The nature of demand is also shifting, with changes in end-uses, appliance efficiency, and patterns of daily living. Smart metering, by extending information and communications technology (ICT) in energy infrastructures to the level of the individual customer, adds a layer of complexity to an already complex sociotechnical regime and policy environment.

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[29] The source for these levels is Bronfenbrenner U and Crouter A (1983) The evolution of environmental models in development research. In PH Mussen (ed) *Handbook of child psychology vol. 1: History, theory and methods.* 4th edition, pp357-414. New York, Wiley.

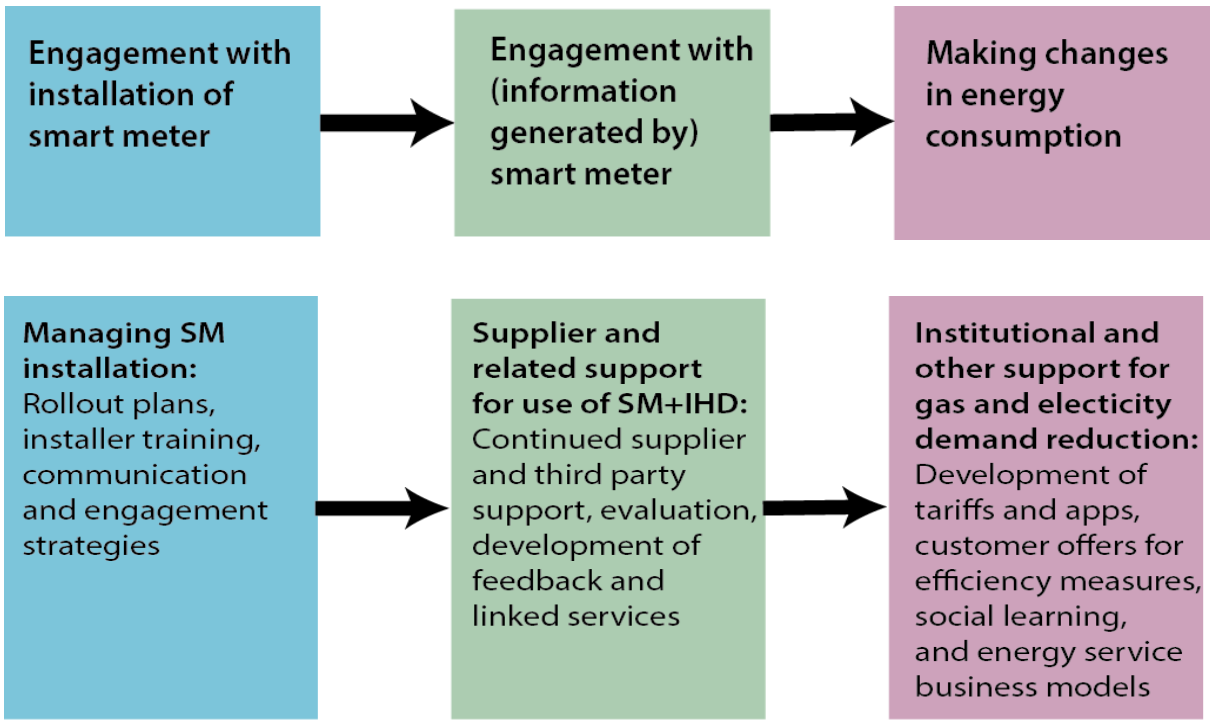
[30] We were not able to address the wider system level in any depth, and concentrated on the household and the agencies in direct contact with the household.

[31] Wilson C and Dowlatabadi H (2007) Models of decision making and residential energy use. *Annual Review of Environment and Resources* **32**, 169-203

[32] The Edison Institute produced a striking account of the changing situation in the USA last summer: see http://www.eei.org/ourissues/finance/Documents/disruptivechallenges.pdf

This complexity, allied with the need to focus on qualitative as well as quantitative outcomes, is the main reason behind a realist approach to evaluation, in which programmes are seen as social interactions set within complex reality, rather than experiments that are amenable to tight control.[33]

As explained above, delivery-level actors are organisations with a direct relationship with households as part of the smart meter roll-out. We can add these actors to the initial transition point diagram, to show how they might contribute to smart meter roll-out:




These delivery-level actors pose a challenge in terms of evidence-gathering for the synthesis, as empirical evidence about 'what works' in the GB situation is still emerging, given that the programme is at an early stage. While we can draw on material from overseas to make general points about the delivery level, there are a number of ways in which the GB residential roll-out is atypical, such as the high proportion of meters situated inside buildings, the direct involvement of householders at installation, and the supplier-led (rather than network operator-led) roll-out. In the near future, there is a need to consider furthersome local co-ordination of third parties such as community groups and local authorities. There are also questions relating to delivery-level provision for more vulnerable customers.

## Transition points and the evaluation questions

The interface between households and the institutions that serve them was explored using the realist evaluation approach. Our evaluation questions were structured by the three transition points at household- and delivery-levels:

[33] Pawson et al., 2004, op.cit.

| Transition Point (TP) | Household level questions | Delivery level questions | Where is this addressed? |
|---|---|---|---|
| **Questions for TP one: engagement in installation of smart meters** | *How, and to what extent, does engagement in the installation process influence subsequent engagement in using smart meters and the information they generate?* | *What actions of energy companies,* Smart Energy *GB, DECC and third party organisations would help maximise engagement in the installation of smart meters?* | *Chapter 4* |
| **Questions for TP two: engagement with information generated by smart meters** | *To what extent do customers engage with the information provided by smart meters and in-home displays in a way that encourages reduced energy consumption?* | *How can delivery-level support achieve widespread and effective customer use of smart meters and IHDs?* | *Chapter 5* |
| **Questions for TP three: making changes in energy use as a result of having a smart meter** | *To what extent do customers make changes in their electricity and gas consumption, in the short and longer term, as a result of having a smart meter?* | *How, and to what extent, are additional support and information required in order for 'smart' customers to make changes to their energy consumption?* | *Chapter 6* |

These and related sub-questions also helped to structure the review of literature and other sources of data.

# Chapter 4: The installation process

This chapter examines householders' engagement in the installation process and how this might shape the way they understand and use their energy usage data.

| | |
|---|---|
| ***How and to what extent does engagement in the installation process influence subsequent engagement in using smart meters and the information they generate?*** | ***What actions of energy suppliers, Smart Energy GB, DECC and third party organisations would help improve engagement in smart meter installation?*** |

Subsidiary questions address specific elements of installation, customer support and the role of social learning:

- What aspects of the installation process encourage householder engagement in the process?
- What individual and household characteristics influence the level of engagement in the installation of smart meters?
- What wider factors influence the level of householder engagement in the installation process?
- What implications does this have for energy suppliers (training of installers, roll out approaches), Smart Energy GB, others?
- To what extent are additional inputs required to engage all sections of the population at installation?

**Structure of chapter**

The chapter starts by setting out the policy aims and assumptions articulated by DECC and others in Programme documentation. Throughout, the 'installation process' refers to the installation visit, plus preparatory material and contact with the householder in advance of the visit. It also includes any immediate follow-up. The chapter sets out our understanding of how consumers might learn about smart metering and energy use during installation, with the associated challenges, using research evidence. It also provides some limited evidence in relation to pre-installation engagement.

Based on this evidence, we identify some hypotheses about factors likely to influence the effectiveness of consumer engagement during the installation process, and present findings from the Early Learning Project in relation to these hypotheses and the questions set out above. Finally, the chapter summarises what we now know about these questions and sets out policy implications.

## Policy aims and assumptions related to smart meter installation

The Consumer Engagement Strategy assumes that immediate benefits to customers and the uptake of new energy services can only be fully achieved if there is a range of engagement activities during the Foundation and main installation stages. These activities include: provision of direct feedback (in near-real-time) and indirect feedback (such as home energy reports); advice and guidance; and motivational campaigns.

Regulatory requirements for installation are set out in the Smart Metering Installation Code of Practice (SMICoP)[34] and supplier licence requirements. They include the responsibility to offer an in-home display (IHD) to all customers, to demonstrate use of the smart meter and display clearly and accurately, and to provide supporting material, taking account of any customer vulnerabilities or special needs.

The policy (or programme) design envisages that installers will explain IHD use. The SMICoP requires suppliers to ensure that *"Use of the Smart Metering System is demonstrated to the Customer in a clear and accurate manner, and is easy to understand, including what information is available from the Smart Metering System, how this can be accessed, and use of the IHD (where provided)".* (3.6.1)

SMICoP also stipulates that suppliers must offer energy efficiency information (general) and advice (specific) during the installation visit. The guidance is to be provided in suitable format for customer needs, which include visual or hearing impairment, low literacy, and known vulnerability. Should customers request additional information or advice, they are to be given details of where and how they can obtain it.[35] SMICoP states that installers must be trained to the standards defined by the National Skills Academy for Power (NSAP). This accreditation should ensure competence in meeting SMICoP obligations to carry out safe installations in a professional manner and conveying information on smart metering and energy efficiency.

In the Consumer Engagement Strategy consultation response, DECC also states that:

*The Government would expect suppliers as standard to:*

- *demonstrate the IHD – help customers to understand how to operate the equipment and how it can be used to help them manage their energy consumption (e.g. by demonstrating how the display changes when an appliance is switched on);*
- *provide written material - signpost where the customer could go for a reminder of the IHD's functionality or for more energy efficiency advice. This would include any standard Smart Energy GB and, potentially, Green Deal material;*
- *initiate discussion on energy saving behavioural changes – discussion should be tailored to the consumer's interests or the conversation should be closed down early if the customer clearly wishes to do so.* (4.17)

Thus DECC envisages that householders will receive demonstration, advice and written material which will enable and encourage them to use the IHD to learn about their energy use and ways of saving energy, during the installation visit.

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[34] https://www.ofgem.gov.uk/ofgem-publications/57316/smartmeteringinstallationcodeofpractice.pdf

[35] SMICoP section 3.7, p 22.

Installers are expected to have institutional backup for their communication work. The consultation response states that the Government expects Smart Energy GB activities to include: '*providing energy efficiency advice and guidance (both via suppliers and through third parties) that relates to the smart meter roll-out*… [and] *engaging vulnerable and low income consumers to provide additional support … where needed*.' (4.72) Suppliers have an obligation to fund Smart Energy GB, set up in 2013 and tasked with:

- building consumer confidence in the installation of smart meters.
- building consumer awareness and understanding of how to use smart meters and the information obtained from them.
- increasing consumer willingness to use smart meters to change their behaviours so as to enable them to reduce their energy consumption.
- assisting vulnerable, low income and prepayment consumers to realise the benefits of smart metering systems while continuing to maintain an adequate level of warmth and meet their other energy needs.[36]

The policy design therefore assumes that Smart Energy GB will develop appropriate advisory materials for suppliers and others to use as part of the support for the installation. It also appears to assume that some of the impact of Smart Energy GB will be felt prior to installation (through awareness-building), while some will be felt afterwards (e.g. assisting vulnerable customers to realise benefits from smart metering).

How is this to be achieved? What is the theory of change underlying policy design? The behaviour change framework set out in the Consumer Engagement Strategy consultation document proposes that motivational campaigns will influence energy literacy, the salience of energy to householders, and social and household norms; while advice and guidance will influence, in particular, energy literacy[37], knowledge of behaviours, self-efficacy and beliefs about outcomes.[38]

## Research and theory in relation to the installation process

The research literature on domestic energy use offers some clear general theoretical considerations, which can be summarised as:

- energy systems are socio-technical in nature, and users' knowledge and practical know-how are integral elements of a system, along with the building and appliances through which they use fuel and electricity.[39]

- adoption of new technology is part of a process in which people incorporate new information and skills into their body of knowledge and abilities.[40]

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[36] http://www.eua.org.uk/sites/default/files/3%20lawrenceslade.pdf

[37] e.g. understanding how energy is wasted; the benefits of energy efficiency; likely candidates for energy-hungry appliances (http://webarchive.nationalarchives.gov.uk/20121217152440/http:/decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/4897-consumer-engagement-strategy-con-doc.pdf, p.22)

[38] ibid., Figure 5.

[39] Verbong et al., (2013) op.cit.

[40] Jean Piaget is the best-known early exponent of 'constructivist' theory, which has been incorporated into educational orthodoxy. An example of a constructivist approach to energy feedback is found in Ellis P and Gaskell G (1978) *A review of social research on the individual energy consumer*. London School of Economics Department of Social Psychology

- implementing technical change is a social learning process, often taking place over lengthy periods of time[41,42]

There has been little research worldwide relating specifically to smart meter installation. Given that most smart meters worldwide have been installed without a dedicated customer interface, this is perhaps not surprising. However, some evidence is available from Ireland, the Netherlands and the Energy Demand Research Project in GB. There is also research into in-home energy advice which is relevant to smart metering.

Examples of research that are directly relevant to the way consumers engage with the installation process are summarised below under the headings of:

- how the installation process can support learning;
- importance of setting learning in the context of building energy performance and lifestyle factors;
- role for social and institutional support.

*a) How the installation process can support learning*

Meter installation is an opportunity both to introduce new equipment into a household and to pass on some knowledge that will help the household members to benefit from it. If this second opportunity is taken up, the meter is not introduced simply as a 'fit and forget' item. Instead, the IHD (and the information it provides) becomes a tool that customers can learn to use, in order to obtain benefits.

In the Netherlands, where consumer engagement and energy savings are central aims of the smart metering programme, early research concluded that the installer's visit is a key element of the customer experience.[43] Surveys carried out during the Energy Demand Research Project (EDRP) trials of smart metering confirmed that customers expected, and could have benefited from, more engagement and instruction when their smart meters and displays were installed. The findings also indicated that greater savings could have been achieved with better support at the installation stage.[44]

Smart meter installation, like other forms of technology adoption, can be part of a process in which people incorporate new information and skills into their repertoire. Research into the effectiveness of energy advice is relevant here. It emphasises the importance of dialogue between adviser and advisee, and 'seizing the moment' when new equipment is installed.[45] Research into advice programme effectiveness also points to the value of consumption feedback and measurement in diagnosing problems, making them visible to the householder and offering solutions that stabilise or reduce energy use while maintaining or improving comfort. This comprehensive approach is important in supporting householder learning. [46]

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[41] Wilson and Dowlatabadi (2007), op.cit.

[42] Wolsink, M (2011) The research agenda on social acceptance of distributed generation in smart grids: renewable as common pool resources. *Renewable and sustainable energy reviews* **16**: 822-835

[43] Van Elburg, H (2013) *Domestic energy monitoring roll out in the Netherlands*. Presentation to IEA-4E workshop, Nice, May 2013.

[44] AECOM (2011) Energy Demand Research Project: final analysis. Raw G and Ross D, AECOM, London. p.4

[45] e.g. the work of New Perspectives in evaluating the Energy Efficiency Advice Centres during the 1990s and opening years of this century; Banks, N (2000) Socio-technical networks and the sad case of the condensing boiler. Proceedings, *Energy efficiency in household appliances and lighting,* Naples, eds. Bertoldi, Ricci and de Almeida.

[46] e.g. Darby S (2003) *Making sense of energy advice.* Proceedings, European Council for an Energy-Efficient Economy. Paper 6,157

However, it is important to recognise sensitivities when a 'public' person enters a private domain.[47]

*b) Importance of setting learning in the context of building energy performance and lifestyle factors*

Energy consumption is highly variable across households of similar demographic types. Energy use is influenced by physical/technical aspects of the home in conjunction with the knowledge, know-how, routines and values of the occupants.[48] As the energy efficiency of buildings improves, we can expect the relative significance of 'lifestyle' factors to increase. Given this variability in householders' attitudes towards energy and their diverse ways of living, there is recognition that effective interventions need tailoring to specific individuals and circumstances[49]. A 'one size fits all' approach to meter installation is therefore likely to be unproductive.

Household-specific feedback is likely to be seen as more acceptable than generalised information or exhortation. This is summed up in a quotation from the Navigator research into public attitudes to smart meters and their accompanying IHDs:

*I like the fact it's not a company saying come to us and save, save, save, it's about what you use.*[50]

*c) The role of social and institutional support*

Implementing technical change requires social and institutional support. Some parallels can be drawn between the introduction of smart meters for energy monitoring and the adoption of self-testing kits for health monitoring (see Annex C)[51]. One of the messages arising from this research is that feedback mechanisms work best when used in combination, including information, regular support from a health professional, and peer support.

A similar message emerges from the evaluation of the Digital TV switchover for disabled, older, isolated and low-income customers, that 'early, effective and coordinated mobilisation of informal and formal supporters' would offer the best prospects for positive impacts.[52]

## Findings from the Early Learning Project research

This section builds on the theory and research reviewed above and analyses the data collected in the Early Learning Project to answer the high level questions posed at the start of the chapter. The Early Learning Project and the installer focus groups conducted for this project (Annex D) have contributed substantially to our knowledge of what can happen at installation, and we draw on both in this and the following chapter.

During Foundation stage, and specifically the research period for the Early Learning Project, individual suppliers have adopted different approaches to selecting customers to have smart meters installed, and to providing advice and guidance for the customer journey. In terms of

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[47] Palm J (2010) The public–private divide in household behavior: How far into home can energy guidance reach? *Energy Policy* **38**, 2858-2864

[48] Gram-Hanssen K (2010) Residential heat comfort practices: understanding users. Building Research and Information 38 (2), 175-186

[49] Wolsink, M (2011) op.cit.

[50] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48381/5424-smart-meters-research-public-attitudes.pdf, p29.

[51] Burke L et al (2011) Self monitoring in weight loss, a systematic review of the literature. *J Am Diet Assoc*, Jan 2011:111(1) 92-102

[52] Freeman J, Lessiter J and Beattie E (2007) Digital Television Switchover and disabled, older, isolated and low income consumers. Report for Ofcom. Goldsmiths, University of London.

identifying homes to have an installation, there were two broad approaches by the larger suppliers studied in the Early Learning Project:

- customers were selected (e.g. dual fuel or electricity only) and invited to get in touch with the supplier if they were interested in having a smart meter installed.
- customers were offered smart meters when their gas and/or electricity meter was due for replacement: they were contacted by their supplier to advise that their meter needed replacing, and offered an upgrade to smart metering.

During the installation visit itself, all customers were offered an IHD and provided with some explanation of how to use it, although variable amounts of time were spent by installers explaining and demonstrating the IHD. All customers were left with some written material on the smart meter and IHD, and a number to call if they had queries. All smart meter installers had been trained in basic energy efficiency issues and received an energy efficiency accreditation, and were expected to offer advice on energy efficiency during installation. Some customers were left with general written information and tips on energy efficiency.

The experience of prepayment customers is addresses later.

***1) To what extent does engagement in the installation process influence subsequent engagement in using smart meters and the information they generate?***

Based on the proposition that installation is part of a learning process, we set out some broad hypotheses about how different people might respond to installation under different sets of circumstances. We would expect the following factors to influence programme effectiveness, particularly the early potential outcomes of customer satisfaction along with willingness and ability to use an IHD:

- householders having some prior interest in technology, energy use, financial savings or environmental issues (knowledge and/or motivation on which to build);
- householders having the capacity to reduce their energy consumption without suffering (implications for the fuel poor, and those in poorly-insulated rented housing)[53].
- householder consent to the proposition of a smart meter, implying clear prior information from trusted sources, and a considerate approach from the utility;
- a satisfactory installation experience, in which householders and installers have time to communicate usefully;
- installers' ability to communicate well with householders and teach them what they need to know about their smart meter system;
- provision of informative and interactive IHDs, along with readily-available complementary information on energy use and options for energy saving;
- wider support for consumers in the installation process from third parties, for example, local authorities, charities, local networks. This applies especially to households facing difficulties with health, low income, housing or social isolation.

[53] This is most relevant to Chapter 6, but is included here because householder perceptions of the possibility of energy saving may well influence their willingness to use a smart meter and IHD to assist with this.

**Pre-installation engagement**

From the research literature on technology adoption, feedback and learning, we would expect prior knowledge, awareness and expectation to assist with householders' learning and also, in general, to be associated with support for smart meter adoption. Literature from the public health field, for example, offers

- the transtheoretical model of behaviour change, in which 'action' is preceded by three stages of precontemplation, contemplation and preparation, during which people start to make sense of new information and to consider what specific implications if might have for them;
- evaluations of public health advertising campaigns, offering lessons on how best to encourage behaviour change: for example, not telling people what they should do, and conveying the message that support is available to help them achieve realistically-defined benefits;
- the finding that health feedback mechanisms (e.g. for blood pressure or blood sugar) work best when combined with good general information, regular input from a health professional, and/or peer support.

(See Annex C for further detail on lessons from the public health sector.)

DECC-commissioned tracker surveys have shown an increase in awareness of smart meters between March 2013 and March 2014. Furthermore, a majority of the Early Learning Project survey respondents who were aware that they had a smart meter said they had heard of smart meters before they were contacted about receiving one. However, only 14% felt that they knew a great deal or a fair amount already[54]. It would seem, therefore, that whilst there was a reasonable level of general awareness at the time of the research, there is room for awareness and knowledge to increase. This was borne out in the installer focus groups:

> *I think [awareness] has gone up a bit, it's appearing more in the media now, and we have an advert and general word of mouth… the typical thing we hear from customers - 'How does it work?' - people are excited to see what happens. They don't really know much about it and physically want to know what is happening and what it's displaying,* (Installer, GB focus group)

Installers also commented on the impact of the BG advertising campaign during the summer of 2013:

> *I've got more questions after that …Especially around the display unit I think, because in the advert it kind of focuses on it, so we've got more questions about that.* (Installer, GB focus group)

However, it is worth noting that experiences from public health behaviour change programmes have demonstrated a relatively low rate of change (given the relatively high cost) from mass media campaigns, which has encouraged the public health field to adopt more sophisticated social marketing approaches[55]. This requires in-depth research into what might best reach, motivate and support change in different social groups. It also requires definition of what the most significant groups might be, given that people will tend to belong to several simultaneously. For example, a middle-income, middle-aged female homeowner with an

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[54] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

[55] Department of Health (2011) *Changing behaviour, improving outcomes: a new social marketing strategy for public health*

extended family, an interest in home improvements but an aversion to ICT; a young, low-income and highly-educated male tenant who often moves house, with poor local connections but strong online connections.

Customer expectations and perceptions are factors in long-term acceptance of new technology, and these can be unrealistic. For example, in the Irish electricity smart meter trials[56], customers ranged from expecting 5% to 20% savings, but almost none achieved even the lower estimate. In a small-scale Northern Ireland trial, with 56 customers, all but three reported having saved money, although the actual number who made savings was only 18, and many spent more than they had before the meter was installed.[57] There would seem to be some merit in establishing realistic expectations.

Experience in the Netherlands and in parts of the USA strongly suggests that if roll-out is presented as compulsory in any way, a backlash could set in. In GB, DECC-commissioned research indicated that it is important to make it clear to the public that accepting a smart meter is not mandatory.[58]

When it comes to approaching customers to invite them to request or accept a smart meter, consideration must be given to those aspects which are most interesting or attractive to them. Qualitative research with low-income and vulnerable consumers found that the benefits mentioned most often were being able to monitor electricity usage and not having any more estimated bills.[59] The most common motivations for Early Learning Project survey respondents deciding or agreeing to have a smart meter (apart from being told by their supplier they needed their meter replaced (35%)), were the prospect of more accurate bills (23%), seeing how much electricity and gas they were using (22%) and an end to calls from meter readers (18%). There were also some overlapping categories in the Early Learning Project survey findings relating to energy and cost management: 12% of smart-metered respondents gave bill reduction as a reason for accepting a smart meter, 12% wanted help with budgeting, and 11% wanted to avoid wastage.[60] Early Learning Project research with prepayment customers showed the main reported motivations for accepting a smart meter were an accessible display and the promise of cheaper bills. This evidence from GB showed a significant proportion of customers who at least consider the possibility of demand reduction or cost savings when deciding whether to accept a smart meter, although energy saving was not necessarily the most important factor in people's stated beliefs about what smart meters could offer them: better visibility and understanding seemed to occupy that position.

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[56] CER (2011) *Electricity smart metering customer behaviour trials (CBT) findings report*. CER, Dublin

[57] Liddell C (2012) Smart Meters, Smart People. University of Ulster. http://eprints.ulster.ac.uk/25443/1/SMARTerMetersExReportWEB-7Jan13.pdf

[58] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48381/5424-smart-meters-research-public-attitudes.pdf

[59] NEA and Consumer Focus (2012) Smart for all – Understanding consumer vulnerability during the experience of smart meter installation. Report for DECC. http://www.consumerfocus.org.uk/publications/smart-for-all-understanding-consumer-vulnerability-during-the-experience-of-smart-meter-installation.

[60] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

There are decisions to be made about customer targeting strategies, for example, whether to first target households who are more interested in and supportive of smart metering, with the expectation that they will then spread useful word-of-mouth publicity about their experiences. Only 1% of smart meter customers surveyed in the Early Learning Project had been influenced to accept a smart meter by the recommendation of a friend or family member, but of course this has the potential to increase once more households have smart meters installed.

During Foundation Stage, different approaches are being used to introduce the smart meter to households. These fall into two main types: one invites customers to request a smart meter and the other involves presenting the installation as a routine meter replacement. Only 5% of the Early Learning Project survey respondents reported that they had asked their supplier for a smart meter, unprompted, while a further 6% requested one after being told about smart meters by their supplier. For a large majority of the sample, then, the decision to accept a smart meter was a relatively passive one: for example, they agreed to an installation when it was offered (59% of the sample), or allowed [routine] replacement of their old meter by a new smart one (19%).

Qualitative work with a mix of vulnerable and non-vulnerable householders found that those with a supplier where most customers 'opted in' to smart metering appeared more likely to mention multiple benefits than those whose smart meters were supplied more on a replacement basis. This finding was supported in the Early Learning Project survey: respondents who had asked their supplier for a smart meter, or actively responded to an offer of one, were more likely to be satisfied with it, and to speak highly about it, than those who had simply been told that their meter needed replacing.[61]

Only one of the four major EDRP trials (2007-10) showed no positive effect on energy consumption from smart meters. This was the Scottish Power trial, where the new meter was presented to householders as a routine replacement, with little or no supporting advice and information provided during the installation visit.[62] A rough parallel could be drawn with the (relatively few) Early Learning Project survey customers who were not present when their SM was installed, and who were relatively unlikely to know how to use their IHD. The researchers concluded that this group of 'not present' customers would benefit from a follow-up visit from the supplier.

So far, the evidence suggests that relying solely on the need for routine replacement as the justification for installations will not be the most effective strategy for promoting full customer engagement with the installation.

### Householder knowledge and expertise

Past research indicates that prior consumer knowledge and interest are important considerations in tailoring approaches to support effective learning. This is borne out in the Early Learning Project findings.

The Early Learning Project[63] found that older smart meter customers, those from lower social grades and those with the lowest annual household incomes (below £16,000) were less likely to say that they knew about smart meters in advance of being contacted by their supplier about having one installed. The consumer survey report also suggests that an increase in awareness

[61] NEA and Consumer Focus (2012) op.cit.

[62] Klopfert F and Wallenborn G (2012) Empowering consumers through smart metering. Report for BEUC; AECOM (2011) op.cit.

[63] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

of potential benefits from smart meters might have a positive impact on engagement and use of IHDs amongst these groups. Similarly, older smart meter customers (aged 65 and over, particularly those of 75+ years) were generally less satisfied with aspects of the installation and generally less able to recall aspects of installation (as were those from lower social grades.) Some older interview respondents reported finding the information provided at installation difficult to take in, or being overwhelmed, while others felt they were not good at understanding technology, and would need further time or support to become familiar with it.

Installers identified older and disabled customers as more challenging to talk with, but they had some support for this from the routine specified for Priority Service Register (PSR)[64] customers:

> *… we have a specific vulnerable customer journey. When the appointment's being booked we offer vulnerable customers what we call a smart support coordinator, and then that person in the call centre will follow that customer the full way through the journey so they'll be in touch with that customer or their third party carer once the technicians do the call on the day, and then we'll follow up …They normally phone about an hour after we leave.* (Installer, GB focus group)

The evidence from Early Learning Project thus points to a need for special care in preparing information materials for the elderly, and in training installers to communicate satisfactorily with them. Those over the age of 65 were less likely to be satisfied with explanations about how the IHD worked (77% over 65 compared to 87% under 65) and any printed material providing details of how to use the IHD (66% over 65 compared to 76% under 65 who received material). During the in-depth interviews some older customers described the explanations and information they received as "going over my head". Older customers were more likely never to have engaged with the IHD, with those over the age of 65 more likely to have never plugged it in (14% over 65, compared to 8% under 65s). They were also more likely to have stopped using it because they did not understand how to use it (19% of over 65s, compared to 8% under 65).[65]

Installers identified two customer-related factors that particularly affected their approach to Foundation Stage installation – customer interest, and the time available to themselves and their customer:

> *… three different types of customers with regards to their engagement, to how you pitch it. So, you've got the ones that … know more about it than you and it gets embarrassing because the … questions they're gonna ask you, go right over your head. So you just let them speak. And then you've got people who are interested in but not very good with technology, and you've got the ones who are really interested in technology but have no engagement, no time free. You put it down to three groups of engagement - and you get the phobic ones, who don't want to talk to you.* (Installer, GB focus group)

It follows that installers need to be flexible in their approach if they are to communicate effectively:

> *You're not going to go to a property and say that you haven't got the time and you've got the manual and the video for them. The next person might ask you every question you've ever been asked.* (Installer, GB focus group)

The Early Learning Project survey showed slightly greater satisfaction with installers' explanations among those who like to have the newest gadgets. This makes sense in terms of

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[64] The energy suppliers' Priority Services Register offers extra free services to people who are of pensionable age, registered disabled, have a hearing or visual impairment, or have long term ill-health.

[65] Appendix to DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

learning theory if, as seems likely, these customers have a more developed vocabulary with which to ask relevant questions and to understand the answers.

### The installation visit

Almost 90% of customers in the Early Learning Project survey were either satisfied or very satisfied with their installation overall. Customer satisfaction with the installer's promptness and professionalism, his/her ability to answer questions, and information given on or around the day (e.g. leaflets), all contributed significantly to levels of overall satisfaction with installation. The practicalities - arrangements, tidiness and professionalism - emerged as the single most significant factor contributing to overall satisfaction with installation for all customer groups, by a considerable margin.

Evidence from the Early Learning Project research also suggests that a well-received installation visit can lay the foundation for positive attitudes towards the IHD and the information it provides. These levels of satisfaction suggest that installer training with respect to customer experience to date has been effective and worthwhile. It was clear from the installer focus groups that training is extremely important in building confidence and ability with communications. Installers used phrases such as 'very customer-focused', and 'knowing how to adapt to different styles of people'. They took pride in the skills needed to walk into any situation and deal with it constructively. However, there were concerns about the extent to which skills could be maintained during a scaled-up roll-out, with a significant proportion of the work contracted out:

> *…it's a difficult one – do we ask for a certain technical standard as well as some sort of qualification in dealing with customers? I don't know how you actually do that within the [EU] procurement framework. It's different when you're interviewing staff and you bring them in that way, because you can gauge … how good their people skills are from an interview, … whereas whenever you're going out to procure a contractor to install meters in several hundred thousand homes … it's not something that probably naturally comes across during a tendering process, because you're not necessarily talking to all of the individual engineers themselves.* (Installer, Northern Ireland focus group)

Timing was another issue raised by installers. Installations can take from under half an hour for an electricity smart meter alone to four hours or even more for a difficult dual-fuel installation. The average time spent with a customer on a normal work day was one and a half to two hours, which normally allows some time for a conversation about the meter and display. This question of timing is likely to be particularly important where vulnerable customers are concerned. Advice will be of most value when the customer is receptive and can digest it, and this may not be in a single 'dose' at installation, especially if the customer is in a hurry.

The significance of the IHD is recognised in publicity material and on utility websites as the element of the smart meter system that customers are most likely to be interested in. With the technology goes the need to understand and use it effectively, as one NI installer pointed out forcefully:

> *'… there is no point wasting billions of pounds if we don't educate the people in advance... because all you'll do is you'll increase their cost, and they're not going to thank you for that, you know… for putting this meter in and not knowing how to work it and saving them nothing, and the electrician wasn't able to tell me.*

In the small-scale trial of smart meters with specially-designed displays in Northern Ireland, the value of personal contact and tangible reminders of the visit was clear. Customers appreciated the welcome pack and home visit, especially the energy audit and Standby Off plug. However, it

is worth noting that the 'How to Use HenRE' [the IHD] manual was used only occasionally, and none of the 56 participants in the trial visited the website for further information.[66]

One GB installer explained how they normally go about explaining the IHD with a combination of written material, a chance for the customer to test out the display, and some personal explanation:

> *I think a lot of guys… with the display unit we've got because it's usually the end thing that you do, they'll say, I'm going to come and talk to you about everything I've done at the end, when I can explain this more thoroughly… I give them the booklet to explain it at the start so, whilst there's nothing they can do because there's no power, they read the booklet. Then once you've put the power back on, give them the display whilst you're doing the gas* [where it is essential to concentrate on safety], *and when they come back they say 'Oh, what does this bit do?' because they've already read a little bit about it. (Installer, GB focus group)*

Two-thirds of Early Learning Project survey respondents who were present for the smart meter installation were able to recall that the installer had showed them how the IHD worked. But installers pointed out that they have to prioritise safety and workability and so the amount of time left for customer explanations and engagement may be squeezed. After that they were largely left to learn what they could from their IHDs.

The Early Learning Project prepayment research found that there may be a novelty effect whereby some people start off engaging/experimenting with their IHD when it is first installed and then fall into a settled pattern of use, and the research suggested that the goal should be to encourage people to try and change their behaviour during this 'critical period'.

However, a good installation experience can leave consumers with a willingness or interest to engage with the IHD when the installer has left. In the Early Learning Project qualitative research, interviewees frequently reported that they had learned more about using the IHD when they began to 'play with it' on their own. Some also remarked that functions they discovered for themselves were more likely to 'stick' or be retained. This emphasis on self-teaching with the IHD is not a negative comment on Foundation stage installation, as the great majority of Early Learning Project survey respondents stated that they were satisfied with the information they received during installation, and there are limits to what can be learned at any one time. Rather, it points to the importance of the IHD being accessible and user-friendly, and to the role of the installer in giving householders the confidence to play around with it and learn from it.

The Early Learning Project qualitative research with credit customers found some variation in the extent to which installer explanations were understood by different groups, to the extent that they could go on to achieve the best outcomes.

The point was echoed in prepayment customer research findings:

> *Although …Smart PPM respondents felt in most cases that the installer had provided them with adequate instructions on how to use their IHDs, this had not translated into behaviours whereby they were taking advantage of its full range of functions*. [67]

This issue is addressed in greater depth in Chapter 6.

There has to be some form of preliminary communication that makes engagement possible, otherwise the householder may not have the vocabulary with which to interact with the installer, as noted by two installers in one of the GB focus groups:

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[66] Liddell (2012) op.cit.

[67] DECC (2015) Smart Metering Early Learning Project: Prepayment Qualitative Research

*… I'd say if you've done the job, most people just stand there and listen and don't ask you any questions…but you know that they're not understanding a word that you say unless you can get them to interact with you, which is why this YouTube channel now is good so they can watch that.*

*DVD is the best option I think because while you're changing the gas meter they could be watching the DVD and then ask you any questions once it's finished to save time. Not everyone has internet access.*

This supports the proposed role for Smart Energy GB and for local organisations in preparing customers for installation by introducing energy-related concepts and issues in a variety of accessible ways.

***What actions of energy companies, Smart Energy GB, DECC and third party organisations would help maximise engagement in the installation of smart meters?***

This section draws on the findings above to reach conclusions about what additional steps are necessary to ensure the installation process helps to maximise householder benefits.

There has been limited general pre-installation communication to date, but now that Smart Energy GB is established this can be expected to increase. There may be value in providing more general information to the public and in supporting local organisations to undertake local preparatory work – for example, housing associations whose properties will be smart metered.

The installers interviewed for this project emphasised the importance of preparing customers for installation.

*I think there has to be a certain amount of learning before the installer even hits the door. You could use television programmes, you could use community groups, you could use a lot of training before we actually start the roll-out and then the installer just gives them the quick refresher.* (Installer, Northern Ireland focus group)

81% of smart-metered customers who were surveyed for the Early Learning Project, up to two and a half years after installation, recalled receiving some form of message prior to installation, if only to confirm the date and time. Just under half of them remembered being sent material that explained how the IHD worked, and a similar proportion remembered being sent material that explained how the smart meter worked[68]. This suggests that there is scope for improving preparatory information, using more than one medium.

Installers from Northern Ireland saw community events as having been an invaluable preparation for the roll-out of keypad meters there, and a way of reducing their own workload. Community events could also be used as ways of transmitting know-how post-installation. However, these would fit better with a roll-out approach involving a high density of installations within given areas and time periods, rather than targeting early adopters. While a geographically-based roll-out is not in prospect, there is still scope for some local co-ordination of effort.

The installation visit itself is a key point in the customer journey and a prime opportunity for engagement. The Early Learning Project findings indicate that Foundation Stage installations have been conducted professionally, leading to good levels of satisfaction. In the Early Learning Project survey, there was a weak but significant association between the amount of information and customer service that customers received from their energy company around the time of the installation (in terms of booklets, follow-up calls, energy advice etc.) and the extent to which

[68] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

people felt in control of, or had tried to reduce, household energy consumption as a direct result of the smart system.[69]

The Early Learning Project smart metered respondents' recall of follow-up contact by the supplier was limited, with only 30% remembering any communication after installation; the most common memory was of a quick phone call. As discussed below, some customers (primarily those who are least likely to learn how to use meter data by themselves or through informal networks) are more likely to benefit from follow-up than others. This suggests a need for more effort to build upon the information provided during the installation visit for this subset of the customer base, to ensure these householders understand and use the IHD and other feedback provided.

Additional support may be especially useful for particular groups. For example, the prepayment research concluded that customers may well need support in the transition to smart prepayment. Respondents mentioned the potential for providers of social housing or independent third parties to provide support to those in social rented properties, although they recognised potential tensions between tenants and landlords. Face-to-face support, including advice about effective energy management strategies, was often felt by respondents to have the greatest potential to engage interest and change behaviour. However, they also commented that this will depend on who delivers it and how this is done and identified the key characteristics for success as independent, informed advice offered in an accessible manner.

Installers themselves need backup, to assist them in answering difficult questions or troubleshooting technical problems. The installer focus groups pointed out the importance of having accessible support via their phones, and also (GB) the need for well-trained call centre staff who knew about the whole process of installation, from booking appointments to fielding customer queries after installation.

## Summary and conclusions

The policy design implies a variety of organisational steps and measures around consumer engagement which have not been implemented at this point in the roll-out. The quality and effectiveness of activities in the supply chain, including installer training, partnership development with third parties, coordination of Smart Energy GB and supplier engagement activities, will also have a significant impact on householder engagement and benefits.

The evidence supports the voluntary approach to roll-out, i.e. people have a choice about whether to accept a smart meter. It also implies the need for a careful and staged customer journey including specific information about the installation process.

The Early Learning Project research also indicated that relying solely on routine meter replacement as the justification for installations may not be the most effective strategy for ensuring that customers engage well with the installation. Furthermore, a strategy which first targets those consumers more interested in or supportive of smart metering, and invites them to request a smart meter, may have merit.

Prior awareness of smart metering appears related to the level of householder engagement with the IHD. Such awareness might prompt some householders to request a smart meter in the first place, so that they are predisposed to engagement, and also supply them with a vocabulary and concepts that they can use in talking with the installer. Given that the level of general awareness of smart metering appears to be rising, and the most common attitude towards

[69] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

adopting a smart meter is neutral, there seems to be an opportunity for co-ordinated engagement activities.

The Early Learning Project revealed good levels of satisfaction with smart meter installations. Practicalities of the installation – arrangements, tidiness and professionalism – were important in contributing to householder satisfaction, as were installers' explanations and advice. The Early Learning Project survey findings showed that satisfaction with aspects of installation is related to ease of using the IHD. They also show that satisfaction with information, explanations and advice at and around installation influences overall satisfaction with the installation. The installers we spoke with made clear the significance of engaging customers in installation, being well-informed themselves, and having access to clear supplementary information and support.

During the installation process, information should be tailored to consumers' abilities and learning preferences. This implies a need to train installers (or other advisers) to be able to make careful assessments in the home of what is necessary and possible, in order to help householders (a) make the most of their smart meter and IHD by understanding new information, and building confidence in their ability to use it; (b) improve their prospects of affordable warmth and/or energy savings.

A significant minority – just under a third – of Foundation Stage customers surveyed could not remember being told how to operate their IHD, which suggests there is still some way to go in improving engagement. Specifically, there are concerns about

- maintaining and building on installers' skills, especially when the work is contracted outside the company;
- making sure that all installers have time to conduct a useful conversation about metering and energy use with any householder who wants one; and
- making sure that they have appropriate materials and backup to inform all customers about changes in energy supply systems, options for reducing their consumption while maintaining or improving comfort, as well as providing sources of further advice and guidance.

These conclusions suggest the following policy implications:

- Smart Energy GB has valuable roles to play in
  (a) providing clear, reliable information on smart metering to the general public;
  (b) mobilising, supporting and co-ordinating local networks and bodies such as housing associations, so that they are able to supply more detailed, household-specific guidance to those who need it.

- It would be beneficial for energy suppliers to provide information and help with setting expectations prior to the installation visit.

- Suppliers need to ensure that workforce incentives and outsourced contracts allow sufficient time for meter installers to offer a positive consumer experience, including demonstration of the IHD and energy efficiency advice relevant to the customer's situation and concerns.
- Information, advice and guidance provided during the installation process need to be tailored, especially to the needs of vulnerable and prepayment customers, e.g. helping them to navigate IHD functions.

- The customer experience could be further enhanced by energy suppliers collecting information about households ahead of the installation, so that installers have advance intelligence and can tailor advice and guidance to suit the needs of individuals (including but not limited to the vulnerable).

A final point: while Smart Energy GB is well-placed to develop people's readiness to adopt and use smart technology, it has a challenge ahead in terms of shaping realistic expectations about energy use and control, and in communicating with 'on the ground' actors who are already trusted intermediaries and will be in more direct touch with households. To meet this challenge, as their 2013 Consumer Engagement Plan recognises, it is necessary to understand household characteristics, and how these might influence attitudes and behavioural responses.

This synthesis shows that it is also necessary to go into some detail about how people learn to use smart meter information, and how they might use it to assist them in reducing their energy use. These form the topics of the next two chapters.

# Chapter 5 Engagement with smart meter information

This chapter considers evidence for the ways in which householders engage with smart meter information, and implications for delivery organisations:

| | |
|---|---|
| ***How do customers engage with the information provided by smart meters and in-home displays in a way that encourages reduced energy consumption?*** | ***What additional support is required to increase customer use of smart meters and IHDs?*** |

Subsidiary questions relate to specifics of design, information environment and sources of support:

- What is the role of non-IHD forms of feedback?
- What features of IHD design are of most value in communicating with householders?
- What is the role of informal sources of information and support?
- What special considerations apply to prepayment and vulnerable households?

**Structure of chapter**

The chapter starts by setting out the policy design aims and assumptions articulated by DECC and others in programme documentation. Then it sets out our understanding of consumer engagement with smart meter information from a research perspective, both in terms of theories about processes (or mechanisms) which could be operating, and results from previous research. Using this, it identifies some hypotheses about factors likely to influence the use of smart meter information to reduce consumption during the roll-out, and presents findings from the Early Learning Project against these hypotheses and the questions set out above. Lastly it summarises what we now know against these questions and the policy implications.

## Policy design: aims and assumptions

The policy design envisages that installers will explain IHD use, provide supplementary information material and point the customer towards other sources of help and advice, as set out in Chapter 4, which then enable them to make good use of smart meter information.

The response to the Consumer Engagement Strategy consultation states that '*four main levers of energy saving behaviour change - direct feedback in near-real-time, indirect feedback, advice and guidance, and motivational campaigns… will be used by the different parties involved in delivering consumer engagement during Foundation Stage and mass roll-out*.'[70] (p.4)

[70] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43042/7224-gov-resp-sm-consumer-engagement.pdfm, p4.

The levers of *direct feedback* (via the IHD) and *advice and guidance* are particularly relevant to this stage of the customer journey, and the IHD is a central element in the policy design[71] for energy saving. The Consumer Engagement Strategy (CES) consultation document states that:

> *The IHD provides the direct feedback that the behaviour change framework flags as important and is therefore a central tool of consumer engagement. Requiring all suppliers to offer an IHD to all domestic consumers will ensure that as many as possible have easy, rapid access to relevant information on usage, expenditure and their meter balance.* [72]

In their response to the consultation submissions[73], DECC state that:

> *Suppliers will be required to ensure that the IHD is accessible to as wide a group of consumers as possible. However, even an inclusively designed IHD will not be accessible to all consumers, and suppliers will still need to consider what adjustments are required to ensure that disabled consumers are not disadvantaged relative to others.* (4.6)

As noted in Chapter 4, the policy design envisages that installers will explain IHD use. The Smart Metering Installation Code of Practice (SMICoP) aims '*to ensure that customers … know how to use, and benefit from, the smart metering equipment*'[74]. The behaviour change framework proposes that direct feedback will impact in particular on energy literacy and beliefs about outcomes, while advice and guidance will impact in particular on energy literacy, knowledge of behaviours, self-efficacy and beliefs about outcomes.[75]

The offer of energy efficiency information (general) and advice (specific) at the installation visit are mandated via the SMICoP (sections 2 and 3), and it is envisaged that 'energy efficiency guidance offered to the customer complements any centrally co-ordinated consumer engagement campaign' and that 'installers are trained and competent to provide energy efficiency guidance that is appropriate to the customer's needs' (2.6.5). Suppliers are to make sure that energy efficiency guidance and materials are in a format suitable for customer needs, including those of vulnerable customers and those with visual, hearing or cognitive impairment; and that customers are made aware of additional sources of help and information (3.7).

The consultation response also states (4.72) that the Government expects Smart Energy GB activities to include: *providing energy efficiency advice and guidance (both via suppliers and through third parties) that relates to the smart meter roll-out*… [and] *engaging vulnerable and low income consumer to provide additional support … where needed*'. A range of channels is to be used to address consumer concerns and explain the benefits of smart metering. The response envisages that Smart Energy GB will develop its activities, informed by expert advice, in order to deliver the objectives which Government has set down. These include: *to build consumer awareness and understanding of how to use smart meters and the information obtained from them* and *to assist vulnerable, low income and prepayment consumers to realise the benefits of smart metering systems while continuing to maintain an adequate level of warmth and meet their other energy needs*.

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[71] As noted in Chapter 2, policy design is a reflection of the programme theory of change.

[72] http://webarchive.nationalarchives.gov.uk/20121217152440/http:/decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/4897-consumer-engagement-strategy-con-doc.pdf, 4.13

[73] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43042/7224-gov-resp-sm-consumer-engagement.pdf

[74] Consultation document, 2.24

[75] Ibid., Figure 5

## Research and theory on consumer engagement with smart metering information

There is a body of theory and research findings relevant to consumer engagement with smart meter information (see Annex B). Here, we look at:

- How direct feedback 'works' and IHD design
- Engagement with other types of feedback
- Evolution of engagement with smart meter information over time

### *a) How direct feedback 'works', and IHD design*

Many trials and experiments have established that making energy use more visible through IHDs can assist in developing energy literacy and ability to reduce peak or overall demand[76]. Understanding the mechanisms in play can help with developing hypotheses about the important factors and what actions may be needed to improve outcomes.

Feedback theory offers some answers to the question of how smart metering might work in psychological terms to bring about energy saving. The basic idea is that feedback on energy use alerts users to their consumption by making it more visible, gives them a means of measuring or assessing that consumption, and allows them to see the consequences of different actions and decisions, such as raising the indoor temperature or turning on the TV. In this way it acts as a necessary step in a cycle of action, reflection, learning and experimentation.[77]

Feedback is most effective when it focuses attention on specific tasks, and when it reinforces a householder's sense of efficacy by showing the effects of any changes made.[78,79]

One of the earliest reviews of research into energy and behaviour identifies two theoretical frameworks for analysing responses to feedback.[80] The authors contrast what they refer to as 'behavioural' and 'cognitive' schemes. In the former, feedback is interpreted as having a *motivating* function for individuals: it acts as a prompt to think about their energy use and to make changes, and can then reinforce their sense of the value of change by showing the impact in terms of consumption. In cognitive schemes, though, people are seen primarily as information processors who *make sense of the world around them*: feedback forms a crucial part of a longer-term sense-making process.

The thinking behind both frameworks is supported by studies carried out over varying lengths of time. However, the latter would seem to offer more potential for durable change. This is relevant to the Early Learning Research findings (discussed later) about whether customers use their IHDs simply for information on usage in real time, or for monitoring over the longer term.

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[76] For two major reviews, VaasaETT (2011) *Empower Demand. The potential of smart meter enabled programs to increase energy and systems efficiency: a mass pilot comparison*; Ehrhardt-Martinez, K., Donnelly, K.A., and Laitner, J.A. (2010) *Advanced metering initiatives and residential feedback programs: a meta-review for household electricity-saving opportunities*. American Council for an Energy-Efficient Economy, Washington DC

[77] The Kolb learning cycle – see Kolb D (1984) *Experiential learning*. Prentice Hall, Englewood Cliffs, NJ

[78] Wilson and Dowlatabadi, op.cit.

[79] Kluger AN and DeNisi A (1996) The effects of feedback interventions on performance: a historical review, a meta-analysis and a preliminary feedback intervention theory. *Psychological Bulletin* 119 (2), pp254 and 278

[80] Ellis P and Gaskell G (1978) *Op.cit.*

These points have implications for IHD design. Qualitative and quantitative research has shown the importance of display design in inviting customers to use the device, and then maintaining their interest by offering clear information on aspects of energy use that most interest them.[81]

The recent large-scale smart meter trials in the Netherlands found that IHDs were of greatest importance for 'novice engagement'. The report on the trials notes that:

> *These consumers actually prefer the accessibility of a simple yet visually appealing in-home display. In fact, for older people, those with minimal education and low levels of numeracy and computer illiterates, for example, a physical in-home display will be a necessary first step to activate consumer interest and engagement in accessing real-time energy information from the smart meter. The interface design and the interaction within the household also play an important role in reinforcement and habit formation with the monitor.* [82]

b) *Engagement with other forms of feedback*

It is important to recognise the impact of synergies between different modes of feedback, and between feedback and other guidance, discussed further in Chapter 6. Different modes will tend to work better for different purposes – for example, historic feedback is likely to be particularly useful to people wanting to know more about their heating consumption, while real-time direct feedback is best for informing us about the power demand of different appliances. The VaasaETT report on energy efficiency through ICT comments that

> *There is a lot of debate in the field of smart meter enabled energy efficiency and demand response about which forms of feedback work best, but what this research …has shown, is that multiple feedback channels work best…different feedback channels have different purposes… typically, successful programmes put many of the above forms of feedback together in one programme...* [83]

One of the most thorough academic studies of smart energy management design-in-use concludes that displays should not be developed as standalone interventions, but should be incorporated into a broader change strategy that uses information and guidance from a range of sources.[84] As smart meter data can be used to develop more informative bills and home energy reports (for example, including comparisons with similar households and tailored advice), these are obvious candidates for inclusion in such broader strategies.

Studies of informative billing and home energy reports offer a consistent account of customer satisfaction with the improved information.[85] As smart metering offers a way of improving the accuracy and detail of these reports, the assumption is that billing and reports based on smart

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[81] Anderson W and White V (2009) Exploring consumer preferences for home energy display functionality. Report for the Energy Saving Trust. Centre for Sustainable Energy, Bristol; Darby S (2010) Smart metering: what potential for householder engagement? *Building Research and Information* **38** (5), 442-457

[82] van Elburg (2013) Energy Savings Monitor Smart Meter report. Translated from the Dutch for DECC, p.6

[83] Lewis PE, Dromacque C, Brennan S, Stromback J and Kennedy D (2012) *Empower Demand 2: energy efficiency through information and communication technology: best practice examples and guidance*. VaasaETT.report for ESMIG. http://esmig.eu/sites/default/files/final_empower_2_demand_report_final_distr2.pdf

[84] van Dam, SS (2013) Smart energy management for households. PhD thesis, Technical University of Delft. http://abe.tudelft.nl/index.php/faculty-architecture/article/view/614

[85] e.g. Wilhite H (1997) *Experiences with the implementation of an informative energy bill in Norway*. Ressurskonsult A/S report 750; data from OPower, and from take-up of home energy reports (specially if paper-based) in the Dutch smart meter trials.

data are likely to be appreciated by customers, provided the information is well-presented. Evidence from the USA, Netherlands and Austria supports this.[86]

At this point it is worth pointing out that as yet we have very little evidence on the effectiveness of mobile phone apps, even when their primary or only function is to offer feedback on energy use.[87] It is also worth stressing that an app on a mobile phone or similar device is not equivalent to an IHD with ambient feedback in the home, as sometimes assumed: the impact of a mode of feedback relates to design, location, situations in which it can be used, possibilities for interaction with different household members and synergies with other forms of information. So it is not possible to extrapolate from findings with one mode of feedback to another. Apps for smartphones and similar devices will need careful monitoring and evaluation over time and with a range of users before we can draw useful conclusions about their effectiveness.

*c) Evolution of engagement with smart meter information over time*

An important dimension of consumer engagement with smart meter information is the extent to which it develops over time, as a contributory factor to savings.

The research literature offers two main strands of reasoning in relation to underlying mechanisms. The first is based on theories of socio-technical systems and practices, according to which knowledge and practical know-how (e.g., about homes, appliances) and daily routines form part of an energy system, along with the physical elements. Hence we would expect that *introducing new elements to a system* – smart meters with displays, plus the information generated by these and the extent to which they become a normal part of household life[88], plus some knowledge of how to interpret it – *will lead to changes in how people act and think in relation to energy use.*[89]

Using a second strand of reasoning, we can see smart meter adoption as part of a process that *evolves over time*: it will not have a single fixed outcome. According to this, people interpret new information in the light of what they already know, often with the help of others, and use it to test out ideas about what changes are desirable and feasible.[90]

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[86] As in the footnote above; also Schleich J, Klobasa M, Golz S and Brunner M (2013) Effects of feedback on residential electricity demand—Findings from a field trial in Austria. *Energy Policy* **61**, 1097-1106. For further material on non-IHD feedback, see Annex B; there is also a summary of several of the main points in Darby (2010a) *Literature Review for the EDRP project*. Ofgem, London. https://www.ofgem.gov.uk/ofgem-publications/59113/sd-ofgem-literature-review-final-081210.pdf

[87] In the report on the Netherlands smart meter trials, there is a report of a trial of a phone app by Liander, leading to savings of 3% for electricity and 4% for gas. The conditions for the trial are not known. The report comments that 'the more advanced applications, on online media, may stand a better chance of succeeding with users who are already motivated, tech-oriented and media-savvy, and will be able to use the *added* value [our emphasis] from using a PC, tablet or smartphone. Those with less motivation and/or technical affinity often find these too complex or demanding for user use, and prefer a simple monitor at a fixed location in the house, visible to all members of the household. Interface design *and* household interaction play an important role in changing consumption routines. van Elburg (2013) *Energy Savings Monitor Smart Meter report*. Translated from the Dutch for DECC

[88] Hargreaves T, Nye M and Burgess J (2013) Keeping energy visible? Exploring how householders interact with feedback from smart energy monitors in the longer term. *Energy Policy* **52**, 126-134; Consumer-Led Network Revolution Project Social Science Report, CLNR-L052, April 2014

[89] Hinton E (2010) *Review of the literature relating to comfort practices and socio-technical systems*. Environment, Politics and Development Working Paper Series 35, Department of Geography, Kings College London

[90] Vygotsky, L.S., 1962. Thought and Language (Edited and translated by Eugenia Hanfmann and Gertrude Vakar). MIT Press, Cambridge, MA.

In both of these framings, the IHD is a tool for learning how to interpret energy information and put it to use. Specifically, it makes electricity consumption and cost visible in near-real time, and gas consumption and cost visible at slightly lower resolution. In addition, householders with new meters start to receive more accurate bills, are likely to have access to new online data, and may have some new written (home energy report), audio or video material to turn to for guidance. These too can be tools for learning, within a framework of existing knowledge and what is picked up from the installation process and in the course of daily life from family, friends, colleagues, neighbours, local organisations and mass media. Some examples of this are offered later in this chapter.

There is considerable research evidence that neighbours, friends and family play an important role in shaping energy usage patterns[91], that energy use is a social rather than an individualised process[92], and that social interactions are significant in helping people develop energy literacy[93]. This stems from analysing the activities that lead to energy use, and how these are influenced by social norms and acquisition of know-how; also from social learning theory[94].

Neither the policy design nor these two lines of reasoning assume that information alone will alter behaviour. They propose that new information 'works' as part of a complex system of things and actors, and that it works through being made sense of[95]; and that sense-making and changes in behaviour take place in the course of everyday experience and in social contexts, whether at household[96] or neighbourhood[97] level.

## Findings from the Early Learning Project

This section builds on the theory and research reviewed above and analyses the data collected in the Early Learning Project to answer the high level questions posed at the start of the chapter:

1) **How do customers engage with the information provided by smart meters and in-home displays in a way that encourages reduced energy consumption?**

Hypotheses from theory and previous research are that:

a) Engagement with information from smart meters will be associated with an increase in people's awareness of using energy, in general terms; their understanding of how, where

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[91] e.g. Jensen OM (2005) Consumer inertia to energy saving. Proceedings, ECEEE summer study, 1327-1334; Klopfert and Wallenborn (2012), op.cit.

[92] Hargreaves T, Nye M and Burgess J (2010) Making energy visible: A qualitative field study of how householders interact with feedback from smart energy monitors. *Energy Policy* 38 (10), 6111-6119

[93] e.g. Darby (2006a) op.cit

[94] e.g. Lave J (1993) The practice of learning. In Chaiklin S and Lave J (eds) *Understanding practice: perspectives on activity and context*. CUP, Cambridge

[95] This is a familiar set of ideas in social psychology and educational theory.

[96] Hargreaves et al., 2010, op.cit.

[97] Roberts S and Redgrove Z (2011) *The smart metering programme: a consumer review*. Report to Which? Centre for Sustainable Energy, Bristol; Burchell K, Rettie R and Roberts T (2014) *Working together to save energy? Report of the Smart Communities project*. Kingston University.

and when they are using electricity and gas, and their ability to act to manage and/or reduce usage;

b) The extent to which consumers use information from smart meters and IHDs in a way that encourages reduced consumption will be influenced by:
   i. the usability of IHD designs;
   ii. extent of householder knowledge and expertise about smart metering, digital technology, energy use, and budgeting;[98]
   iii. the way that the Programme supports and encourages the customer (and household) to make use of smart meter information in appropriate ways, at installation and subsequently;
   iv. household learning through family and social contacts

c) Engagement with smart metering information therefore emerges as part of a process involving other actors and information sources, rather than an isolated event. The literature leads us to expect that:
   i. already-knowledgeable householders are likely to be able to engage more readily with SM information than those who are relatively new to the idea of smart metering (as discussed in Chapter 4);
   ii. smart metering data can become part of a wider process of active learning as people try to find out how to improve their homes and/or reduce their energy use.[99] Smart metering information becomes more effective in conjunction with other forms of energy-related information and advice. [100]

Evidence relevant to these hypotheses is presented and conclusions are drawn below.

*Impacts of engagement with smart meter information*

A significant finding from the Early Learning Project relates to the different ways in which the IHD was used, and the implications this has for Programme support for customers. The analysis distinguishes between 'information-driven' and 'monitoring' approaches.

In the former, customers are mostly interested in knowing how much energy different appliances and household activities use, and understanding which appliances cause a dramatic spike in usage when switched on. Once they feel have learned what the display has to teach about these, they may lose interest.

A 'monitoring' approach, by contrast, is where the customer is primarily interested in monitoring the state of things in the house (e.g. checking to see that appliances are turned off before they leave the house, or keeping an eye on energy use day-today) which holds the attention over longer periods of time.

The Early Learning Project found that some customers 'with an exclusively 'information-driven' approach to the IHD appeared to have found the IHD redundant after an initial learning period, and ceased to use it. Those who adopted a 'monitoring' approach, however, were more likely to

[98] e.g. Gram-Hanssen (2010) op.cit; Stephenson J, Barton B, Carrington G, Gnoth D, Lawson R and Thorsnes P (2010) Energy cultures: a framework for understanding energy behaviours. *Energy Policy* **38**, 6120-6129

[99] Darby S (2006a) *The effectiveness of feedback on energy consumption. A review for DEFRA of the literature on metering, billing and direct displays.* Environmental Change Institute, University of Oxford

[100] e.g. AECOM (2011) final report, EDRP trials; VaasaETT (2011), op.cit.

continue to use the IHD, and more likely to realise certain benefits associated with energy saving.[101]

The Early Learning Project consumer survey showed that approaching half (44%) of the smart metered sample respondents took a 'monitoring approach' – that is, they were interested in using their IHD primarily to monitor energy use day to day, and/or to check that appliances were not being left on unnecessarily. Almost all (96%) of respondents with an IHD had plugged it in at some point since the installation visit, and six in ten still had it plugged in and in use when they were interviewed: use had become normalised. The survey results show that smart meter customers whose meter was installed relatively recently were no more likely to have their IHD still plugged in than those who had had an installation around two years ago. Of the smart meter customers who still personally looked at their IHD, almost three quarters reported looking at the display at least once a week, and two-fifths reported looking at it at least once a day. [102]

Evidence from the Early Learning Project suggested that the installation of smart meters had some influence on energy-related knowledge during early roll-out. The survey found smart meter customers were more likely to believe they knew what used the most electricity in their homes than 'legacy'[103] customers. In the in-depth interviews, some smart meter customers were also able to describe additional knowledge they had gained about their energy use via the IHD, although these customers often reported that they had already had 'some idea' of what they had 'learned', prior to the installation.

A majority of smart meter customers surveyed felt in control of the electricity and gas that they use (80% for both). A substantial minority who said they felt in control (28% for electricity, 25% for gas) linked this feeling to their smart meter/IHD. In the in-depth interviews, some customers also reported that the IHD had helped them to feel more in control of their energy usage by making energy more 'visible' to their household, e.g.

> *…before [installation]… I thought that 'this is a heater', but not how much it would cost over a period of time. Now I'm more aware of that sort of thing… I feel more in control*. (Middle-income customer, 35-64, single person household, IHD plugged in.)

The Early Learning Project survey analysis offered some useful pointers to the relative importance of aspects of the consumer experience at and beyond installation but, given the number of influences on final energy use outside of the smart metering experience, it is not surprising that it was limited in its ability to explain relatively complex outcomes such as feeling in control and trying to reduce usage. However, it did show that discussing IHD information with other household members, and depth of engagement with the IHD (that is, using several functions) were linked to claimed attempts to use the information to manage and reduce energy usage. In practice, this variable of 'using the IHD information' related to practices such as using it to work out 'normal' usage, to check that nothing was left switched on unnecessarily when leaving the house or going to sleep, and to estimate future energy bills.

At this point in roll-out, then, we see relatively modest impacts from the introduction of smart meter information to households in terms of raised awareness and understanding. A substantial minority of smart-metered customers are adopting a 'monitoring' approach to their use of the IHDs, using a variety of functions. As will be discussed in Chapter 6, this is likely to be associated with greater energy savings than for customers who simply use their display for real-time information, or who stop consulting it after a while. There is potential for greater impact

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[101] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

[102] This figure is close to that from the 'Smart Communities' project, which found that after two years, around 40% of clip-on display users claimed to use their display every day, in this case with support from weekly emails that prompted use of displays and contributed to a sense of being part of a wider group. (Burchell et al., 2014, op.cit)

[103] That is, those with traditional meters.

from encouraging customers to integrate energy feedback into their general household management – the monitoring approach – through a combination of IHD design, installer training, and Programme design.

*Use and usability of information from the IHD*

Customers of major energy suppliers involved in the Foundation Stage have been using display designs from three manufacturers over the past three years, and these designs are still evolving. They offer a range of functions, including near-real-time demand for electricity, half-hourly gas consumption, historic consumption for both gas and electricity over time periods chosen by the customer, budget-setting and comparisons against budget, 'traffic light' features that indicate low, medium or high usage, and prediction.

While the initial motive was typically to see how much electricity different appliances were using, and/or how much gas was being used at a given time, several interviewees in the qualitative research reported 'playing' with their IHD in order to explore possibilities, and some developed routines using particular aspects of the display. Thus the 'traffic lights' were useful for showing exceptional use and prompting a response; the 'instantaneous use/cost' screens could be used before leaving the house or going to bed, to check that nothing was unnecessarily switched on; and a 'historic consumption' screen could be checked daily to see that usage was within acceptable limits. Some respondents used the IHD as a way of checking or estimating their bills, so that two forms of feedback were being brought together.

Most respondents in the Early Learning Project survey - 71% - agreed that they found their IHD easy to use. Groups which were less likely to find their IHDs easy to use included more vulnerable groups such as older customers, those from lower social grades and those with lower levels of education. As highlighted in Chapter 4, there is a need for additional support for these customers.

Preliminary work for Smart Metering GB notes that 17m adults in GB (~37% of the adult population) have [up to] the numeracy level expected of an 11-year -old, while 16% of adults in England have literacy levels at or below that expected of an 11-year old. This has clear implications for the design and testing of IHDs and related information.

Research and commentary on IHD design note the balance to be struck between immediate appeal, relevance, clarity and ease of use on the one hand, and enough detail to hold the user's interest on the other[104]. A GB installer commented on this issue:

> *I agree with the simpleness but … you should also have the option for the complicated, because the novelty does wear off on these meters relatively fast for most of our customers. But… if you're just bored one day yourself and if you're to pick it up and read through the book and have a mess with it there's something to do with it. If it was too simple, you just look at it, there's nothing to do there…* (Installer, GB focus group)

GB installers also noted that IHD usability was linked to customer age. During the course of the Foundation Stage roll-out by one company, the design of the IHD changed to something more complex and installers commented that:

> *The only problem I found with the phase 3* [display]*… is that, I found that [display] 2 were easier to use if you were say an elderly person.*
>
> *Yeah, bigger buttons, straight to the point.*

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[104] for example, see van Dam, S (2013) *Smart energy management for households. A practical guide for designers, HEMS developers, energy providers, and the building industry*. Delft University of Technology, Faculty of Architecture and The Built Environment,Real Estate and Housing Department. Available online

> *… no problem, whereas phase 3 is very much catered towards the younger generation that have grown up with that … If someone is 92, they ain't got a chance….*

By contrast, they expected young customers to be able to cope with digital technology in general:

> *… I was talking to a teenager today, he said 'It's so simple, even adults can use it*'.

As noted in Chapter 4, prior technical interest was associated with more adept and varied use of the IHD, but the Early Learning Project survey showed that people do not need to be unusually interested in technology to benefit from having an IHD: more were using an IHD than the number who stated an interest in gadgets, and some interviewees '*who reported a general lack of technical ability … said that the IHD 'did not bother them' and they were happy to use it and play with it'*.[105]

The Government require 'ambient feedback based on level of consumption (low, medium or high)[106], and GB installers noted that 'traffic light' features were widely used, especially for quick checks:

> *…keeping it simple is the best thing… you have the traffic lights, and they [householders] walk out the door, and it shows it's in the red, they think what they've got on, so they go around the house…*

The Early Learning Project qualitative research found that the IHD made energy use 'visible' to respondents, particularly for electricity, and especially through the traffic light signals. Some tended to note unusual activity, for example, the IHD being red when nothing appeared to be switched on. This sometimes prompted action, such as 'hunting' for the source of the red signal. Others, however, simply noted changes but did not tend to act on them.

But the installer focus groups showed that even traffic lights can be problematic with some customers consumers if they become complicated, and if they cause undue alarm:

> *Problem with the traffic lights on that* [design] *is … three different modes* [cumulative, instant, predictive]*… I've been to a customer that's turned off all the heating because she was petrified 'cause the traffic light was on red, but … it was going red because* [it predicted that] *she'd go over her budget for that day. But she thought, she was told by the engineer that red meant to be using a lot of energy, so she turned everything off.* (GB installer)

There is also an issue about what is judged to be 'low' or 'high' consumption by the metering system:

> *… the green, amber and red. I'd bring the kilowatt ratings down on them because I don't think 2.1 kW you should still be in green… I think we should just go on kilowatt rating.* (GB installer)

Almost all participants in the Early Learning Project qualitative research agreed that the IHD traffic light signals were simple and intuitive, but the research found that frustration or confusion sometimes set in if the display was often amber or red, and a respondent did not understand why this should be the case. Calibrating the IHD to fit with household consumption could help make sense of the thresholds of green, amber and red, and also, in some circumstances (e.g. a large household) make green an achievable goal, where it had previously been unattainable."[107]

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[105] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

[106] Response to Smart Metering roll-out consultation (2012), section1.23.

Recent qualitative studies carried out by both Ipsos MORI and Creative Research[108] highlight an appetite among some customers for more IHD features, which could sustain longer-term interest.

Respondents with smart prepayment meters were mostly positive about their IHDs primarily because they allowed them to easily monitor their account balance without having to access their (often very inaccessible) meter. Levels of engagement with their IHD varied depending on how confident respondents were in using it as well as their motivation to lower their bills. The least engaged respondents only accessed the default overview screen on the IHD which for this particular supplier displayed their credit balance and the remaining number of days of credit.

In summary, the evidence supports hypothesis b) (i) (above): the usability of IHD design does influence the extent to which householders use information from their smart meters. In general, the IHD designs provided to Foundation Stage customers involved in the research, with their ambient feedback, seem to have enabled a substantial proportion of them to engage with the information provided, in ways that encourage reduced consumption (e.g. by developing a 'monitoring approach', as discussed further below in relation to programme support). Many of the rest, who did not seem to have moved beyond an 'information approach' (using real-time feedback, but little else), are likely to have gained some understanding from that, though more limited benefit.

However, some consumers may be finding the designs inherently hard to use. In particular, the calibration of the IHD 'traffic lights' to individual household consumption patterns needs attention, as it seems likely to improve usability substantially, and also to improve the prospects for longer-term monitoring. IHD design is still evolving, and new features will be a way of sustaining interest.

For prepayment customers, good design will be especially important to enable them to exploit the full potential of the IHD. There is also a specific initial issue to be resolved: whether to have their credit balance and energy consumption information on the first screen of the display, or the simpler solution of splitting the two items between screens, which will make the second screen (energy consumption information) less likely to be accessed?

*Householder knowledge and expertise*

The Early Learning Project found evidence of variation in use of IHD information, with complicated relationships between factors relating to demography, educational levels, prior awareness of smart metering, attitudes, expectations and experience.

For example, customers *not* interested in gadgets were more likely to have unplugged their IHD by the time of the survey than those who were. Those interested in gadgets were more likely to say their IHD was easy to use, as were younger consumers and those who had actively requested a smart meter, while some interviewees who were less technically confident or saw themselves as technophobes had been reluctant to use their IHD for fear of breaking it.[109]

Older householders, those in lower social grades, those with less formal education and those living with someone with long-term ill-health or disability, were less likely to say that they knew how to operate different functions on the IHD. Interestingly, families with children were more likely than average to speak highly of their smart meter, to say that their smart meter had encouraged them to try and reduce their energy demand, and to agree that they would like

[109] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

more information, suggesting a relatively high degree of engagement and also a disposition towards learning and action.[110]

Those in the small minority (4%) who had never plugged in their IHD at all were more likely to be elderly, from lower social grades, without formal qualifications, in single-person households and in households where someone had a long-term health condition. Customers in this last group are more likely to be on the Priority Services Register (PSR), eligible for extra help at installation, but not all will be on the register. Older smart meter customers, those from lower social grades and those with the lowest total annual household incomes (below £16,000)] were more likely to say they do not find the IHD easy to use, that they did not know how to use various functions on the display and that they unplugged their IHD as they did not understand how to use it.

A finding from the Early Learning Project qualitative research is worth noting here: that respondents from the higher income and higher social grade groups seemed more likely than others to use their IHDs in a playful, exploratory way, while those on lower incomes and in lower social grades were more likely to feel anxious about what the IHD showed them, or to feel that it was not useful as they were already being as frugal as possible with their energy use.

There is therefore some evidence to support hypothesis b) (ii): differences in knowledge and expertise at installation do bear some relation to the extent to which they go on to use information from the IHD. However, none of the groups singled out in the survey seemed intrinsically unable to engage with the information, and there would seem to be plenty of potential to increase its usefulness to a wider range of customers through better Programme support.

*Effectiveness of programme support for the use of smart metering information*

a) *installation advice and support*

As described in Chapter 4, the Early Learning Project found satisfaction with information and explanations provided by the installer were important factors, relative to other parts of the customer journey, in helping people to understand how to use the IHD.

Installers taking part in the Foundation Stage of roll-out emphasised the crucial importance of the display as a focus for customer attention and as a teaching aid during the short period of time available during installation:

> *I get a lot of questions about the energy display. Obviously, we go there and try to encourage people to save energy, and a lot of them would ask, how much is it costing to work? How can you help me save money? That's what everyone wants to know and they want an answer within two minutes… Once you have the monitor, you can act on reducing your bills. (Installer, GB focus group)*

The finding about the differences between 'information-driven' and 'monitoring' approaches has important implications for programme support. If supplier explanations and advisory material are focussed primarily on teaching an 'information driven' approach (e.g. demonstrating the IHD by turning on an electric kettle), it is likely that many customers will conclude that this is the primary function of the IHD. Many may not go further and develop a monitoring approach, but will stop using the IHD after a short period. This could have important implications for benefits, if an opportunity to encourage continued learning is thereby lost.

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[110] Appendix to DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

The Early Learning Project prepayment research concluded that *'Although existing Smart PP* [prepayment] *respondents felt in most cases that the installer had provided them with adequate instructions on how to use their IHDs, this had not translated into behaviours whereby they were taking advantage of its full range of functions beyond information on account balance.'* And that *'Customers will need information and support to help them make the transition from legacy to Smart PP' which should 'take account of customers' different preferred learning styles and communication channels.'*

There is therefore evidence that the content, quality and tailoring to the individual consumer of installers' advice and demonstration of the IHD could have an important impact on householders' use of IHD information in a way that encourages reduced energy consumption. Our understanding is that demonstrating the IHD in a way that encourages an 'information' approach is still normal practice. While this is a useful early step on the customer journey, potential benefits are limited if s/he does not move beyond this.

*b) Follow-up advice and support*

Chapter 4 emphasised the importance of follow-up support, particular for older householders and others who may struggle with the IHD. The Early Learning Project also illustrated how people can only absorb so much new information at any one time: the installer's visit can be a significant station on a learning pathway, but is most productive when customers learn something that is linked with prior knowledge, and that can then be developed through experimenting with the IHD, discussing energy-related topics with others, and seeking further advice.

The Early Learning Project survey found that only 30% of customers remembered any of a list of types of follow-up contact from their supplier that were suggested to them, and this was most commonly a quick phone call to check that the smart meter was working. There would seem to be scope for using telephone calls and other forms of follow-up in greater depth to help people understand how to use their IHDs to best advantage.

*c) Informal learning through family and social contacts*

This may arise through interactions with immediate household members as well as neighbours, friends and extended family. The most relevant Foundation Stage data relates to the period after installation, when customers are most likely to be learning how to use smart meter information, and to be making judgements about how useful it is to them. Unless they live on their own, they may be doing this with others. Over a third of respondents in multi-person households with a previously- or currently-used IHD said that more than one member used it. Different household members may use the IHD for different purposes, e.g. checking usage over time, or checking that appliances are not left on when leaving the house. The Early Learning Project qualitative research turned up examples of the IHD being used as a focus for discussion, and to teach household members about their energy consumption.

Wave 3 of the DECC Smart Meter Tracker Surveys found that older people (75+) were more likely to mention friends and relatives as a source of advice than the rest of the respondents: 15% compared with 10%. So were those on the lowest annual incomes (<£15.5k), and those with no internet access. These customers, who typically are among those with most difficulty in using an IHD, thus rely most heavily on informal help from those around them.

The Early Learning Project research noted many instances in which the IHD is used as a talking point and a teaching aid, with some explicit examples in the in-depth interviews of the IHD being used in a targeted way to try to teach others about their energy consumption. These included parents encouraging their teenage daughters to have shorter showers by demonstrating how

the shower made the IHD light go red. However, only a quarter of multi-person households said that they discussed information on the IHD with others 'very often' or 'sometimes' (a factor identified in the survey analysis as linked with attempts to change energy use), and around seven in ten said that they never did.

Overall, older customers, those who had accepted a smart meter on a replacement basis rather than asking for one, those who had only used their IHD for a short time before unplugging it, and those who had not had a clip-on display before acquiring a smart meter, were least likely to have discussed the information on the IHD with others. (For older customers at least, this may be partly explained by the fact that they are more likely to live in single-person households). While the first of these categories is demographic, it is interesting that the other three have more to do with interest/knowledge, curiosity, and length of time during which the customer could build up knowledge and understanding of their usage.

Social learning beyond the immediate household is probably still at a low level, although the Early Learning Project qualitative research (albeit in the context of pre-installation learning) found that informal social learning about smart meters and IHDs, through recipients' social networks, may have had some benefits.[111] There is therefore some early evidence of social learning and diffusion contributing to household use of IHD information in a way that encourages reduced energy consumption.

### 2) What additional support is required to increase customer use of smart meters and IHDs?

This section draws on the foregoing analysis to reach conclusions about what additional steps are necessary to enable householders to use smart meters and in-home displays in a way that encourages reduced energy consumption.

It is clear from the findings described above and in Chapter 4 that the detail of installers' explanations, demonstrations and advice on using the IHD will have a profound impact on the extent to which customers go on to use IHD information in a way that encourages reduced consumption. There is little evidence that specific demographic groups will be unwilling or unable to do this, but there are some significant differences in terms of their detailed needs, and for some types of household, separate follow-up support will be needed to access a reasonable level of benefits. As discussed in Chapter 4, this will need further development if outcomes are to be optimised.

Vulnerable households were identified in the Early Learning Project as requiring more support to help them put smart metering information to use. For example, it may be necessary to spend an extended amount of time face-to-face with the customer to explain the IHD as written information may not be used. Similarly, it is vulnerable groups in particular who may benefit from a follow-up call or home visit to check they understand how to use the IHD and how the information might benefit them. Salient advice could include suggestions on how to reduce energy used when heating, showering or washing clothes, and how to use the IHD to support such changes.

NEA, Consumer Focus (now Citizens Advice) and Age UK have all been prominent in exploring the issues and advocacy, and their work argues for a need for third party support around the time of installation for several groups of vulnerable customers including those with low levels of literacy and numeracy, those in rented accommodation, particularly if this is in the private sector, and older people. Smart Energy GB has recognised the need for particular recognition of

[111] DECC (2015) op.cit.

these groups, noting a relative lack of interest in technology among vulnerable groups.[112] Their Consumer Engagement Plan points to the need to integrate support for vulnerable customers into plans in a structured way, and selects three groups for special attention. These are prepayment customers, renters and those in fuel poverty.

DECC published research exploring access to smart meter benefits for blind and partially sighted householders in 2013, which recommended that the most appropriate approach for this particular group would be to combine a specially-designed IHD that could be used along with other accessible web- or smartphone-based applications: multiple information channels.[113]

There would seem to be a strong case for continuing to offer additional support to vulnerable customers: preparing installers, arranging for translation if necessary, checking that carers or other companions will be available if necessary, and following up the installation visit. It should be noted that all suppliers hold Priority Service Registers, although not all vulnerable customers will be on these registers (and this is therefore not a comprehensive means of dealing with the needs of vulnerable consumers). Under the SMICoP, suppliers have an obligation to ensure that installers undergo training that enables them to understand the definition of vulnerability, identify potential cases, and offer guidance responsive to their needs[114]

Although there is mistrust of the major energy suppliers, they are still an obvious source of information and advice, not least because they have access to some customer information and are responsible for meter installation.[115] This puts them in a strong position to offer support, and results from the EDRP[116] provide evidence that consumers will in practice seek information and advice from them. The EDRP trial findings in general support the setting up of dedicated advice lines for smart metered customers, with staff trained in domestic energy efficiency and tariffs, as well as smart meter-specific issues.

An ability to refer customers to appropriate local sources of help is also important, given the value of in-home advice in many situations. As noted in the section above on policy design, the Government expects Smart Energy GB activities to include energy efficiency advice and guidance via suppliers and third parties. (There is a difference between providing general information on a programme or innovation to the general public – for example, raising awareness of what a smart meter is and what it can do, or publicising arrangements for data privacy – and offering detailed guidance on how to go about reducing energy demand in a particular home occupied by a particular set of people. Both are needed.) We also know that in-

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[112] BS Consulting, NEA and Consumer Focus (2012) *op.cit*; Smart Meter Central Delivery Body (2013) *Engagement plan for smart meter roll-out*.

[113] SQW (2013) Study on access to smart meter benefits for blind and partially sighted consumers. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/175653/access_to_smart_meter_benefits_for_bps_consumers.pdf

[114] SMICoP para. 2.6.8

[115] Just under a third of customers surveyed for Wave 3 of the smart meter tracking cited their energy company as somewhere they would go to for information about smart meters and displays; see also Boardman, B. and Darby, S. (2000) Effective Advice: energy efficiency and the disadvantaged. *Environmental Change Institute, University of Oxford, UK*

[116] The final report on the EDRP trials notes that e.on experienced an average of 30 additional minutes of call centre contact for each customer having a meter exchange. This indicates a substantial need for support from the supplier, even if most of that occurs immediately around the time of installation (as was the case for e.on). Detailed information on the queries to a dedicated customer service helpline at SSE during the trials showed that they covered a wide range of concerns, including requests for quite detailed energy advice.

person energy advice in response to questions raised by the householder is more effective than written advice handed down 'from above'[117].

It seems, then, that the Smart Energy GB engagement plan needs to support 'hands on' contact with householders by third parties such as NGOs, community groups, local authorities and housing associations, rather than attempting direct advice. These organisations are a potential source of learning and training for the programme as a whole, as 'middle actors': Smart Energy GB could act as a facilitator for knowledge exchange between these bodies, as well as keeping them supplied with information on legal, technical, financial and consumer protection issues, and learning from their experience.

Early Learning qualitative research with prepayment customers in GB found that their initial awareness of smart metering was relatively low, but that they recognised two potential benefits from it that are specific to prepayment customers: a reduction in perceived social stigma, and easier recharging arrangements.[118] There was some evidence that switching to smart prepayment reduced self-disconnection and recourse to emergency credit, partly because it was easier to see when credit was running out. Self-disconnection is a problem for an estimated 10-25% of prepayment customers in Great Britain[119].

Respondents with smart prepayment meters were mostly positive about their IHDs, though some were bothered by the red 'traffic light' and several reported difficulties in understanding the information. Some legacy meter customers anticipated that better information on appliance usage via a smart meter would help them in managing their energy use, and there was some evidence of scope for savings through more careful management.

Some respondents identified social landlords as having a role in assisting them with energy management and energy efficiency measures, and in being able to offer face-to-face advice, although there was also scepticism as to how this might come about. The Early Learning Project prepayment research explored support that might be required in the focus groups and comparisons were drawn with digital switchover, with respect to the communication campaign that ran for several months leading up to the switchover and the additional support offered to more vulnerable/less technically able people.'

## Summary and conclusions

Smart metering gives customers a tool to assist in building up their energy-related knowledge and their ability to manage, together with complementary information and advice. This ideally takes place as part of a process involving other actors and information sources, rather than a one-off installation event.

Research evidence has shown the importance of the IHD as the first and most visible element in a smart meter system for the customer, and the desirability of designing something that can be used at different levels of complexity while having very clear, simple basic functions.

An app on a mobile phone or other device should not be seen as equivalent to an IHD in the home that offer constant ambient feedback along with other functions. Newer feedback and/or control offerings such as this will need to be monitored and evaluated over an extended period with different types of customer and in a range of situations before we can draw sound conclusions about effectiveness.

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[117] e.g. New Perspectives and Energy Inform (2004) *Savings from behavioural changes following energy advice: report on a survey.* New Perspectives for the HECA Forum Ipswich

[118] DECC (2015) op.cit

Engagement with the IHD and other energy information is best viewed as a long-term and social process, in which people learn from a variety of sources, from experiment and experience.

IHD designs provided for Foundation Stage customers seem broadly effective, although there is still a need to continue testing designs that encourage users to adopt a range of different functions. Calibrating the ambient (traffic light) feedback to different consumer circumstances was identified as a specific issue.

The IHD is used in three main ways:

1) information on cost and usage of different appliances and activities;

2) monitoring consumption over the longer term and building up a picture of household activity in relation to energy use and budgeting;

3) for prepayment customers, monitoring their account balance.

The second use (monitoring consumption over the longer term) is associated with more enduring use of the IHD and better reported outcomes. An easy-to-use IHD is an important contributor to all aspects of engagement, since it is more likely to be 'played with' and used in a variety of ways. There are also likely to be benefits from combining the IHD with other forms of feedback (such as home energy reports), and synergies between general information, feedback, advice and efficiency programmes.

The installation experience is an important influence on householders' use of IHD information in a way that encourages reduced energy consumption. The content, quality and tailoring of installers' advice and demonstration of the IHD are crucial, and should be designed to promote a 'monitoring' approach. However, there are limits to what can be learned during a single installation visit, even in ideal conditions. There would be benefit from suppliers and third parties using telephone calls and other forms of follow-up to help people in understanding how to use their IHDs.

These conclusions reinforce some of those from Chapter 4 and point to a number of additional policy implications:

- The installation process should be designed to promote a 'monitoring' approach in the use of smart meter information (including amongst prepayment customers who may otherwise only engage with the IHD for payment purposes) as this is more likely to lead to long-term benefits;
- There is a need to ensure that the ambient "traffic light" real-time feedback is suitably calibrated to the consumption range of individual households;
- Follow-up advice should be available to households, following installation of their smart meter, requiring good coordination between Smart Energy GB, suppliers, installers and third-party organisations in the planning, implementation and follow up to installation;
- Chapters 4 and 5 together make the case for carefully planned and targeted support arrangements for vulnerable and prepayment consumers, potentially involving additional face-to-face support during or after the installation visit, including practical advice on steps which individuals might take;
- The need for continuation of the special arrangements for vulnerable consumers on the PSR, and for ensuring that as many other vulnerable consumers as possible are identified.

# Chapter 6 Post-installation changes in energy use

This chapter considers evidence relating to householders making reductions in energy use linked to smart metering, and implications for delivery:

| | |
|---|---|
| ***To what extent do customers make changes in their electricity and gas consumption, in the short and longer term, as a result of having a smart meter?*** | ***To what extent are additional support and information required in order for 'smart' customers to make changes to their energy consumption?*** |

Subsidiary questions address:

- how much change in consumption is it realistic to expect as a direct result of smart metering?
- characteristics of households whose usage decreases or increases following smart metering.

**Structure of chapter**

The chapter starts by setting out the policy design aims and assumptions articulated by DECC and others in programme documentation. Then it sets out our understanding of smart metering and energy saving, both in terms of theories about processes (or mechanisms) which could be operating and energy savings observed in previous studies. From this, it identifies some hypotheses about factors likely to influence the use of smart meter information to reduce consumption during the roll-out, and presents findings from the Early Learning research against these hypotheses and the questions set out above. Lastly it summarises what we now know against these questions and sets out the policy implications.

## Policy aims and assumptions

The 2014 DECC Impact Assessment for domestic and SME smart meter roll-out starts from the premise that a lack of accurate, timely information on energy use may prevent customers from reducing consumption and bills. The IHD is seen as a central element in bringing about savings:

> *…information about energy consumption and cost implications communicated via the IHD can help to manage consumption and awareness of its costs. This can be used to avoid large energy bills...* (p52)

The Impact Assessment notes the uncertainty about levels of response to a full roll-out of smart meters, and the significance of evidence concerning enablers for behaviour change.[120] It

[120] DECC (2014) Smart meter roll-out for the domestic and small and medium non-domestic sectors (GB): impact assessment. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/276656/smart_meter_roll_out_for_the_domestic_and_small_and_medium_and_non_domestic_sectors.pdf pp45-46. , pp44-45.

projects annual average residential energy savings of 2.8% in the central scenario for electricity, and of 2% for gas credit and 0.5% for gas prepayment customers, in comparison to a scenario without smart meter roll-out[121].

The Central Office of Information, in their work to develop a behaviour change framework for the Consumer Engagement Strategy consultation[122] identified a range of typical behaviours which could lead to energy saving, consisting of 14 'routine' and 12 'purchasing' behaviours (examples of each are switching off lights when not in use, and installing insulation).

The Consumer Engagement Strategy[123] recognises synergies with other policies which could be exploited to increase consumer benefits related to energy saving:

> *Increased understanding of energy saving resulting from smart metering could encourage take-up of the Green Deal by encouraging choices which would increase the energy efficiency of the home, such as installing insulation. In relation to low income consumers at the risk of fuel poverty, the CES consultation suggested that suppliers could bring together their activities to meet obligations such as the Affordable Warmth element of the Energy Company Obligation with the smart meter roll-out. They could also use the smart meter installation visit to identify vulnerable consumers and offer them further assistance if necessary… (6.1) …The Government will continue to assess how consumer engagement can exploit synergies between smart metering and other policies in order to maximise consumer demand and levels of energy savings achieved. (6.10).*

The theory of change summarised at the beginning of Chapter 4 was that motivational campaigns influence energy literacy, the salience of energy, and social and household norms; while advice and guidance influence, in particular, energy literacy, knowledge of behaviours, self-efficacy and beliefs about outcomes. In this chapter, we take the theory of change further, moving from transition points 1 and 2, which relate to engagement with the installation process and with information from the smart meter (see Chapter 3) to transition point 3, where the focus is on the potential for changes in energy use. Relevant background material is summarised below.

## Research and theory on energy saving linked to smart metering

Chapter 5 has already set out the evidence and theory about how smart metering "works" in terms of making energy visible and outlined psychological and social processes involved in engaging with smart metering information. This section extends this to consider the processes involved in reducing energy consumption along with evidence about outcomes from different approaches and for different types of consumers.

'Energy saving' is a relative term, used here to refer simply to a net reduction in electricity or fuel consumption, and comes in various forms: as changes in daily actions (e.g. closing windows above switched-on radiators), reduced demand for energy services (e.g. lower thermostat settings), or technical improvements in energy efficiency (e.g. purchasing more efficient appliances). For the purposes of this chapter, a smart meter works for its owner if s/he is using it to assist in achieving short-term savings or a more lasting reduction in energy use. That is, the smart meter contributes to bringing about a change in consumption.

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[121] The IA also considers scenarios with lower and higher savings assumptions. For electricity the low savings scenario reflects 1.5% energy savings, with 1% for gas credit and 0.3% for gas prepayment; the high savings scenario reflects 4% energy savings for electricity and 3% and 1% for gas credit and gas prepayment respectively.

[122] http://webarchive.nationalarchives.gov.uk/20121217152440/http:/decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/4897-consumer-engagement-strategy-con-doc.pdf

[123] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43042/7224-gov-resp-sm-consumer-engagement.pdf

A range of theory and research findings relate to how, and to what extent, customers make changes in their electricity and gas consumption as a result of having a smart meter. These cover:

- mechanisms by which engagement with smart metering information can lead to energy saving;
- observed and measured energy savings;
- customer characteristics and capacity for energy saving in different customer groups.

Taking these in turn:

*a) Mechanisms by which engagement with smart metering information can lead to energy saving*

The theoretical background to interpreting residential energy use shows how institutions, infrastructures, technologies, skills, patterns of daily life, and meanings combine to influence how energy is used in different circumstances. The impact on energy use of a new technology such as smart metering will be influenced by the nature of the hardware and related software, the knowledge and expectations of those who adopt it, the nature of their daily lives, and their 'infrastructures of demand' (including buildings, appliances and controls). Feedback fits into this picture in relation to software, knowledge and control.

The final report on the EDRP trials sets customer response in a framework of *means, motive and opportunity* for behaviour change: the hypothesis was that smart metering encouraged savings if the user was able and willing to make savings, and had the ability and necessary tools with which to do this. The trials showed how the impact of an intervention also depended on the detail of deployment: how smart metering was carried out, and what types of further information, advice, prompts and support are likely to be required if the impact is to be maximised. Further information can be delivered through generic written material (on paper or online, before, during or after smart metering installation), verbal advice as part of the installer visit, during which customers can be encouraged to experiment with their IHD.

Knowledge is held to be significant in the more 'educational' or practice-theoretical approaches to analysis.[124] However, abstract or 'distant' formal knowledge (for example, of the relationship between energy use and carbon emissions) seems to have little impact on energy use:[125] in order to make a difference to consumption, the knowledge needs to be specific and is often 'tacit' and practical.

Qualitative work with IHD users offers plentiful evidence of the social nature of domestic energy consumption, with occupants negotiating decisions and actions among themselves and also with friends, family and acquaintances beyond the home. One of the most thorough qualitative studies has shown how IHD users can be empowered by the new information, reduce consumption, discuss energy issues productively with family and friends, and seek further information and advice. But for a minority, the study concluded that using an IHD could make environmental and financial challenges seem larger and worse, even among early adopters, creating fatalism, a sense of futility, anxiety and even guilt. They were sometimes the focus for household disputes. Hence the conclusion that:

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[124] e.g. Gram-Hanssen K (2010) op.cit.

[125] Banks N (1998) Cultural values and the adoption of energy efficient technologies. Unpublished DPhil thesis, University of Oxford; Darby S (2006b) Social learning and public policy: lessons from an energy-conscious village. *Energy Policy* **34**, 2929-2940; Whitmarsh L (2009) Behavioural responses to climate change: asymmetry of intentions and impacts. Journal of Environmental Psychology 29 (1), 13-23

> *Smart energy monitors* [IHDs] *... are only as good as the household, social and political contexts in which they are used. Ensuring that these contexts are supportive of changes in domestic energy consumption patterns seems vital if smart energy monitors are to realise their potential*.[126]

This conclusion firmly sets smart meters in a social context, a theme that runs through much recent literature on feedback.

Interest in feedback from a display often diminishes over time[127], but this does not necessarily mean that effect also diminishes, although effect is far more likely to persist if the householder continues to take some interest in their feedback. Reviews of longer-term impact from displays and other feedback show that energy savings can persist and even increase over time[128], a finding consistent with a 'social learning' theoretical approach. Another explanation could be that the impact of early behavioural changes may be augmented by energy savings from investment in efficiency measures, as appliances are replaced or home improvements carried out.

We know remarkably little about just where savings and more durable reductions are made through changes in behaviour and routines, though a rough order of priority seems to run from lighting through the more discretionary household appliances to space- and water-heating.[129] However, it seems likely that some lasting reductions in usage are related to decisions to invest in efficiency measures, to replace inefficient appliances by more efficient models, and to forego some purchases because of their energy implications.

The third transition point covered by this chapter is different in kind from the other two, and more open ended. It involves putting new information from the smart meter to work in the home, in order to reduce energy use. At this point, however well a householder understands and interacts with the smart meter, and however well they understand the possibilities open to them, the long-term potential outcomes vary enormously according to their circumstances, and potential short-term gains from behavioural change can also vary substantially.[130]

Here, the engagement between householders and their homes becomes central: tenure, structure, state of repair, occupancy, ability to invest in efficiency measures, and carry out maintenance, heating system, appliance ownership and usage… all these will be reflected in the energy consumption, even before considering day-to-day routines with lighting, heating, hot water and appliances. The average small percentage savings arising from better feedback are perhaps best seen as potential 'forerunner' savings. People rarely make drastic changes in their energy use, unless forced into it, but they do, over time, make adjustments in behaviour and investments in efficiency or (not the same thing) low-carbon technologies. The drop of around 15% in residential gas and electricity consumption in the UK since 2004 illustrates this.[131]

As indicated above, there is plentiful evidence that feedback 'works', when offered via IHDs, written documents such as bills and home energy reports, and (to a lesser extent) other media.

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[126] Hargreaves et al. (2010) op.cit p.6119; see also Hargreaves et al. (2013) op.cit.

[127] e.g. van Dam SS, Bakker CA, van Hal JDM (2010) Home energy monitors: impact over the medium-term. *Building Research and Information* **38** (5), 458-469;Hargreaves et al., (2013), op.cit.

[128] e.g. VaasaETT (2011), op.cit.; Ehrhardt-Martinez et al.(2010) op.cit.; OPower data

[129] Leighty W and Meier A (2011) Accelerated electricity conservation in Juneau, Alaska: a study of household activities that reduced demand 25%. Energy Policy 39 (5), 2299-2309; NEA and Consumer Focus (2012) op.cit.; Buchanan K, Russo R and Anderson B (2014) Feeding back about eco-feedback: how do consumers use and respond to energy monitors? *Energy Policy* **73**, 138-146

[130] E.g. Gram-Hanssen (2010) op.cit: behavioural differences can account for variance by a factor of three or more.

[131] Digest of UK Energy Statistics 2013

Much of the literature deals with short-term effects (up to a year), but longer-term datasets are starting to appear that show persistent impact when comparing customers with and without access to improved feedback.[132] We also have some evidence about how energy literacy can spread in and beyond households through informal networks.[133] These considerations can be included in the theory of change for the Programme as it develops.

*b) Observed and measured energy savings*

There is plenty of evidence (a) that improved feedback is typically associated with durable[134] single-figure-percentage savings on average and (b) that the size of the effect varies according to the type and quality of feedback, and the context in which it is used. Thus feedback in near-real-time is typically more effective in leading to savings in electricity use than more indirect and less frequent feedback through bills and statements; however, the latter is more suited to attempts to manage heating fuel.[135]

Variability in effect size is usually attributed to some combination of:

- the nature of demand infrastructure (housing, appliances, vehicles etc);
- energy users' demographic status (age, income, tenure, gender etc.);
- values, beliefs and aspirations;
- formal and informal knowledge.

Small-scale feedback experiments and trials (with and without smart meters) tend to show more substantial savings than large-scale trials. A review of 100 trials, published in 2011, found that 17 IHD trials with up to 100 participants achieved 11% savings, whereas four with over 500 participants achieved only 5%. It points out that the larger trials mostly offered only one form of feedback to participants, whereas the smaller ones typically offered at least two. Larger trials, of course, are also likely to include a higher proportion of unenthusiastic participants, and to pay less attention to individuals.[136] The ACEEE review of 2010[137] reports similar results: around 6% savings for the trials with more than 100 participants, and 12% for those with fewer than 100.

The Irish smart meter trials, in which a thousand representative participants had smart meters, with or without different forms of feedback and time-of-use tariffs, reported [138] average

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[132] The best-known is the OPower dataset, now stretching over upwards of five years; others are referenced in ACEEE (2010) op.cit., Darby (2010a), op.cit., and VaasaETT (2011), op.cit.

[133] e.g. Hamilton J and Killip G (2009) Demonstration, inspiration ... replication? Assessing the impact and limits of social learning from Eco-Homes Open Days in the UK. Proceedings, ECEEE, paper 4074; Ornetzeder M and Rohracher H (2006) op.cit.; Darby S (2006b) op.cit.

[134] Durability is sometimes disputed, and some studies show a falling-off in interest after a few months, sometimes accompanied by a falling-off in savings. However, the three reviews in the following footnote all report that savings are typically persistent over longer periods, provided that the feedback is maintained. feedback and programme quality affect outcomes. The longest and largest dataset (OPower) shows savings from 'home energy report' feedback persisting over several years: for example, their 2014 impact evaluation from Puget Sound energy shows 'Households … that continued to receive reports through the fifth year generated savings [of 3% for electricity and 1.5% for gas] at or above levels established in the first two years of the program. Households in the suspended group that were in their third year of not receiving reports still generated at least half of the savings of the current treatment group.' (p2)

[135] See ACEEE (2010), Darby (2010a) and VaasaETT (2011), all previously cited.

[136] VaasaETT (2011), op.cit.

[137] ACEEE (2010), op.cit.

[138] CER (2011) Electricity and gas smart metering customer behaviour trials (CBT) findings reports.

electricity savings of 2.5% relative to a control group, at the end of a year of TOU tariffs and improved feedback, with the figure rising to 3.7% when customers had a bimonthly bill and an IHD. Comparable figures for peak-time savings were 8.8% and 11.3%. For gas, savings at the end of a year were 3% from smart metering (and the associated more accurate bills), rising to 3.6% for those with bimonthly bills, an IHD and a seasonal tariff. Three quarters of participants were still using their displays at the end of the year, and two-thirds said that it was helping them.

The comparable headline figures from the more complicated EDRP trials in Great Britain showed that a combination of smart meters and displays gave persistent energy savings of around 3% against controls, for both gas and electricity. The EDRP trials showed that a combination of 'generic advice' (normally in leaflet form) and consumption feedback did not always show an effect but, when there was one, savings of up to 5% were achieved. This is in line with expectations from previous research.

The recently-completed Dutch trials found electricity savings of <1% from smart metering plus a bimonthly energy statement (though many customers did not realize the statement was there for them), and 3-4% if this was supplemented by an IHD.

From these three large national trials of new technology and procedures, it seems reasonable to conclude that durable average savings of around 3% are achievable for both electricity and gas through improved feedback including IHDs. Given the growing evidence to support a theory of change that allows for learning effects over time as people use feedback, this may well be a conservative estimate. However, early findings from the Energy Consumption Analysis of smart-metered customers (see below) suggest that it is realistic for the time being.

These average figures mask considerable variations between households, given the huge number of variables influencing energy consumption.

*c) Customer characteristics and the capacity for energy saving in different customer groups*

Chapter 5 has examined how householder knowledge and expertise is a driver of the extent to which they go on to use smart metering information. Here we consider a range of characteristics that evidence and theory suggest will affect energy saving capacity.

The question of capacity for energy saving relates to:

- core energy service requirements, and the ability of a household to make savings without jeopardising health or welfare;
- the state of their housing and the extent to which they can make changes in the building, heating systems or appliances;
- income, and ability to invest in energy efficiency measures; and
- ability to access, absorb and use new knowledge, where education level, age/experience, and social connectedness are likely to be relevant.

As was demonstrated in a small-scale Northern Ireland smart meter trial,[139] there are low income consumers who have little if any opportunity to make savings, with baseline consumption so far below the average for their demographic that it borders on risk. For the sake of their health, these should be using more energy and/or living in better-insulated homes.

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[139] Liddell C (2012) Smart Meters, Smart People. University of Ulster. http://eprints.ulster.ac.uk/25443/1/SMARTerMetersExReportWEB-7Jan13.pdf

A major consideration for many prepayment and low-income customers is the capacity to make any substantial savings through home improvement, expressed by one prepayment interviewee as

> *You see these people on TV who do certain bits to their home but they are splashing out loads of money to do things to the home to try and reduce the amount they use. I know it works in the long run but it's the upfront [cost], having the time to do it and having the expertise to do it which we haven't got.*[140]

At the other end of the scale, high energy consumers may find the feedback from smart meters persuasive, but only insofar as learning about the cost of using certain appliances (e.g. tumble driers and dishwashers) makes using them seem even more attractive.

The Early Learning Project prepayment research found that some struggled to understand how to interpret the 'energy consumption gauge' and '£/h'. This might result in householders thinking they need to cut back on energy use when they do not need to/should not do so, or not recognising that there is the potential for them to reduce their energy consumption whilst maintaining comfort and warmth and thereby save money, where this exists.

35% of the GB population are now estimated to rent their homes, and 60% of those aged 25-34.[141] This limits their options for change, and given that they move house relatively often – particularly those in the private rented sector – it would seem likely to have more limited local knowledge (for example, about how to access services) and social networks.

Technical knowledge could be said to influence willingness to engage with the IHD (as shown in the Early Learning research) and it is likely that people with a good working knowledge of their home, and especially those with DIY experience, are more able and more likely to make efficiency improvements than those without this sort of knowledge.[142]

The research literature throws up varying evidence on the capacity of different households to achieve savings following advice and/or improved feedback. Energy advice programmes, especially those that are client-led and involve personal contact between adviser and householder, can lead to significant savings in low-income households[143], and an evaluation of GB advice programmes in 2004 concluded that those on lower incomes tended to save more than those on higher.[144] The Netherlands smart meter trials, too, found indications of greater savings for less affluent groups.

A report for the European Consumers' Bureau, based on the findings from six large-scale European trials, concludes that, from the point of view of energy-saving potential, the two groups with enough consumption and capability, and enough motivation, to be worth supplying with smart meters are those who are high-consuming, motivated and capable, and those with average consumption who are also motivated and capable; therefore, according to this report, smart meters should be deployed on a voluntary basis or by targeting 'extravagant' customers, which could have the indirect effect of introducing a social norm (that smart meters are desirable).[145]

A modified version of this approach was advocated following a field trial of electric smart meters in Linz, where smart metering produced 4.5% savings on average, and was found to be most

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[140] DECC (2015) Smart Metering Early Learning Project: Prepayment Qualitative Research

[141] ibid.

[142] Aune M (2007) Energy comes home. *Energy Policy* **35**, 5457-5465; Darby S (2006b) op.cit.

[143] Darby S (2003) *op.cit*

[144] New Perspectives and Energy Inform (2004) Savings from behavioural changes following energy advice: report on a survey

[145] Klopfert and Wallenborn 2012, op.cit.

effective for the 30th-70th percentiles in terms of prior consumption. Above and below this, feedback appeared to have no effect. The authors contrast this finding with the German energy law which stipulates that smart meters should only be mandatory for households using more than 6MWh per year of electricity – that is, considerably more than the average of approximately 3.5MWh per year[146,147].

The Irish gas smart meter customer behaviour trial findings, published in 2011, conclude that 'participants with the highest and lowest education and social grade are least likely to reduce usage. This may reflect motivation (among those with AB social grade) and communication (among those with lower social grades C2 and DE). While efforts were made in the communications strategy to be inclusive, the [trial] results may reflect more fundamental barriers to engagement among those with lower levels of educational achievement.'[148]

It seems, then, that there is potential for households in all income groups to make some energy and/or cost savings arising from smart metering, although that potential will vary according to circumstance. Vulnerable customers are likely to need greater support and guidance than others.[149] For those at the bottom of the income scale and in the deepest fuel poverty, whose main problems relate to housing quality and income, it is unrealistic to expect smart metering alone to make a substantial difference to consumption, even if it is able to offer noticeable benefits.[150]

## Findings from the Early Learning Project

This section builds on the theory and research reviewed above and analyses the data collected in the Early Learning research to answer the high level questions posed at the start of the chapter:

1) **To what extent do customers make changes in their electricity and gas consumption, in the short and longer term, as a result of having a smart meter?**

Hypotheses from theory and previous research are that:

In terms of mechanisms:

- improved feedback will have a motivational effect through the 'prompting' of the IHD and the enhanced information on the bill, and will have short- to medium-term impact on usage, prompting people to switch off their appliances and alter their heating patterns;
- improved feedback will have an educational or sense-making effect, as customers adopt an IHD into their daily lives, experiment with their usage to see the effect on consumption and demand, discuss it with others, and use information from the display and bills with

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[146] Schleich, J., Klobasa, M., Gölz, S. and Brunner, M. (2013): Effects of feedback on residential electricity demand - Findings from a field trial in Austria Energy Policy. *Energy Policy* 61, 1097–1106

[147] http://www.frontier-economics.com/documents/2011/05/frontier-report-economic-potential-of-smart-electricity-meters-in-germany.pdf

[148] http://www.cer.ie/docs/000340/cer11180(ai).pdf (p64)

[149] As shown during the introduction of keypad meters to low-income customers in Northern Ireland, where savings were of the order of 10% when the customers were also offered in-home advice.

[150] Boardman, B. (2012) Fuel poverty synthesis: Lessons learnt, actions needed. *Energy Policy*, 49: 143-148

related information from other sources such as mass media, friends, their supplier and NGOs;

In terms of outcomes for different groups:

- as longer-term reduction in usage relies in part on investing in efficiency measures, tenants and low-income customers will be more restricted in the options open to them to than homeowners and higher-income customers, and will make smaller savings in the longer term, other things being equal;
- single occupants and socially isolated customers will tend to learn less and do less as a result of adopting a smart meter than those who live with others and are more socially connected outside the home;
- change will not always be in the direction of reduced demand. Some people may be confirmed in their view that their usage is non-negotiable, once they are more familiar with it, while some need to burn *more* fuel in order to keep healthy, given the state of their housing.

Evidence relevant to these hypotheses is presented below.

The Energy Consumption Analysis project[151] undertaken by DECC analysed consumption for customers that had smart-type meters installed in 2011 and for a matched control group. Using a difference-in-difference analysis, the results showed that for electricity, smart-type meters enabled an average annual reduction compared to traditional meters of 2.3% with 95% confidence intervals between 1.6% and 2.8%, and for gas, an average annual reduction compared to traditional meters of 1.5% with 95% confidence intervals of 0.9% and 2.1%. These findings are statistically significant and provide evidence that smart-type meters installed during 2011 enabled energy saving benefits to be realised during this early stage in the Programme's development.

As the Early Learning Project survey respondents were drawn from a similar population to that of the Energy Consumption Analysis, we can examine the processes at work leading to energy saving via the survey results, although it was not possible to link the two datasets directly due to the low level of overlap in samples.

It is worth noting that an attitudinal comparison of Foundation stage smart meter customers with the national population suggests that the smart meter customers surveyed during the early roll-out were somewhat less likely than GB citizens in general to feel they were struggling with their energy bills. They were as likely as members of the GB population to agree that "It's not worth me doing things to help the environment if others don't do the same", or to be on the lookout for new home improvement ideas, but less likely to agree that "I'm the type of person who likes to have the newest gadgets in my home.".[152] They cannot therefore be characterised as 'early adopters', or as having particularly strong motivation to reduce consumption for financial or environmental reasons.

However, the smart metered sample in the Early Learning Consumer Survey did differ from the population at large in being more likely to be connected to mains gas, to pay for their gas and electricity by direct debit, to live in two-person households and to have lived in their homes for over 10 years. They were less likely to be in receipt of benefits, or to live in flats or maisonettes.[153]

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[151] DECC (2015) Smart Metering Early Learning Project: Energy Consumption Analysis report.

[152] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research, Appendix 4.

[153] ibid.

The Early Learning Project survey found that the smart metered customers were *more likely* than equivalent matched legacy-metered households to:

- have tried to reduce energy usage;
- recently installed loft insulation;
- purchase energy efficient appliances;
- feel they knew what used the most electricity in their home.

However there were *no differences* between smart and legacy meter customers in relation to:

- perceptions of how their energy use had changed over time;
- frequency of reported energy efficiency behaviours.[154]

There was mixed evidence on the extent to which the smart meter and IHD enabled a sense of control over energy usage. Smart metered customers were more likely to say they felt in control of gas use, but there was no difference in relation to electricity.

The matched comparison analysis reveals a lack of any general shift in routine energy behaviours, but masks positive impacts for some individuals. In the Early Learning Project qualitative research, some respondents reported changes they had made which were specifically linked to the smart meter, including ceasing to use inefficient or 'expensive' appliances, and increasing their consistency in energy saving actions, such as turning off lights and plug sockets.

The Early Learning Project survey offered evidence of smart metered customers who claimed that they had not made changes in their energy use because, as far as they were concerned, they had reached an acceptable level and further change would compromise their comfort. It also cites customers who had made changes that they did not attribute to the smart meter. The Early Learning Project qualitative research provided examples of how IHDs are used to encourage more thoughtful energy use in the household. This strand of research evidence tends to support the 'learning' model of feedback effectiveness. [155]

The Early Learning Project survey shows how smart metering can be linked to perceived energy saving activity through two types of interaction: between customers and installers, and between customers and their IHDs. For example, satisfaction with the practical aspects of installation, satisfaction with information received at installation and ability to use the IHD for a variety of functions – were linked to some of the beneficial outcomes of smart meter roll-out. However, they were more limited in their ability to explain relatively complex outcomes such as 'feeling in control', 'trying to reduce household energy usage', and 'choosing to buy more energy-efficient products'.

The Early Learning Project found that the use of diverse IHD functions appeared as a significant factor in continued IHD use and achieving positive energy outcomes including behaviour change. Encouragingly, the survey found that the length of time since installation was related to overall satisfaction with the smart meter and to reported behavioural change. Customers who had their smart meter installed more than two years before the survey were more likely to report changes in their engagement with energy information, changes in behaviour, and that their gas and electricity usage had decreased since installation than those who had their smart meter installed more recently (e.g. 26% who had a smart meter installed more than two years ago

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[154]Behaviours asked about in the survey were controlling the temperature of different rooms in the house, turning the heating off when going out for a few hours, switching off lights in unused rooms, washing clothes at low temperatures and ensuring one only boiled the kettle with the necessary amount of water.

[155] This model has recently been explicitly supported by qualitative empirical evidence from householders who purchased energy monitors online and then sent in reviews of their purchases. Buchanan et al. (2014), op.cit.

reported a decrease in energy usage, compared to 17% of those who had a smart meter installed less than 12 months ago).[156]

As described earlier, the prepayment research showed that levels of engagement with their IHD varied depending on how confident they were in using it as well as their motivation to lower their bills and many were not engaging in information on the IHD beyond that on account balance.

Each of these findings supports the hypothesis that IHDs can be used as part of a long-term process of learning and sense-making. The finding about differences between customers who had been using smart meters for varying lengths of time, in particular, strongly suggests that they are somewhat more likely to be moving along a learning curve than taking part passively in a 'fit and forget' exercise.

Fewer than a quarter of IHD users from the Early Learning Project survey had used their IHD to forecast what their next bill might be, and just over a third had used it to assess their baseline energy usage. Clearly, if being able to obtain information from the IHD on a variety of aspects of energy use is pivotal to achieving positive outcomes, there remains a great deal of scope for enhancing this. The qualitative work indicated that some people had never touched some of the buttons, especially those which were small or hidden.

2) **To what extent are additional support and information required in order for 'smart' customers to make changes to their energy consumption?**

Evidence from the Early Learning Project in relation to energy-related behaviour is limited at this stage in the roll-out, although, coupled with broader evidence on the impacts of feedback in other studies, it suggests that more could be done to support consumers to achieve energy saving.

Steps have been identified in previous chapters on the importance of engaging consumers effectively prior to and at the installation, and to encourage on-going use of the IHD, particularly through a "monitoring" approach, and to promote synergies with energy efficiency programmes. These points are relevant but not repeated in this section which deals with further support requirements for different groups.

The Early Learning Project research with prepayment customers (who tended to be on low incomes, tenants and with aspects of vulnerability) concluded that these households would need to be supported to develop effective behavioural strategies in order to be able to act on smart meter information. Without such strategies they might not bother trying to reduce their consumption, or quickly give up in frustration: '[C]ustomer support should not just focus on helping people to use their IHD effectively, but also provide them with a range of behaviours to help them better manage their energy consumption.' There is an apparent tension between the benefit of delivering this support as part of the installation process, when consumers are most likely to start using the IHD and experimenting, and the need to avoid overloading consumers with information. Follow-up is advocated in the ELP survey report in various forms; the authors highlight the potential to give further advice on energy saving, including personalised advice based on energy data gathered so far.

A specific vulnerable customer journey, which includes follow up, would seem to be worth pursuing; other approaches might involve trusted parties like community leaders (as in Northern Ireland at the time of keypad meter introduction), and housing associations.[157]

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[156] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

[157] Housing Association involvement is strongly advocated by the National Right to Fuel Campaign (2011) http://www.right2fueluk.com/downloads/NRFCsmartmeterreport.pdf ; social landlords are seen as having a role in

Fuel poor customers are of particular concern, whether they are using large amounts of energy to heat inefficient housing (often single parents with children), or suffering from cold and social exclusion because they cannot afford to pay for more heating.[158] Self-disconnections happen frequently among a small but concerning minority of vulnerable customers on prepayment meters[159]; the issues have been recently analysed in New Zealand, and many findings are applicable to the UK.[160] Self-disconnection patterns (particularly when these are frequent, usually take place at the same time of day, and occur more often in colder weather) are signals of energy being unaffordable, and therefore of vulnerability.

Spending more on energy – provided it is a matter of control and choice – should not inevitably be regarded as a negative outcome. In the Northern Ireland smart meter trial with low-income customers, some were content to spend more because they were using energy more efficiently and saw the increased expenditure to be value for money.

Smart meters could provide a useful additional means of identifying vulnerable customers and, in particular, patterns of heating use and bill payments suggestive of fuel poverty. Smart meter data can also help with identifying solutions. But this does require customers to agree to pass on their daily or half-hourly data under current data access rules, and the institutional support to offer effective advice and to follow it up. Reducing the invisibility of the most vulnerable may need to be more prominent in the programme's benefits case and justification, as a potential public service benefit over and above energy savings, demand response, and ability to switch between tariffs and suppliers. Identifying and protecting vulnerable customers could, in the broader framework of consumer engagement, contribute significantly to acceptance of this technology.

## Summary and conclusions

The hypothesis that improved feedback will have both immediate (motivational) and longer-term (learning) effects on energy use is supported by a large number of studies. On average, the effect is typically of the order of a few per cent compared with households without the feedback. Variability is high and energy outcomes are hard to account for, given the large number of variables influencing residential energy use.

The Early Learning Project supports wider evidence about how customers use IHDs as part of a process of learning and sense-making. However, it also provides evidence that this is sometimes only of short duration, when they do some initial experimentation to find out about the consumption of different appliances (the 'information' approach) and then cease to find their display useful, or unplug it in order to make way for another appliance.[161] As noted in the previous chapter, though, a substantial minority of Foundation Stage customers developed a 'monitoring' habit over time, as well as discussing usage with others.

The mixed research evidence on the potential for savings among different customer groups reflects the complexity of the variables, among many trials conducted with different materials and different populations in different energy systems. There is some support for the proposition

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engagement, preferably face to face, in the qualitative study of prepayment customers by Creative Research (2014).

[158] Liddell (2012), op.cit.

[159] ibid.

[160] O'Sullivan K, Howden-Chapman P, Fougere GM, Hales S and Stanley J (20130) Empowered? Examining self-disconnection in a postal survey of electricity prepayment meter consumers in New Zealand. *Energy Policy* **52**, 277-287

[161] DECC (2015) Smart Metering Early Learning Project: Consumer survey and qualitative research

that savings are most likely in the middle of the income/consumption spectrum, but no-one is necessarily excluded except those who are most frugal with fuel and electricity. The highest consumers have the greatest scope for savings, though they may not have the greatest motivation. Fuel poor households may have scope also, particularly if they can access the resources to improve their housing.

Tenants and low-income customers are more restricted in the options open to them than homeowners and higher-income customers. Additionally, tenants move house more often on average than homeowners, and would seem likely to have more limited local knowledge and social networks. Low literacy and numeracy levels among some customers increase the imperative to design IHDs and support materials using clear formats and plain language.

These conclusions point to some implications for policy and implementation:

- Chapter 5 concluded that follow-up advice provided after installation is important. This chapter has made the case that energy efficiency advice should link to other energy efficiency programmes.
- Building on this, the evidence points to a need to support the development of effective behavioural strategies, and the development of advice on options open to tenants to reduce their energy bills, especially those in the private rented sector.
- Suppliers, with support from Smart Energy GB, should consider developing further the idea of a specific vulnerable customer journey. Approaches might involve trusted parties like community leaders (as in Northern Ireland at the time of keypad meter introduction), and housing associations.[162]
- Smart Energy GB has already identified the need to consider support for specific groups, including prepayment customers, tenants, and those in fuel poverty. Thought must be given to identifying the right potential partners for delivering this support.
- In order to assist fuel poor and financially vulnerable consumers, there is a case to explore how smart metering data could be used with their consent to identify consumers who could benefit from additional support.

[162] Housing Association involvement is strongly advocated by the National Right to Fuel Campaign (2011) http://www.right2fueluk.com/downloads/NRFCsmartmeterreport.pdf ; social landlords are seen as having a role in engagement, preferably face to face, in the qualitative study of prepayment customers by Creative Research (2014).

# Chapter 7: Conclusions

This chapter does not repeat in detail the conclusions of the three preceding ones, but draws general conclusions from the project.

## Priorities for effective engagement

This project confirms policy assumptions that customer engagement before and during installation is vital to encourage take-up and use of smart meters, and indicates that post-installation engagement can add value.

Installation, broadly understood, is a process of introducing equipment, informing and demonstrating how to use it, answering questions and providing relevant information material. If well-handled, the installation process has the potential to be a key moment in a customer journey towards better understanding of energy use.

The project offers indications of what a good installation process looks like. It requires co-ordinated advance information at national, local and household levels; well-organised logistics and appointment systems; sufficient time allocations for installers; and well-designed training and materials. Installation needs to take account of the circumstances, predispositions and knowledge of different households.

Installation is not an isolated episode, and customers continue to learn to use their smart meters well afterwards. The Early Learning Project evidence suggests that learning will be enhanced by a good installation experience and may be set back by an unsatisfactory one.

Evidence from the Early Learning Project indicates different trajectories of IHD use. A substantial minority of customers integrated their IHD into daily life, using it regularly as part of their household management – a ‘monitoring’ approach. These customers were more likely to be experiencing certain benefits associated with energy saving than those who took an interest in the IHD for a short time, typically to find out the power demand of different electrical appliances in real time, and then tended to lose interest – this was referred to as an ‘information’ approach. This suggests that there will be advantages in following up of smart meter installation, to encourage customers to move from ‘information’ to ‘monitoring’, something that can enable them to realise more benefits.

If these factors are addressed then it becomes more likely that the expected overall savings from the roll-out will be realised. There will however be considerable variability between households, given the many physical and social factors influencing residential energy demand. To take only one example, tenants typically face a very different range of options for reducing their energy use from homeowners. This could be a significant area for further study.

## Implications for suppliers

The supplier-led nature of the roll-out creates both opportunities and challenges in terms of realising consumer benefits. Relations between energy suppliers and their customers will be thrown into sharp relief by the roll-out, which offers suppliers opportunities to build trust, shift perceptions and increase engagement with their customers. The opportunities for positive

outcomes for suppliers from well-conducted installations, such as greater customer loyalty and uptake of smart meter-based services, could also have public policy benefits.

The project findings indicate advantages from suppliers taking on a number of considerations alongside the requirements of the Smart Metering Installation Code of Practice:

- developing differentiated strategies for customers with different motivations, knowledge, and economic, demographic and tenure characteristics (with particular attention paid to the vulnerable);
- considering early approaches to those who are disposed to be 'early adopters' and who may encourage others;
- the need for careful 'customer intelligence' ahead of installation, if a differentiated strategy is to be applied;
- considering how best to engage third parties in the roll-out, which may require local co-ordination in some areas;
- providing additional support for marginalised groups including the vulnerable and fuel poor;
- providing suitable design and additional support for prepayment customers;
- creating ways of working with third parties such as energy consultants and ESCos, the voluntary sector (including advocacy and representative groups), Citizens Advice, tenants and neighbourhood groups.

The need for differentiation faces installers with challenges. It would be possible on the basis of this project to specify skills that all installers should have in order to respond effectively to different consumer profiles. On the other hand, it may be more effective for there to be specialisation across installation teams and advisors – for example, some dealing only with 'easier to engage' consumers and others trained for more complex briefing, installation, demonstration and follow-up.

### Looking to the future

A second general conclusion relates to the longer term. Smart metering can be seen as a point of entry to a more feedback-rich environment (for which there is evidence of an appetite) that will enable consumers, prosumers[163] and suppliers to improve energy management radically, with the development of smarter grids, TOU tariffs and energy service offerings. Learning about the uses of smart meters and IHDs can be a 'point-of-entry' for many households into understanding and choosing options. The justification for investing in the installation process is therefore not limited to immediate or short-term benefits. The socio-technical perspective on energy use outlined in the report emphasises the interdependence of knowledge and skills, energy markets and supplier pricing policies, household preferences, and the design of homes, appliances and software. Smart metering is one element in this mix of variables; for it to be fully effective, attention needs to be paid to the others as well.

Future smart grid developments could add a significant new dimension to domestic energy management. Over time it is reasonable to expect market-based innovations and partnerships to develop, involving architects, designers, appliance manufacturers, service providers and others. This strongly suggests that the purpose and function of 'consumer engagement' will evolve, and will need to be kept under review.

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[163] That is, households that provide some of their energy needs through solar PV, solar water heating etc.

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