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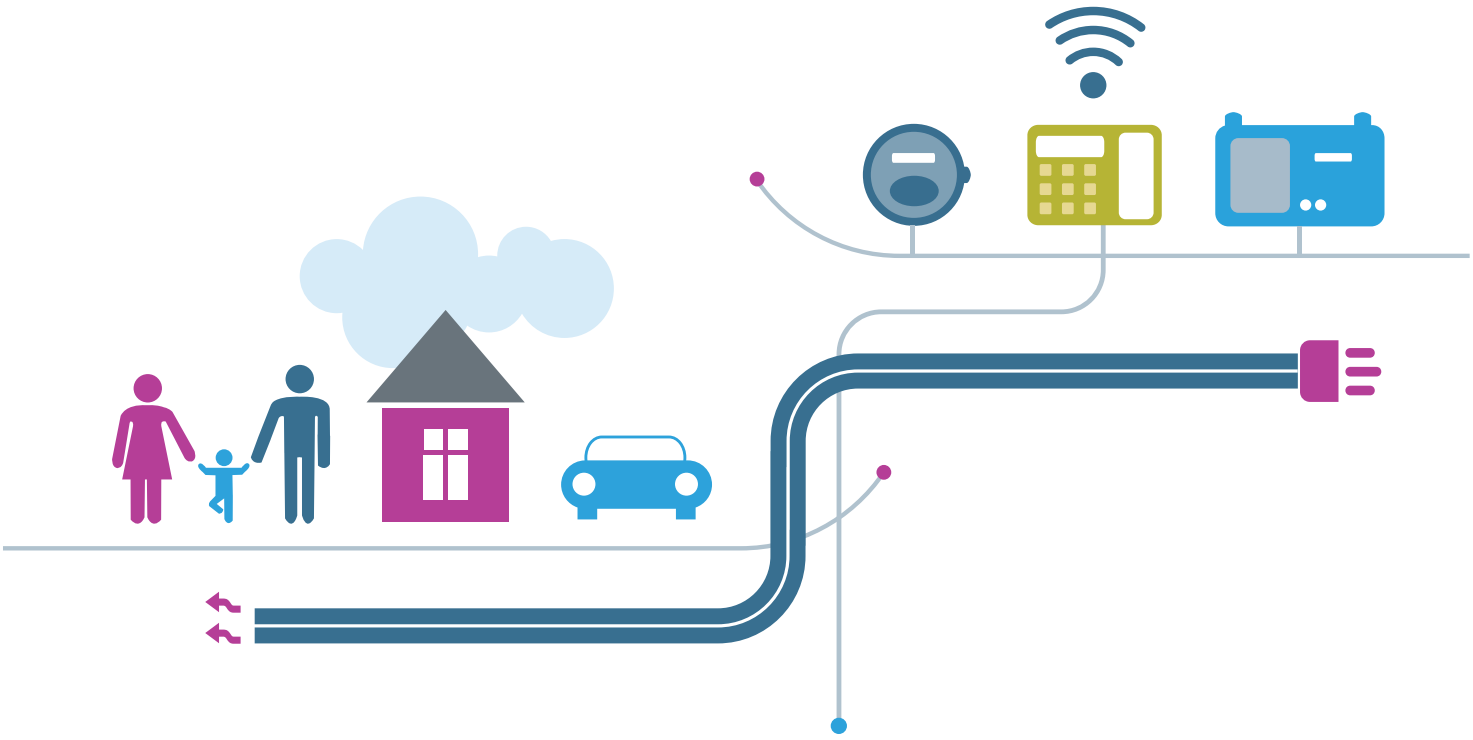
SMART METERING IN HOME DISPLAYS

WHAT ARE THEY?
WHAT BENEFITS WILL THEY DELIVER?



A BEAMA briefing paper

EXECUTIVE SUMMARY

This paper provides an update on In Home Displays (IHDs), the value they offer and how they have improved as a result of technological advances and consumer feedback since the initial research was conducted that led to IHDs being mandated as part of the GB smart metering programme.

The advent of Consumer Access Devices (CADs) is rightly creating a lot of interest, and in some quarters has prompted questions about whether IHDs remain as relevant to British consumers as they were when they were mandated. This paper addresses the most common questions being asked about IHDs and provides some evidence to support an objective discussion about the best way to maximise the consumer benefits of smart metering.

Evidence from multiple sources demonstrates the consumer benefits of IHDs and shows that consumers respond positively to them. In particular, the first key research finding from DECC's Early Learning Project and Small-scale Behaviour Trials, published in March 2015, shows "a positive early consumer response to IHDs and smart metering".

BEAMA's own report *"Assessing the Use and Value of Energy Monitors in Great Britain"*, published on 3 April 2014 concluded:

> Based on average results of trials in Great Britain and Europe, electricity savings from In Home Displays (IHDs) are over 9% per year for at least three years, representing a typical saving of at least £147 to a household in Great Britain. Savings on electricity alone will pay for the cost of the IHD in less than four months.
>
> Gas is difficult to measure without a smart meter and is barely represented in the trials, but if the savings for electricity are extrapolated to gas, it represents a saving of £186 over three years. The average combined saving for a customer with electricity and gas is therefore estimated at £318 after the price of the IHD is deducted.

Overall this equates to £6bn of consumer benefits delivered for a fraction of the overall cost of the smart metering programme: £400m as part of a £11bn programme.

IHDs continue to represent the highest proven and enduring returns for any consumer engagement element, and they underpin the bulk of the benefits in the Smart Metering Programme's impact assessment.

INTRODUCTION AND SCOPE

The UK Government has taken a different approach to introducing smart metering to most other countries in the world: it has put consumers at the heart of the programme. This means that consumer benefits are central to the rationale for smart metering, and that the programme is designed primarily to deliver benefits to consumers. Considerable efforts are being made not to repeat the mistakes of other smart meter rollouts such as in California and Victoria, Australia. In these programmes the costs were passed directly to consumers with few obvious benefits, which led to a significant consumer backlash.

To address this, the UK has decided to implement a retailer-led rollout (as the energy retailers hold a direct relationship with consumers) and has established Smart Energy GB to ensure consumers understand how to get their benefits. Crucially, the Government has also mandated that every consumer be offered an In Home Display (IHD) that provides immediate and direct information on their current and historical energy consumption.

In addition, provision is being made to enable consumers to access their raw meter data via a "Consumer Access Device" (CAD). The data is stored in the smart meters in the consumer's premises and the consumer remains in control of that data, but users may choose to make this data available to third-party service providers if they wish, further enhancing the benefits they can derive from their smart meter. Similarly, the consumer can permit third parties access to historic data through the Data Communication Company (the DCC, which will manage the communications infrastructure, called the Wide Area Network or WAN, that gives third parties access to consumption data). The DCC itself does not have access to the data and does not store it in any form. Third parties wishing to access data through the DCC need to demonstrate compliance with strict privacy and security requirements.

BEAMA has recently released a paper that explains what a CAD is and outlines a number of possible use cases[1]. This paper is a companion document and seeks to provide similar information about IHDs. However, whereas CADs are a new type of product as yet untested in the market, IHDs have been available for a number of years and numerous trials have been conducted using them. Therefore the purpose of this paper is to provide an up-to-date briefing document in the light of recent product development and trial results.

THIRD PARTIES WISHING TO ACCESS DATA THROUGH THE DCC NEED TO DEMONSTRATE COMPLIANCE WITH STRICT PRIVACY AND SECURITY REQUIREMENTS.

[1] Consumer Access Devices: Applications for data in the consumer home area network (C HAN) and wider market considerations. BEAMA, October 2014

WHAT IS AN IN HOME DISPLAY?

At its simplest an IHD is a unit that provides consumers with real time information from their electricity and gas meters. Whilst some of this data is available on the meters themselves, a fuller set of data is transmitted wirelessly using a Home Area Network (HAN) to a display that can be placed in a suitable location in the home. Furthermore, good IHDs seek to present this data in a more understandable format, often using graphics and alerts rather than sometimes unintelligible numbers. The mandate has driven a considerable amount of innovation around IHDs which continue to develop at a rapid pace in line with other consumer devices.

The sort of information an IHD can provide is illustrated below. Here the level of electricity being used is shown in a speedometer format so, as in a car, users can see at a glance if they are "speeding", i.e. using a lot of electricity. Similarly, the size of the gas flame shows the amount of gas they have been using. They are therefore able to judge if this is as they would expect or, for example, if the heating on when they don't need it, or they have left an electrical appliance running.

This "at a glance information" is one of the most important elements of an IHD: it gives users the opportunity to adjust their level of consumption now, thus avoiding unnecessary usage and saving money. Historical information has its value, but the energy has already been used and therefore cannot be saved. It is this immediacy of information that is one of the IHD's best features.

EXAMPLE 1: PICTORIAL REPRESENTATION OF CURRENT ENERGY USE "AT A GLANCE".

THIS "AT A GLANCE INFORMATION" IS ONE OF THE MOST IMPORTANT ELEMENTS OF AN IHD

[2] A CAD fitted with Ethernet will be around 2/3 the cost of an IHD; one fitted with WiFi will be about the same cost as an IHD

WHAT IS AN IN HOME DISPLAY?

Allied to this is its presence: perhaps in passing the IHD a user sees the speedometer is in the red and wonders what is on that shouldn't be. As with a clock on the wall you can never be quite certain when it is needed: "oh, is that the time..." Thus a second value of an IHD is its omnipresence: it pushes information out and doesn't wait to be interrogated.

A third value is that it is available to any member of a household – it is not private. This can be particularly pertinent in a family with children: pester-power can be quite effective!

Smart metering is expected to bring about a number of changes in how energy is purchased. One change is that, as with mobile phones, pre-payment is expected to increase in popularity. Recent research findings by Smart Energy GB show that 48% of people in Great Britain are interested in using smart pay-as-you-go services to pay for their energy. Smart pay-as-you-go will be assisted by immediate feedback from an IHD. In the following example the red apples denote a day's worth of credit whilst each leaf approximates to an hour's worth of credit. As credit expires so the tree loses its fruit and then its leaves, giving very visual feedback to users.

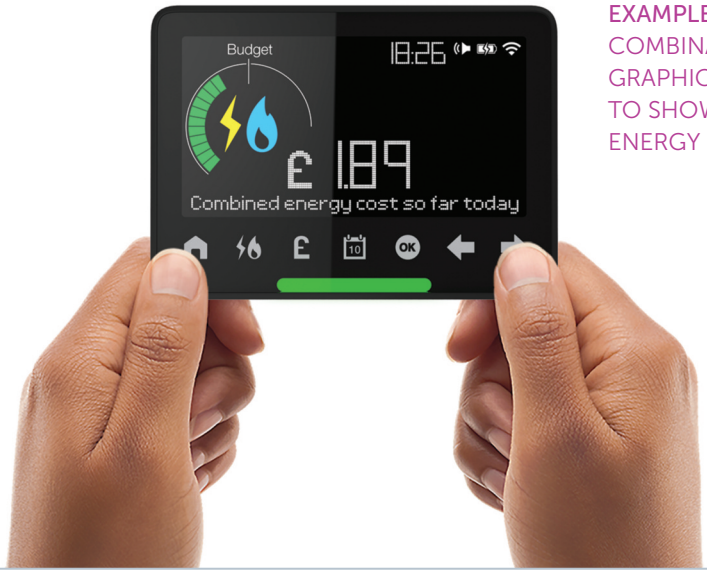
Another change is expected to be the use of dynamic time of use tariffs, whereby the cost of energy varies in line with grid demand using pricing signals to encourage users to modify their usage. Again, an IHD is able to provide an important element of feedback to users by signalling when energy prices are high or low and alerting people to an upcoming change in pricing.

Budgeting and providing peace of mind is a further valuable role that an IHD can play. The next IHD has a budget bar that shows users whether they are within or over their current budget. Consumers therefore have a very simple tool showing when they are saving money or, if they have spent too much, how soon they need to recover and get back within budget.

It is for these reasons that IHDs are often referred to by people who use them as their smart meter: the IHD is what they interact with, it has a permanent presence and it can deliver several immediate benefits.

IHDs will be permanently visible in the home and will show high-level energy consumption and tariff information from the smart meter without the need for active intervention by consumers or energy retailers. They are part of the smart metering system and do not rely on any additional devices or connections. Through a user interface they are able to provide further, more detailed information and prepayment services as detailed by the Smart Metering Equipment Technical Specifications (SMETS).

EXAMPLE 2:
PICTORIAL REPRESENTATION TO HELP PAYG CONSUMERS BUDGET THEIR ENERGY USE



EXAMPLE 3:
COMBINATION OF GRAPHICS AND TEXT TO SHOW REAL-TIME ENERGY USE.

HOW DO THEY WORK?

EXAMPLE 4: EARLY-GENERATION RTDs

IHDs first came on the market about a decade ago. At that time they were called Real Time Displays (RTDs) and some early examples are illustrated above.

Many of these were relatively basic, generally only showed numbers and relied on batteries that had to be changed fairly frequently. The user interface needed much improvement, many people did not understand terminology such as kilowatts, and when the batteries ran out they were often put away. Consequently their acceptance as consumer products was limited and unfortunately RTD came to synonymise "return to drawer".

Nevertheless several trials showed their potential, not the least of which was the UK's Energy Demand Reduction Project (EDRP). Completed in 2010, this project involved over 50,000 households and trialled several forms of energy feedback. The results of this trial, which showed an average saving of two to four per cent for RTDs, and the "Domestic Energy Feedback" report written by Sarah Derby of Oxford University in December 2010, were key inputs to the UK government's benefit analysis and decision to mandate IHDs as part of the retailer-led smart metering programme.

Since then IHD design has moved ahead significantly, as the examples above illustrate. Changing technologies, prices and attention to user feedback that befits a consumer product have all contributed to a sea change in designs. The UK has led the world in these innovations because of the mandate and because industry has been able to retrofit displays to UK electricity meters.

Last year BEAMA commissioned the Vaasa Energy Think Tank, a leading energy research consultancy, to conduct a survey of the recent use of energy monitors across the globe and so update the evidence base used in 2010. The resulting report, *"Assessing the Use and Value of Energy Monitors in Great Britain"*, was published in April 2014. It drew upon six British and European programmes, containing 65 sub-pilots representing over 28,000 participants. A further six British studies, including research from three British utilities, were used for qualitative data.

HOW DO THEY WORK?

The Summary of Findings stated:

> Based on average results of trials in Great Britain and Europe, electricity savings from In Home Displays (IHDs) are over 9% per year for at least three years, representing a typical saving of at least £147 to a household in Great Britain. Savings on electricity alone will pay for the cost of the IHD in less than four months.
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> Gas is difficult to measure without a smart meter and is barely represented in the trials, but if the savings for electricity are extrapolated to gas, it represents a saving of £186 over three years. The average combined saving for a customer with electricity and gas is therefore estimated at £318 after the price of the IHD is deducted.
>
> Across Great Britain, when rolled out to all electricity and gas customers, IHDs are expected to deliver electricity savings to residential customers amounting to over £2.8bn (over three years). For gas the saving is expected to be around £3.3bn. The overall saving for British residential energy customers would therefore be over £6bn assuming just three years of usage per IHD (this is not to intimate that IHDs will not be used after that time but that research into savings after that time is not available).
>
> Pilots have mostly been conducted on first generation display products – where large, good quality colour ambient and numeric displays are used (typically £15-20 cost) these can enhance savings to around 11-18%. Best practice concerning IHDs and the programmes that support them, are continuing to improve. Savings from IHDs are therefore expected to improve further as the mandate for IHDs in Great Britain develops.

In summary, multiple research activities over an extended period of time not only show the potential of IHDs to deliver immediate consumer benefits but also show that these benefits are increasing as design and technology improves. Add to this the potential benefits new functions such as pre-payment, dynamic tariffs and budgeting may bring and it can be seen that IHDs do work. Furthermore, the VaasaETT estimate of over £6bn of benefits can be delivered for a programme cost in the order of £400m, thereby demonstrating significant programme benefits with a 15-fold return on investment.

There is a growing body of evidence that demonstrates the effectiveness of IHDs in giving consumers the information they need to control the way they use energy and in driving down consumption. This is fundamental to the business case for the GB smart metering rollout.

OTHER FORMS OF ENERGY FEEDBACK

The great advantage of smart meters is the ability to collect consumption data. This data can be then used to provide feedback to consumers and to influence their consumption behaviours.

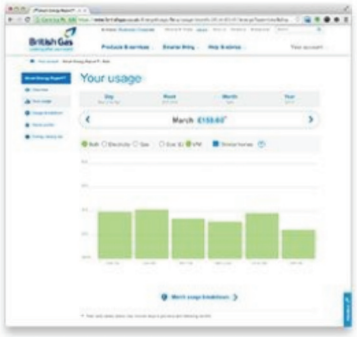
Consumption data can be collected in two ways: through the meter backhaul or through a CAD out onto the internet. A CAD is essentially an IHD without a display but with IP connectivity such as wired Ethernet or WiFi. Both are classified as Type 2 devices in the SMETS, and they share the same security and data functionality. Both means of collecting data can be used and there are reasons why this might be desirable.

Data collected through the back haul is passed to the consumer's utility and, with the consumer's permission, to other third parties via the DCC. By default a utility is limited to a daily meter reading unless a consumer wishes to opt out, in which case only a monthly meter reading can be collected. If consumers choose to they can opt in, thus allowing collection of half-hourly consumption data.

On the other hand, a CAD can be fitted where granting access to smart metering data is entirely under the consumer's control. This data is provided in real time within the home as for an IHD and how often it is read remotely is determined by the service being provided.

These arrangements provide for four main types of alternative to an IHD:

- A written "energy report". This type of report uses data collected through the back haul and is most often provided as a comparison with a peer group of similar properties. It is a periodic report and a selection is illustrated below. The cost of these reports is primarily the operational cost of development, generation and delivery.



- A web portal that provides primarily historical information in a range of different presentations, sometimes with comparisons to previous periods and peer properties. As with energy reports the cost of these sites is primarily operational and includes data management. The real-time data supplied by this internet solution may not be as detailed as can be achieved with a local device such as an IHD.
- A mobile "app", often referred to as a Virtual IHD. Here the data is delivered by a CAD and is therefore capable of delivering real time information. However, costs may be greater as they include capital expenditure for the CAD[2], the development and maintenance of the app, and ongoing operational data management expenditure.
- A smart TV application where a low cost CAD function is added to a set-top box and the information served up as a page on a smart TV. This could include small icons and alerts that show relatively unobtrusively on the pages being viewed. Costs here could be minimised because, as with an IHD, data is mainly retained within the home.

[2] A CAD fitted with Ethernet will be around 2/3 the cost of an IHD; one fitted with WiFi will be about the same cost as an IHD

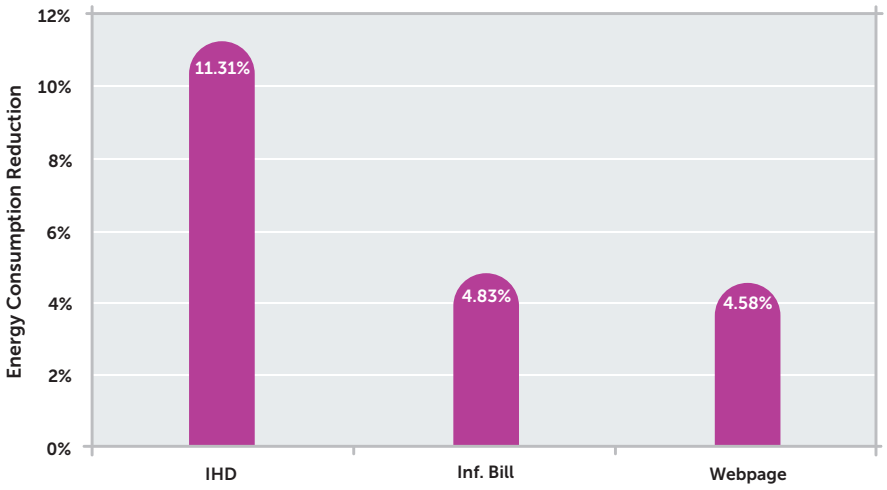
OTHER FORMS OF ENERGY FEEDBACK

For many people, the Virtual IHD/CAD combination is the nearest alternative to an IHD. However, a Virtual IHD is not an IHD, in that:

- it is not permanently visible;
- it requires a user to deliberately interact with it;
- it depends on the Utility providing a data service and the user having both a mobile device and a home broadband service.

This is not to say that a mobile app working with a CAD has no utility: for many reasons it is entirely complementary to an IHD. It is able to provide integration with third party data, it can access the power of cloud analysis services and it can be displayed on much more capable display devices. It can also be provided by a variety of different companies offering different levels of service and catering for a variety of needs.

Part of the task for the 2014 VaasaETT report was to compare results for IHDs with alternative means of providing energy feedback.



GRAPH 1: COMPARISON OF CONSUMPTION REDUCTION USING DIFFERENT MEANS OF DATA PROVISION.

The Summary of Findings reported that

> Consumption reduction is highest for real time feedback. The convenience and presence of an IHD means they are more regularly used than other channels. Other feedback channels such as web pages and informative bills are, however, a valuable addition to IHDs. Savings from web pages are around half that of IHDs.

There was very little research data to support Virtual IHDs and smart TV applications, both of which depend on a Consumer Access Device; these are currently in the early stages of development. With regard to CADs, the Summary of Findings also stated that

> The introduction of CADs is expected to complement the rollout of IHDs and initially give some households an additional route to 'pull' and 'push' data. More research into their effectiveness is needed but with more development and the right business models, they promise to provide a future access point for future additional smart services.

Further recent survey results from Smart Energy GB indicates that there is a healthy appetite for an app as described in the research, however, their effectiveness remains to be assessed in field trials.

OTHER FORMS OF ENERGY FEEDBACK

Research conducted in support of a TSB Smart Metering; Smart Home Trial in 2010 called Project Volcan showed that consumers do not regard all forms of feedback as being alternatives. Indeed, it showed that they regarded them as complementary and used them in different ways. They saw the IHD as an always-on trigger for action that they could refer to easily at a glance. The mobile app that was trialled was seen as providing greater information in a more accessible format and a good way to explore recent consumption when triggered to look at it by the IHD. The web was seen as a place to go to analyse their consumption, something that they would do relatively infrequently. Written reports and smart TV applications were not trialled.

All of the forms of feedback have strengths and weaknesses. A Virtual IHD, when activated, can show real time usage. It can also alert people to predetermined situations both passively and, should the user wish, actively – for example by using text alerts, although the effectiveness of VIHDs has yet to be established. A smart TV app can show real time usage and can alert users using icons on the screen. However, it is restricted to those homes that have a smart TV and has yet to be trialled to see how users react to the application; and, of course, it can only communicate with users while they are watching the TV. Written reports and web portals have been shown to be effective, although the VaasaETT research showed that savings were around half those enabled by IHDs.

Accurate comparison of costs can be difficult, because whereas IHDs represent a single capital expenditure all other forms of feedback require ongoing operational expenditure for an undetermined length of time as well as provision of the DCC service. Some, such as the Virtual IHD and smart TV application, will need capital expenditure to cover the cost of the CAD.

In summary, whilst all the alternatives can add significant additional feedback functionality none has the ability to replace the IHD's key attributes of real-time feedback that is always on and public to everyone in the home. Research has established the efficacy of IHDs and has been shown by some margin to be the most effective of the alternative types of feedback currently developed. Evidence also suggests that the feedback mechanisms discussed should be seen not as competing alternatives but as being complementary methods that when combined will further enhance the consumer benefits of smart meters.

EXAMPLE 5:
EASY-TO-READ COMBINATION OF GRAPHICS AND TEXT.

WILL IHDs CONTINUE TO DELIVER RESULTS?

IHDs are consumer products and as such their life cycle is determined by consumer expectations, technical innovation and the life expectancy of their components. In this sphere mobile phones and tablets set the pace: most phones have a life expectancy of around three years. This means that consumers expect better all the time – but equally it means that the functionality improves steadily while costs go down. Thus, whilst an individual IHD will become obsolete as will an individual mobile phone, new IHDs will come onto the market to replace them.

The main impact of this is that energy retailers themselves will have to become more agile in their procurement processes if they are to avoid stocking obsolete product due to the extended nature of their procurement, testing and trialling procedures. Similarly, modern consumer products tend to be evolutionary and developed by rolling product release programmes; for this reason, the repetitive, single-product procurement processes currently practised by most energy retailers may be less efficient and effective than a more flexible approach.

CONSUMERS EXPECT BETTER ALL THE TIME – BUT EQUALLY IT MEANS THAT THE FUNCTIONALITY IMPROVES STEADILY WHILE COSTS GO DOWN

Summary

This short paper has sought to address some of the current questions around IHDs and to provide background data to inform readers.

The effects of IHDs on consumer behaviours have been well researched. This research has shown strong results and UK business are continuing to develop related products and services. Wide research findings demonstrate that IHDs will provide significant consumer benefits, estimated at £6bn, for a fraction of the overall cost of the smart metering programme: £400m as part of a £11bn programme.

IHDs also have considerable future potential supporting services that have yet to be implemented, such as pre-payment, dynamic time of use tariffs and other demand management initiatives that require active and permissive consumer engagement. It is also envisaged that IHDs, as the only proven way to deliver energy consumption data in a way that significantly changes consumer behaviours, will be the "entry-level" technology for most people, and will support significant take-up of other products and services that will complement the visual displays and lead to even greater potential consumer benefits from the smart metering rollout.

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