



# Getting to grips with smart displays

Research review



# About Consumer Focus

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Consumer Focus is the statutory consumer champion for England, Wales, Scotland and (for postal consumers) Northern Ireland.

We operate across the whole of the economy, persuading businesses, public services and policy makers to put consumers at the heart of what they do.

Consumer Focus tackles the issues that matter to consumers, and aims to give people a stronger voice. We don't just draw attention to problems – we work with consumers and with a range of organisations to champion creative solutions that make a difference to consumers' lives.

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# Contents

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Executive summary	4
Introduction	7
Objectives of the review	8
Methodology	8
Potential benefits of inclusivity by design	9
Industry's approach to inclusivity	12
Designing IHDs inclusively	14
Functionality and navigation	14
Hardware	18
Software	22
Installation, information and instructions	24
General design principles by impairment group	28
Hearing impairment	28
Vision impairment	28
Impaired reach and stretch	29
Impaired dexterity	29
Impaired memory and learning ability	30
Impaired perception and attention	30
Usability testing and development	31
Conclusions	33
Next steps	34
Other documents referred to as part of the research review	35

# Executive summary

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As part of the smart meter rollout, all residential households will be provided with an In-Home Display (IHD) capable of displaying near real-time information on their energy consumption, by 2018/19. The core aim of offering IHDs is to give customers a tool to help them better manage their energy use and reduce their energy bills.

The Government has said it would consider how best to ensure that, when providing customers with IHDs, suppliers meet consumers' accessibility requirements<sup>1</sup> in order to support customers to reduce their energy consumption in both the short and longer term. With this in mind Consumer Focus commissioned Ricability, a specialist consumer research organisation to review relevant reports, guidelines and published papers in order to shed light on factors that can affect usability of IHDs.

The review found that to date very little work has been carried out specifically on IHD *usability*. However, work in comparable sectors identifies some inclusive design principles that are relevant to IHD design and may improve usability for as many people as possible. Existing work on the usability of mobile phones and TVs (remote controls, in particular) is perhaps particularly relevant, due to the similarity of controls and/or the display. While not prescriptive, the review sets out requirements to support an accessible, user friendly design. For instance, direction on providing accessible button labels and instructions for users.

Energy customers will have different requirements which need to be reflected in the IHD they receive. For example those using prepayment or on time of use (TOU) tariffs may require different, and potentially more, information to those on standard tariffs or paying by Direct Debit. The 'standard' IHD that will be offered to all consumers will be required to meet minimum standards in terms of information provision and functionality. However a larger range of functions are technically possible. While additional functionality can be welcome, it can add complexity in a single stand-alone device. The challenge then is to balance the technical functionality of the device with simplicity so that they are easy to use.

Literature shows that many people value simplicity in everyday technological devices from TVs to mobile phones and have a preference for intuitive, easy to use products. IHD hardware and software interfaces should be designed with this in mind. Furthermore, to ensure that IHDs are inclusive, and can be used by everybody, consideration should be given to the design needs of older people and those with impairments who make up a large proportion of the population, a proportion that is on the increase.

Evidence from other sectors shows a range of benefits to inclusive design including:

- Greater efficiency and more user trust – therefore higher overall customer satisfaction
- Less learning time for customers
- Lower error rates (mistakes by the user)

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<sup>1</sup> Smart Metering Implementation Programme: Response to Prospectus Consultation; page 15, 2.30. The Government will consider how best to ensure that, when providing customers with IHDs, suppliers meet consumers' accessibility requirements. In the next phase, the programme will explore whether the principles of 'inclusivity by design' could be included within the technical specifications for the smart metering system'.

- Lower contact levels with training and support services
- Fewer returns and complaints

Testing and refining a product with a diverse range of users helps resolve any potential barriers between user and interface that may prevent a group of people from using it easily and effectively.

Substantial numbers of consumers would benefit from an inclusively designed display. According to the Government's recently published *Life Opportunities Survey*,<sup>2</sup> almost one third (29 per cent) of all adults in Great Britain have an impairment<sup>3</sup> resulting from injury or illness, genetic inheritance or the natural ageing process. Impairments are defined as long-term characteristics of an individual that affect functioning and/or appearance.<sup>4</sup> Not surprisingly the percentage of older people with an impairment is considerably higher.

Legislation in this area tends to concentrate on high-level guidance and principles, rather than mandating specifications for manufactured goods or for design processes. However, the Equality Act 2010 will require suppliers to take 'reasonable steps' to ensure the information displayed on the IHD, the controls and instructions, or other supporting information, are provided in an accessible way so not to disadvantage people with a disability. The Standard Licence Condition<sup>5</sup> parts 26.2 and 26.3 says the licensee (suppliers) must provide accessible information relating to any bill or statement of account, or any other service, free of charge to any domestic customer who is blind or partially sighted (or someone acting on their behalf). The licensee must also provide, free of charge, facilities to blind, partially sighted, deaf or hearing impaired domestic consumers who ask or complain about correspondence relating to the supply of the electricity and gas.

The European Commission is examining how to embed the 'design for all' (or inclusive design) principle into its standardisation processes. This is to encourage manufacturers and service providers to design products that are:

- Accessible to nearly all users without modification or
- Easy to adapt according to need or
- Use standardised interfaces that can be simply accessed using assistive technology

The literature review revealed a number of areas where further work is needed to understand the impact on particular consumer segments, or to explore what impact a new functionality might have on consumer behaviour. It is suggested that further work should include:

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<sup>2</sup> *Life Opportunities Survey*, December 2010.

<sup>3</sup> Loss of physiological and psychological functions of the body such as sight, hearing, mobility or learning capacity.

<sup>4</sup> The social model of disability makes a clear distinction between impairment and disability. Impairments are long-term characteristics of an individual that affect their functioning and/or appearance. Disability, however, is viewed as the disadvantage, or restriction of activity and participation, caused by aspects of society that take little or no account of the needs of people with impairments. Section 1(2) of the Disability Discrimination Act 1995 (DDA) defined someone as disabled if 'he or she has a physical or mental impairment which has a substantial and long-term adverse effect on her or his ability to carry out normal day-to-day activities'. The Equalities Act 2010 has subsequently replaced the DDA, although the definition of disability in the Act is similar to that which applied for the purposes of the DDA (see House of Commons Public Accounts Committee (2009), *Skills for Life: Progress in Improving Adult Literacy and Numeracy, Third Report of Session 2008–09*, Report, together with formal minutes, oral and written evidence. Ordered by the House of Commons to be printed 14 January 2009).

<sup>5</sup> Standard Licence Condition 26, (Services for specific Domestic Customer groups)

- User trials for prepayment and TOU customers – until now few user trials have looked at the needs of customers who use prepay energy or time of use tariffs. As noted, while it is likely that they also only use a few core functions regularly, they may have slightly different needs
- Exploring the added complexity of providing a dual fuel IHD
- The effect, if any, that real-time feedback on energy consumption has on low income and vulnerable consumers, for example, could it prompt them to under heat their homes?
- Design guidance specific to the industry to support an inclusively designed product/service

# Introduction

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The Government has proposed that all GB homes have smart meters installed by 2019. Alongside their smart meter every customer will be provided with an In-Home Display (IHD) at no up-front cost, which will be capable of displaying near real-time information on their energy consumption and other related data.

The aim of the IHD is to make normally invisible energy use more visible, by giving people detailed feedback about how much gas and electricity they are using as they use it,<sup>6</sup> which in turn should help them identify where they can make savings on their energy bill. The precise displays customers get and the features those displays have will vary from supplier to supplier, but Government is expected to outline minimum requirements which all standard smart meter IHDs must meet to ensure a level of quality.

Consumer Focus has been working to ensure that IHDs are designed in a way that provides the greatest benefit to customers. It is important that all consumers, including those that have a disability or special requirements, receive an IHD which they find easy to use. This is particularly important as the overwhelming majority of the benefit to customers from having smart meters comes from them being able to use the information provided by their smart meters to better manage their energy use.<sup>7</sup>

Until now little specific work had been carried out on usability of IHDs or energy displays. However, in other sectors such as digital television, a lot of work has already been undertaken around inclusivity by design, which suggests that there were many potential benefits.

In order to advance work in this area, Consumer Focus commissioned Ricability to carry out a review of existing research and literature on the usability of displays. This was to help establish how we can best ensure that all customers have a display that is easy to use. In particular, we asked Ricability to consider the feasibility of adopting inclusivity by design approach to displays.

How easy IHDs are to use (their usability and accessibility) is recognised as an important factor in determining their effectiveness as a customer tool to reduce their gas and electricity consumption in both the short and longer term. In its recent Decision document on smart metering, the Government said it would consider how best to ensure that, when providing customers with IHDs, suppliers meet consumers' accessibility requirements.<sup>8</sup>

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<sup>6</sup> The current design requirements document states that electricity updates will be provided in 'better than 10 seconds' and gas updates every 30 minutes. For electricity only, updates will be provided in 'near-real time'. For electricity and gas, the information on that day's cumulative consumption will be updated every half hour.

<sup>7</sup> £4.6 billion of customer benefits identified in the Impact Assessment are expected to come from households reducing their energy use; DECC/ Ofgem Impact Assessment, 30/03/2011, <http://tinyurl.com/234968z>

<sup>8</sup> Smart Metering Implementation Programme: Response to Prospectus Consultation; page 15, 2.30. The Government will consider how best to ensure that, when providing customers with IHDs, suppliers meet consumers' accessibility requirements. In the next phase, the programme will explore whether the principles of 'inclusivity by design' could be included within the technical specifications for the smart metering system'.

## Objectives of the review

The specific objectives of this literature review were to explore the following:

- What research has been carried out on usability and accessibility of energy displays and IHDs?
- What lessons could be drawn from supplier trials of energy displays and IHDs?
- What problems may customers encounter when using displays?
- How many consumers might benefit from an inclusive by design IHD?
- How feasible is inclusivity by design as an approach?
- What lessons could be learnt from inclusivity by design in other sectors?
- To what extent does industry already meet the needs of customers with impairments? Does existing legislation require suppliers to take steps to ensure that people get an accessible IHD?
- Does existing legislation require suppliers to provide it? Will the market deliver?

## Methodology

This is a review of literature selected to shed light on the factors that can help or hinder usability of IHDs installed as part of the GB smart metering programme; especially for older people and people with disabilities. Literature reviewed is predominantly from the UK, but some international literature has been included when relevant. The research Ricability looked at covered both In-Home Displays and energy monitors; for simplicity both will be referred to as IHDs in the remainder of the report.

The literature reviewed includes reports, guidelines, standards, published papers and independent consumer tests. Within this, good general design practice has been extracted as well as design practice specific to products from other industries.

The industry is still relatively immature with information requirements still evolving. It is not clear to what extent manufacturers have invested in the design and testing of products to ensure as many people as possible can use them. However, no literature directly focused on IHD usability was available at the time of this report.

This report focuses on usability including, where applicable, cost benefit evidence. However, the cost of individual ergonomic design elements that will affect the ease in which consumers can interact with the IHD have not been addressed.

Literature reviewed was published June 2011 or earlier.

Consumer Focus commissioned Ricability to conduct the review, it reflects the findings of the literature only, and it does not include additional views of Ricability.

## Usability of IHDs

The usability of IHDs has been recognised as important to their effectiveness as a tool to help customers reduce their energy consumption in both the short and longer term.<sup>9</sup>

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<sup>9</sup> However, some research evidence suggests that usability alone is not a guarantee that IHDs will actively be used by consumers, even if consumers also find IHDs useful and enjoy using them. For example in one small recent study, even though participants found the electricity monitor easy to use and useful, they used it less than originally expected (see Pelenur M and Cruickshank H (2011), *Applying the Technology Acceptance Model to domestic energy: will we accept passive or active energy management systems in our home?* ISSE. Presented at the American University of Sharjah International Conference on Sustainable Systems and the Environment, 2011). A recent Dutch case study and literature review points out initial savings from IHDs tend to fall back in the medium term, and suggests there is a need for deeper understanding 'that embraces social

To date there have been a number of trials and testing of displays in residential properties in Great Britain with some focus on how the testers found them to function in terms of usability. They have not aimed specifically to sample among people with impairments.

For example, Ipsos MORI published an evaluation of Real Time Displays in homes in early 2011<sup>10</sup> and the Consumers' Association magazine, *Which?*, tested commercially available energy monitors in early 2011.<sup>11</sup>

The Ipsos MORI research looked at people who already have a real time display. It used survey methods supplemented with a small number of in-depth interviews to assess levels of installation and use. Few findings related directly to design or inclusive design issues, but some may have indirect relevance. Those who were not proactive in seeking to get a display were less engaged with it and also experienced more difficulty installing and understanding the display. Functions such as mapping energy use over time were mainly of interest to proactive adopters of the technology. Some respondents felt there were too many functions, too much information – that simpler would be better. Some did not know what to look at on the display – this was especially true among 'priority customers' which includes a higher proportion in rented housing and with lower income. In general, many wanted clearer instructions and explanations. Consumers aged over 75 and those who did not expect a device were among those least likely to *use* it; consumers over 75 and those who found instructions hard were least likely to be *satisfied* with it.

Half of the marks awarded by *Which?* in its evaluation scheme were for 'ease of set up and everyday use' factors, including clarity and good illustration in instructions, smoothness of (DIY) set-up, clear and well laid out display, ease of using the historical function and portability (battery or rechargeable battery as against mains only). The commercial monitors tested varied on these and other performance measures, with only one (the overall winner) getting five stars for quality of information displayed.

## Potential benefits of inclusivity by design

The ideal is an IHD designed, installed and serviced so that everyone can use it, irrespective of their age or ability, though this ideal has so far rarely been realised in practice with other mainstream products.<sup>12</sup> A more realistic target is an IHD that caters for as many people as possible; this is often referred to as 'inclusive design'.<sup>13</sup>

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science, contextual factors, usability and interaction design research' (see van Dam SS, Bakker CA and van Hal JDM (2010), Home energy monitors: impact over the medium-term, *Building Research & Information*, 38: 5, 458-469)

<sup>10</sup> Ipsos MORI (2011) CERT Real Time Display Evaluation, for the Energy Retail Association, February 2011 (draft)

<sup>11</sup> Consumers' Association (2011) Test Lab – Energy Monitors, *Which?*, January 2011; Consumers' Association (2011) Testing Energy Monitors, *Which?*, February 2011

<sup>12</sup> Etchell L and Yelding D (2004), Inclusive design: products for all consumers, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 186–193

<sup>13</sup> The British Standards Institute (2005) British Standard 7000-6:2005. Design management systems – Managing inclusive design – Guide defines inclusive design as 'The design of mainstream products and/or services that are accessible to, and usable by, as many people as reasonably possible ... without the need for special adaptation or specialised design.' Quoted in University of Cambridge, Engineering Design Centre, BT sponsored: Inclusive design toolkit, [www.inclusivedesigntoolkit.com](http://www.inclusivedesigntoolkit.com)

The aim of inclusive design is to develop the IHD in a way that customers with common impairments, such as sight problems, and dexterity issues, can access it, as well as those that don't. Not only might that help keep costs down as fewer specialised displays would be required, but it should also help to reduce the number of customers who don't engage with their IHD because of inaccessible design.<sup>14</sup>

It has been suggested by some parties that, rather than producing displays which follow the principles of inclusivity by design, suppliers could address the needs of customers with impairments by offering them specially tailored devices. In some instances this is likely to be necessary, for example where a customer has a very specific need, such as being blind. However, specially designed products can be expensive and identifying the full range of customers who would benefit is challenging.

The literature that Ricability reviewed identified certain types of designs that work for people with impairments. This type of design is argued to satisfy consumers more widely, in that it has the benefits of:

- tending to fit with general customer preferences for simplicity, intuitiveness and ease of handling<sup>15</sup>
- being able to overcome barriers to use that are likely also to affect a proportion of the wider population<sup>16</sup>
- tending to be effective not just for keen early adopters (those who value the opportunity to try new technological gadgets) and people proactive in having an IHD installed – who are often tolerant of design flaws – but for the majority of users further into implementation<sup>17</sup>

Because of its wide appeal to all kinds of users, inclusively designed technology may also swiftly repay any additional design development costs.<sup>18</sup> For example, the BT Freestyle 7xx series of cordless telephones was developed using BT's embedded inclusive design process. BT claims that since July 2008 sales have increased by 20 per cent and product

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<sup>14</sup> Usability considerations are not just a requirement for impairment groups. For example, design paradigms or models drawn from technologies that not everyone is familiar with, can present as much of a challenge for some users as other important sources of exclusion such as vision, hearing or dexterity impairment. For example, a review of early set top boxes in a usability audit undertaken as part of the Government's Digital Television Action Plan found that the menu-driven model for user-interaction was unfamiliar to some people – especially the older people without experience of personal computers (see Klein JA, Karger SA and Sinclair KA (2003), *Digital Television For All*). Prepared for the DTI Digital Television Project, September 2003). In addition, a substantial number of people without a particular impairment have literacy and/or numeracy problems and low information technology skills, or – for various personal and circumstantial reasons – have little confidence or skill in using new technology-based products

<sup>15</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010; Anderson W and White V (2009), *The smart way to display*. For the Energy Saving Trust by the Centre for Sustainable Energy, September 2009; Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>16</sup> Klein JA, Karger SA and Sinclair KA (2003), *Digital Television For All*. Prepared for the DTI Digital Television Project, September 2003

<sup>17</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009; Ipsos MORI (2011) *CERT Real Time Display Evaluation*, for the ERA, February 2011 (draft)

<sup>18</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

returns have declined resulting in higher overall profitability in spite of higher manufacturing costs.<sup>19</sup>

It has also been shown to result in:

- Greater efficiency and more user trust<sup>20</sup> therefore higher overall customer satisfaction<sup>21</sup>
- Fewer returns and complaints<sup>22</sup>
- Less learning time for customers<sup>23</sup>
- Lower contact levels with training and support services<sup>24</sup>
- Lower error rates<sup>25</sup>

Less cost associated with providing special display units,<sup>26</sup> especially if provision is retrospective or involves adaptation.<sup>27</sup> It can also protect supplier reputations, which can suffer if products and/or services are experienced or perceived to be difficult to use.<sup>28</sup>

### Consumers that would benefit from an ‘inclusively designed’ IHD

Significant numbers of consumers would benefit from an inclusively designed IHD. According to the Government’s *Life Opportunity Survey*<sup>29</sup> (LoS) almost one third of adults in Great Britain have an impairment. This study estimated the percentages of the population with specific impairments (over the age of 16 years) as follows:

Impairment	% GB population aged 16 and over
Sight	3
Hearing	3
Speaking	1
Mobility	8
Dexterity	6
Long term pain	18
Breathing	3

<sup>19</sup> University of Cambridge, Engineering Design Centre, BT sponsored: Inclusive design toolkit, [www.inclusivedesigntoolkit.com](http://www.inclusivedesigntoolkit.com)

<sup>20</sup> Lennard, L and George M (2007), *Ease of use issues with domestic electronic communications equipment, A research audit*, OFCOM, July 2007

<sup>21</sup> Etchell L and Yelding D (2004), *Inclusive design: products for all consumers*, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 190

<sup>22</sup> Klein JA, Karger SA and Sinclair KA (2003), *Digital Television For All*. Prepared for the DTI Digital Television Project, September 2003

<sup>23</sup> Lennard, L and George M (2007), *Ease of use issues with domestic electronic communications equipment, A research audit*, OFCOM, July 2007

<sup>24</sup> Ibid; Etchell L and Yelding D (2004), *Inclusive design: products for all consumers*, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 190

<sup>25</sup> Lennard, L and George M (2007), *Ease of use issues with domestic electronic communications equipment, A research audit*, OFCOM, July 2007

<sup>26</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010

<sup>27</sup> Etchell L and Yelding D (2004), *Inclusive design: products for all consumers*, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 191; The cost of changing design increases exponentially through the development lifecycle (see University of Cambridge, Engineering Design Centre, BT sponsored: Inclusive design toolkit, [www.inclusivedesigntoolkit.com](http://www.inclusivedesigntoolkit.com))

<sup>28</sup> Lennard, L and George M (2007), *Ease of use issues with domestic electronic communications equipment, A research audit*, OFCOM, July 2007

<sup>29</sup> Source: *Life Opportunities Survey - Interim Wave One Results*, 2010 Statistical Bulletin. The impairment groups have been re-ordered in the table to highlight those possibly of most relevance to IHD design and use.

Learning	2
Behavioural	1
Memory	3
Mental health	4
Chronic health conditions	12
Other impairment or health condition	1

Further useful findings from the LoS are that:

- A quarter (25 per cent) of people with an impairment live alone – compared with a seventh (13 per cent) of people with no impairment – so cannot rely on others in the household to use an installed IHD
- Just over half (54 per cent) of adults aged 16 or over with impairments said they had six or more close contacts they could rely on if they had a problem; compared with nearly two-thirds (64 per cent) of adults with no impairments
- A seventh (14 per cent) of respondents with impairments said they had two or fewer close contacts they could rely on in an emergency compared with a twelfth (8 per cent) of those with no impairments

It is also important to note that people often have multiple impairments and that there is considerable variation in the manner and extent to which capabilities can be affected by a given type of impairment.<sup>30</sup> A person supplied with an IHD may have a minor visual impairment combined with a dexterity impairment that has a far greater impact on their ability to use the product, for example. A well designed product may overcome both issues, while a specialist ‘adaptation’ for one or the other alone will not.

Failure to consider the design needs of older people and those with impairments means overlooking a substantial proportion of potential users, and in an ageing society, a proportion that is on the increase<sup>31</sup> and that has considerable purchasing power. 10 years ago, the estimated annual purchasing power of people with disabilities was £80 billion.<sup>32</sup> Understanding the practical impact of different kinds of impairment is crucial to inclusive design.

## Industry’s approach to inclusivity

Indications from other sectors suggest that industry is slow to take the lead and does not always naturally consider usability issues. A research audit carried out for Ofcom, the communications regulator, indicated that it is the promptings of disability groups that tend to lead to the needs of older people and people with impairments being taken into consideration by the manufacturers of domestic electronic communications equipment rather than being driven by business. Companies then respond by making special models rather than mainstream products that can be used by everyone. The same study found little knowledge or awareness among manufacturers of the needs of older people and people with impairments.<sup>33</sup>

<sup>30</sup> A report published in 1999 on Disability in Great Britain (see Grundy E, *et al* (1999) *Disability in Great Britain: results from the 1996/7 Disability Follow-up to the Family Resources Survey*, Department of Social Security, London) provides some useful illustration of the ‘everyday’ capabilities of people with different kinds and degree of impairment using ‘pen portraits’.

<sup>31</sup> Of ‘fuel poor’ households (those that spend more than 10 per cent of their income on heating their home to an adequate standard), around half contain at least one person over 60 and more than 40 per cent contain someone with a long term illness or impairment.

<sup>32</sup> Employers’ Forum on Disability website <http://bit.ly/ojlxZ7>

<sup>33</sup> Lennard, L and George M (2007), *Ease of use issues with domestic electronic communications equipment, A research audit*, OFCOM, July 2007

## Legal obligation and duty

Ofgem, the energy regulator, has various powers and duties provided for in statute. In performing these duties it must 'have regard to the interests of individuals who are disabled or chronically sick, of pensionable age, with low incomes, or residing in rural areas'.<sup>34</sup>

The Standard Licence Condition<sup>35</sup> parts 26.2 and 26.3 says the licensee (suppliers) must provide accessible information relating to any bill or statement of account, or any other service, free of charge to any domestic customer who is blind or partially sighted (or someone acting on their behalf). The licensee must also provide, free of charge, facilities to blind, partially sighted, deaf or hearing impaired domestic consumers who ask or complain about correspondence relating to the supply of the electricity and gas.

The Equality Act 2010<sup>36</sup> requires reasonable steps to be taken where a provision, criterion, practice, or a physical feature puts a disabled person at a substantial disadvantage, in relation to someone who is not disabled. Reasonable steps to be considered when addressing the issue include:

- Removing the physical feature in question
- Altering it
- Providing a reasonable means of avoiding it

This means service providers have a duty to ensure the information displayed on the IHD, the controls and instructions, or other supporting information, are provided in an accessible way.

The proposed EU Equal Treatment Directive is likely to exclude manufactured goods but if the smart metering programme counts as a service, hardware and software integral to it could be covered.

The latest draft requires providers to take into account 'measures to ensure accessibility for persons with disabilities (and) promote the research and development of universally designed goods, promote their availability and use, and promote universal design in the development of standards and guidelines'.<sup>37</sup>

The European Commission is examining how to embed the 'design for all' principle into its standardisation processes. This will encourage manufacturers and service providers to design products that are:

- Accessible to nearly all users without modification or
- Easy to adapt according to need or
- Use standardised interfaces that can be simply accessed using assistive technology

Legislation in this area tends to concentrate on high-level guidance and principles, rather than mandating specifications for manufactured goods or for design processes. This limitation may be inevitable given the need to allow for new developments and to avoid restricting markets unduly. It is important to be aware of the principles that must be followed, but the law is of little practical assistance in meeting the needs of those with impairments through inclusive design.

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<sup>34</sup> OFGEM, Energy Demand Research Project, <http://bit.ly/qwp5H4>, 12

<sup>35</sup> Standard Licence Condition 26, (Services for specific Domestic Customer groups)

<sup>36</sup> Equality Act 2010 c.15, Part 2, Chapter 2, Adjustments for disabled persons, Section 20 – Duty to make adjustments

<sup>37</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011, 19

# Designing IHDs inclusively

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## Functionality and navigation

All IHDs will have to meet minimum mandatory standards. This will cover the information that the display must provide. Above and beyond these, a large range of functions and information is technically possible. However every additional function, in a single stand-alone device, adds complexity. Each extra piece of information has to have a means to access it, generally either through another button or another on-screen menu item or sub-menu.

Energy customers will have different requirements which need to be reflected in the display. For example those using prepayment or on TOU tariffs will require different and potentially more information to those on standard tariffs or paying by Direct Debit. It is important that the customer is able to access key information easily and intuitively. Balancing the needs of different customers, with the need for simplicity is important.

Consumer Focus understands that on Quantum PPM meters, the customer has to press a button over 30 times to access account information. In our recent research on the experience of prepayment customers,<sup>38</sup> we found that ‘... none of those interviewed were aware that this information was available on their meter.’ This reinforces the importance of the displays being simple to use and key information on the amount owing being within a small number of clicks.

The experiences of PPM users, and those of many customers when trying to set their boiler controls, are reminders that mandating functionality alone is not enough to ensure that consumers can access the information they need and use the technology effectively. For example, National Energy Action (NEA) found that Warm Front customers were having a lot of difficulties using their thermostat controls, which was leading to engineers being called out, and adding cost to the programme. As a response to this, a much more user-friendly and accessible thermostat was developed.<sup>39</sup>

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<sup>38</sup> Consumer Focus (2010), *Cutting back, cutting down, cutting off: Self-disconnection among prepayment meter users*, July 2010

<sup>39</sup> National Energy Action (NEA) initially began to work on this project as a response to the high volumes of calls that the Warm Front help line was receiving from older clients who had central heating installed under a Warm Front grant, but could not operate the controls for the system. This meant that an engineer had to be called out, adding cost to the programme overall. A project group was formed with DEFRA (now DECC) NEA, eaga, Powergen and TACMA (controls organisation) to identify the problems. NEA tested different heating control samples with 100 clients to identify any problems with usability and accessibility, and also surveyed 100 clients who already had Warm Front heating installations. Following on from this, the project group invited group members to propose a solution; two members proposed a modified programmer/thermostat control. The model from Horstmann controls was found to best meet the requirements; it included the time clock and thermostat with Braille marking large digital display, hyperthermia protection and a range of preset programmes. A prototype was developed and successfully tested with Warm Front clients. For more information on this work, please contact Arthur Scott, Head of Technical Services at NEA: [Arthur.Scott@nea.org.uk](mailto:Arthur.Scott@nea.org.uk)

It should be noted that in the trials and tests so far there has been very little consideration of the specific needs of customers who use prepay energy or TOU tariffs. They are not specifically referenced in the Ipsos MORI research,<sup>40</sup> though it is noted that a stumbling block to effective installation and use of the displays could be helped by pre-programming devices with the customer's tariff. Nor are they referenced in the Which? tests.<sup>41</sup> Other papers reviewed are similar in this regard.<sup>42</sup> While it is likely that these customers only use a few core functions regularly, they may have slightly different needs from other fuel customers. This needs further work.

### Proposed minimum standards for IHDs

At the time of writing, the minimum requirements for the standard IHD were expected to include, among others, the following functions:

- Current electricity and gas consumption
- Usage in pounds and pence as well as kilowatts and kilowatt hours (kWh)
- Ambient feedback that allows consumers to easily distinguish between high and low levels of current consumption
- Low levels of current consumption
- Historical energy consumption which may allow consumers to compare current usage with past usage – this could be toggled to show consumption over various time periods (current day, week for example)

There may also be a function to compare use or spend, either with a historic point (eg the current week with the previous week) and other prescribed standard functions. IHDs with some or all of the functions described above do exist commercially in Great Britain, but as the minimum standards for IHDs to be distributed as part of the smart meter rollout have not yet been finalised, at the time of writing it cannot be said with certainty that any IHD currently available meets the standards that will be set. The following explores whether there is any existing evidence to suggest how customers could best access some of these functions.

### Functions

As a general point, the choice of functions included in IHDs may not seem to be of direct relevance to the process of making a device that can be used by the widest range of people, including those with impairments. However the specified functions will set the level of complexity of the devices. Complexity affects usability, not just for those with cognitive impairments or who are unfamiliar with menu navigation.

For example, the number of buttons that are needed has an impact on how big and well spaced they can be. The amount of information on the default screen affects how much key information can be made readable either at a distance, or by those with visual impairments. Therefore decisions on functionality have an effect on usability, and will determine which barriers to easy use have to be overcome through good design.

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<sup>40</sup> Ipsos MORI (2011) *CERT Real Time Display Evaluation*, for the ERA, February 2011 (draft)

<sup>41</sup> Consumers' Association (2011) Test Lab – Energy Monitors, *Which?*, January 2011;

Consumers' Association (2011) Testing Energy Monitors, *Which?*, February 2011

<sup>42</sup> King E and Kear D (2009), *Smart Metering – Qualitative research presentation*, Kaleidoscope Research, November 2009; FDS International (2010), *Consumers' views of Smart Metering*, report for Ofgem, July 2010; Accent Scotland (2010), *Effects of Interventions on energy saving behaviour*, Energy Demand Research Programme for Scottish Power: findings of Waves 1 to 3 of trial monitoring, March 2010; Ofgem PowerPoint presentation March 2011, summary of a trial

A research audit into ease of use issues in domestic equipment, carried out for Ofcom, commented: 'As usability experts have pointed out frequently, usability is not simply a matter involving the design of interfaces (such as website, layout of buttons on a remote control or mobile phone) but can and often does involve the whole "system architecture" within an electronic device'.<sup>43</sup>

How and what information is presented is a key part of usability. The consumer research in the public domain on customers' experience with displays is limited but increasing. The following comments on function options are based on a few key trials, relevant market research and other research conducted so far.<sup>44</sup> It is hard to make firm conclusions on ultimate consumer preferences for functions, and still harder to assess how particular function choices may affect inclusive design because no research so far has looked at the usability of displays by people with impairments.

Research projects and consultation responses considering consumption have consistently found a preference among consumers for a default figure given in pounds and pence, not just kW.<sup>45</sup>

In trials, displays that projected 'spend' based on extrapolating the current rate of spend were not helpful, for example because of worrying projections triggered, for instance, when the kettle was on.<sup>46</sup> The way that rate of use might be displayed is covered below under both hardware and software issues.

Cumulative consumption is a measure which shows usage over a current time period, which may be the current day, week, month or quarter for example. It acts as a guide to whether consumption is 'high' or 'low'. It is a function that many potential customers say they would value.<sup>47</sup> Research for the Energy Savings Trust (EST) for example,<sup>48</sup> used focus groups who were initially asked to discuss and set specifications for an IHD, then given actual IHDs to use at home and re-convened to see if their views had changed, in particular as to which functions they wanted and how they should be presented.

After the group had experience of using displays, they still wanted cumulative consumption data, but this did not necessarily need to be always visible, on the default screen. It could be accessed through a simple toggle button<sup>49</sup> instead.

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<sup>43</sup> Lennard, L and George M (2007), *Ease of use issues with domestic electronic communications equipment, A research audit*, OFCOM, July 2007, 10

<sup>44</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010; 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, 6111–6119; Anderson W and White V (2009), *The smart way to display*. For the Energy Saving Trust by the Centre for Sustainable Energy, September 2009; King E and Kear D (2009), *Smart Metering – Qualitative research presentation*, Kaleidoscope Research, November 2009; FDS International (2010), *Consumers' views of Smart Metering*, report for Ofgem, July 2010; Accent Scotland (2010), *Effects of Interventions on energy saving behaviour*, Energy Demand Research Programme for Scottish Power: findings of Waves 1 to 3 of trial monitoring, March 2010; Ipsos MORI (2011) CERT Real Time Display Evaluation, for the ERA, February 2011 (draft)

<sup>45</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010

<sup>46</sup> As reported in qualitative interviews in 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, 6114

<sup>47</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010; Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>48</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>49</sup> Buttons that can be rocked (toggled) eg on and off.

Again most people show a consistent preference for this to be shown in pounds and pence not just kWh.<sup>50</sup> kWh is not an easy unit for most people to understand;<sup>51</sup> it is counterintuitive that kW is the unit for rate of use whereas kWh relates to total consumption. However, an evaluation of Real Time Displays carried out by Ipsos MORI found that some customers like the kW measure because they don't necessarily trust the monetary display.<sup>52</sup> Figures for carbon dioxide volumes are not meaningful to most, nor seen as a necessary function.<sup>53</sup>

The preference for pounds and pence as a measurement reflects the fact that consumer motives to reduce energy use tend to be primarily financial – to reduce fuel bills, with environmental considerations, for most people, a lower concern. Some trials with existing IHDs back this up.<sup>54</sup>

Other forms of comparison are possible, for example comparison with a pre-set target, or community average household consumption. Research conducted as part of the EDRP trials<sup>55</sup> found evidence that suggested consumption against a target level can be helpful in reducing consumption, a constant reminder of the money being spent. However, they can 'also be a source of stress if money is tight'.

However, most people in the focus groups run by the EST – asked after experience with IHDs what their ideal display would include – felt a target budget was not a necessary function as the other information was adequate<sup>56</sup>. Members of the public taking part in IHD research have voiced concerns that such functions might lead to vulnerable consumers under heating their homes, because the warnings (such as a cross or red light coming on when consumption is high) will put pressure on them to do so.<sup>57</sup> There is as yet little concrete evidence as to the extent of this risk. Choices about switching heating and other appliances off have reportedly become a source of household conflict during trials of IHDs.<sup>58</sup>

More research to date has focused on electricity IHDs than on IHDs that show gas use or dual fuel, but minimum requirement IHDs for the smart metering programme will have to be dual fuel enabled. More research is needed to explore how the additional complexity of providing dual fuel information will impact on usability.

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<sup>50</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010; 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, 6111–6119; Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>51</sup> Ipsos MORI (2011) *CERT Real Time Display Evaluation*, for the ERA, February 2011 (draft)

<sup>52</sup> Ibid

<sup>53</sup> 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, 6114

<sup>54</sup> Ibid, 6111–6119; Accent Scotland (2010), *Effects of Interventions on energy saving behaviour*, *Energy Demand Research Programme for Scottish Power: findings of Waves 1 to 3 of trial monitoring*, March 2010

<sup>55</sup> AECOM (2011) *Energy Demand Research Project: Final Analysis*. June 2011

<sup>56</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>57</sup> 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, 6111–6119; King E and Kear D (2009), *Smart Metering – Qualitative research presentation*, Kaleidoscope Research, November 2009; FDS International (2010), *Consumers' views of Smart Metering*, report for Ofgem, July 2010

<sup>58</sup> 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, 6117

Many domestic fuel customers are on prepayment meters (PPMs) and numbers are likely to increase.<sup>59</sup> The information needs of PPM customers are different; if offered an IHD they may have reasonable expectations that it will be able to show, for example:

- Their remaining credit balance
- Any debt they are repaying
- The current tariff rate
- If they are running on 'emergency credit'

Additional functions on a standard IHD add complexity; this can take the form of additional screens to navigate through, visual clutter (more information on the screen at the same time), or both. PPM customers will need the information that is important for them to be available on the first or second screen.

It has been pointed out that IHDs should be ready to deal with different TOU tariffs. The Impact Assessment estimates that one in five of us<sup>60</sup> will take advantage of them, along with the 3.6 million<sup>61</sup> customers that are already on existing TOU tariffs.

## Hardware

The standard IHD is expected to be a standalone piece of hardware that can be placed in a location of the customer's choice in the home (provided there is a signal in that location). The Government has decided that the standard display will be mains powered as a minimum (some display manufacturers may choose to include batteries as well, but this will not be mandatory). If mains powered alone, it will be crucial for some consumers with mobility and or sight impairments, to be able to place the device where they can hold, reach or read it easily.

Points made about the usability of digital TV handsets (remotes), in anticipation of digital switchover, are transferable by analogy to the standard IHD, such as that it should be constructed of non-slippery material which is easy to grip – avoiding shiny metal or plastic that produces glare.<sup>62</sup> The same guidance included a checklist of questions about usability of domestic devices, some of which can be applied to IHDs:

- If the device is meant to be portable, is it large enough to hold comfortably?
- Is it easy to manipulate with right or left hand (can all buttons be reached with either?)
- If placed on a flat surface, can it be operated with one finger?
- Is it well balanced and heavy/light enough to hold comfortably?

Communications Consumer Panel research into making phones easier to use yields similar points: a device that is meant to be portable should be easy to use with one hand partly because many visually impaired people will use a magnifier with the other hand to read it; and if batteries are used, gripping points on the casing are useful so batteries can be changed easily.<sup>63</sup>

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<sup>59</sup> Consumer Focus (2010), *Cutting back, cutting down, cutting off: Self-disconnection among prepayment meter users*, July 2010

<sup>60</sup> DECC/Ofgem Impact Assessment, 30/03/2011, <http://tinyurl.com/234968z>, page 39

<sup>61</sup> energywatch figures, March 2007. The total number of customers with restricted hour meters was: 3,661,523

<sup>62</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>63</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011

Many of the above points on hardware design for IHDs can also be drawn from general inclusive design principles as outlined by Etchell and Yelding.<sup>64</sup> Further general points on design that are important for particular impairment groups are made under that heading elsewhere.

### The importance of simplicity

In one trial where IHDs were fitted experimentally in homes, people found that only a few core functions are really important once they have had actual experience of using them. This was true even though the sample started off with a wide range of personal backgrounds and circumstances, and a wide range of preconceptions about what functions they wanted.<sup>65</sup> Research commissioned by the EST asked focus groups to design an IHD based on their experience in practice. Nearly all the designs featured on the default screen: a graphic showing current rate of consumption, and a large clear numerical indicator of cumulative consumption in pounds and pence. There was a simple method (button) to switch the cumulative figure to kWh, and another to show past consumption figures through various time periods. This would meet the preference of most consumers for simple, clear operations, as well as meeting some accessibility needs for ease of use and comprehension. It also makes it easy to incorporate other inclusive design principles such as large buttons and large, clear displays.

Research shows that most people value simplicity in everyday technological devices,<sup>66</sup> and that some consumers asked about their concerns about IHDs being introduced cite worries that they will be complicated to use and difficult to understand.<sup>67</sup> Research into the usability of mobile phones provides confirmation that older people especially are likely to be less familiar with processes of menu navigation and selection, and people with learning disabilities also prefer operations that are easy to understand.<sup>68</sup> An IHD specification based on these principles would have the information most people want to know on the default display. A very limited number of additional functions (one or two) would be accessed by buttons, one button per function, or possibly a toggle button to go through a short sequence of related functions (such as past consumption figures for different time intervals).

### Hardware – the display

**Ambient feedback:** The choice of how to convey information through an IHD will have usability implications. ‘Ambient feedback’ generally refers to a visual at-a-glance distinction between times of high and low consumption – for example a red or green light on the display.

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<sup>64</sup> Etchell L and Yelding D (2004), *Inclusive design: products for all consumers*, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 186

<sup>65</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>66</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011; FDS International (2010), *Consumers’ views of Smart Metering*, report for Ofgem, July 2010; Ipsos MORI (2011) *CERT Real Time Display Evaluation*, for the ERA, February 2011 (draft)

<sup>67</sup> King E and Kear D (2009), *Smart Metering – Qualitative research presentation*, Kaleidoscope Research, November 2009

<sup>68</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011

It can also be used when a customer has a TOU tariff, for example to indicate 'high-cost' or 'low cost' periods. This can help those with low literacy or numeracy.<sup>69</sup> Equally though, 'warnings' such as red lights etc could lead to problems.<sup>70</sup> Consumer Focus has concerns that certain types of ambient feedback, such as red light to show high usage, could prompt elderly/vulnerable low income groups to under-heat their homes putting their health in danger. But we are unaware of any evidence of this, and urge Ofgem to investigate further. As part of the research, Ofgem should also investigate the feasibility of a function that allows the disabling of the ambient feedback option.<sup>71</sup> In trials, a simple tick or cross device against a fuel tank measure was found engaging, but some participants commented that they thought it could cause stress for low-income users.<sup>72</sup>

**Colour blindness:** About eight in 100 males and one in 100 females are affected by colour blindness<sup>73</sup> with red-green being by far the most prevalent. For red-green colour blind people this means the eye is less sensitive to either red or green and can struggle to identify the difference. Literature for web interface design advises that using colour only to convey meaning is not sufficient, a second means of conveying information should be provided for colour blind users.<sup>74</sup> An example of a second means is given as including text, but this could be by using patterns, icons or even a different colour shade (lighter or darker).

**Audible feedback:** Audible feedback can be helpful for older people and those with low literacy<sup>75</sup> and visual impairments.<sup>76</sup> At its simplest this could be a tone to sound when consumption starts to run above a pre-set level. Research into making phones easier to use suggests it may also be useful to have facility or option to change the volume of any audio messaging (and switch it off), and a range of tones to meet the needs of different kinds of hearing loss.<sup>77</sup> Guidelines relevant to the inclusion of 'text-to-speech' software (for example so that on-screen text can be made audible for some users) are given in digital television usability guidelines.<sup>78</sup>

**Backlighting:** Adequate backlighting for the IHD screen display is important, with the ability to increase back lighting if necessary – and not just for people with visual impairments.<sup>79</sup> People with visual impairments particularly need screen displays that are high contrast and with a large font.<sup>80</sup>

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<sup>69</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010

<sup>70</sup> Ibid; FDS International (2010), *Consumers' views of Smart Metering*, report for Ofgem, July 2010

<sup>71</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010, 11

<sup>72</sup> 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, 6114

<sup>73</sup> Bupa healthcare website <http://bit.ly/pMLx6n> (viewed 3.6.2011)

<sup>74</sup> Queen's University, Web Standards and Accessibility Guide <http://bit.ly/nQIXSj> (viewed 3.6.2011)

<sup>75</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010

<sup>76</sup> <http://bit.ly/qWlg6d> (PDF 697KB), 284

<sup>77</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011

<sup>78</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>79</sup> 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, 6115; Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>80</sup> <http://bit.ly/qWlg6d> (PDF 697KB), 284

**Screen display – general:** Further points on the screen display – given that the screen is likely to be relatively small – come from research on making phones easier to use<sup>81</sup> and include:

- Having high resolution (sufficient for information and icons to be clear to all users)
- Logical organisation of the display
- Clear, with no clutter
- Avoiding the use of the colour red for highlighting on screen

Other points relevant to the screen display are made under software, below.

## Hardware – labels and layout

Guidelines drawn up for digital TV equipment<sup>82</sup> state that:

- Labelling on hardware should be in lower case with few exceptions (such as OK)
- Button labels should be on or immediately next to the button, be clear and legible (in terms of font, size, and colour contrast)
- Labels should be durable (not easily worn off)
- Labels should be consistent with any on-screen display text
- Labelling terms should be clear and unambiguous, avoiding abbreviations where possible

Standard IHDs may not require numeric keypads or directional (arrow cursor) buttons, however if they do the same guidelines state that these should conform to industry standards, for example there should be a nib on the central '5' number button.

## Hardware – buttons

A number of points about buttons on domestic and communications devices can be drawn from research and guidelines, and will be relevant to button design and function on IHDs:

- More frequently used buttons should be easiest to find, with the most important buttons also being the largest<sup>83</sup>
- Hollows in the centre of buttons<sup>84</sup> or raised edges<sup>85</sup> make them easier to find
- Buttons need to be well-spaced as well as a useful size<sup>86</sup>
- An issue that relates to software and hardware combined is where a button has to be pressed several times in a limited time to work a function. This kind of operation is not good from a usability standpoint, especially for those with dexterity impairments<sup>87</sup>

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<sup>81</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011

<sup>82</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>83</sup> Ibid

<sup>84</sup> Ibid

<sup>85</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011

<sup>86</sup> Ibid

<sup>87</sup> Ibid

- Large buttons, labels and spaces between buttons make them easier to use for people with visual impairments and manual dexterity impairments – and are also preferred by other people. There should be sufficient contrast between buttons, labels and background<sup>88</sup>
- Buttons should be intuitively differentiable by size, shape, position and texture<sup>89</sup>; and differentiation by colour as well can be especially useful for those with visual impairments<sup>90</sup>
- Buttons should not be over-sensitive, so they are not pressed by accident by those with visual or dexterity impairments.<sup>91</sup> There should be feedback such as a click to confirm a button has been pressed. Other options are a ‘feelable’ click, noise or vibration<sup>92</sup>
- Button sensitivity becomes more important in conjunction with menus, where a common problem is ‘overshooting’ a wanted menu item, especially for those with dexterity impairments. Any delay between button press and response needs to be calibrated. If the delay allows more necessary button presses, it needs to be long. In other instances, a long delay leads people to think they have not effectively pressed the button, and to try other buttons or further pressing<sup>93</sup>
- For simple button operation, there should be no observable latency between a button press and an on-screen response<sup>94</sup>
- Toggle buttons should have small number of states, ideally only two. Where there are more, they should be in a logical sequence with visual information to show where you are and how to get back to the default<sup>95</sup> (this could be for example a button on an IHD toggling through total consumption for current day, week, month or quarter)

## Hardware – general

The EST research for the Centre for Sustainable Energy concluded that it would be important to optimise the overall size of the IHD, to ensure mainstream acceptability combined with the ability of those with visual impairments – or anyone at a distance – to read the display.<sup>96</sup>

## Software

**Attracting ‘low tech consumers’:** A 2010 literature review suggests that devices such as IHDs tend to be conceived by consumers as ‘high tech’, which can lead to broad usability problems among those who report that they do not view themselves as ‘techy’.

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<sup>88</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>89</sup> Ibid

<sup>90</sup> <http://bit.ly/qWlg6d> (PDF 697KB), 284

<sup>91</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>92</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011

<sup>93</sup> Klein JA, Karger SA and Sinclair KA (2003), *Digital Television For All*. Prepared for the DTI Digital Television Project, September 2003

<sup>94</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>95</sup> Ibid

<sup>96</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

The authors suggest that it is therefore important to ensure that the display helps to dispel the notion that the IHD is aimed only at the technologically proficient.<sup>97</sup>

**Keeping IHDs simple:** Focus group research for the EST suggests that many consumers will not be interested in interactive features on IHDs.<sup>98</sup> The possibility that IHDs will be too complex or technical is found to be a main concern among consumers in other research.<sup>99</sup> Some studies suggest that over time, consumers check IHDs less often and – when they do – use fewer functions.<sup>100</sup> Recent research for the Energy Retail Association (ERA) found that most consumers were not aware of the complex functionality available with their devices.<sup>101</sup>

**Default screen:** Overall it seems important that consumers should be able to access the information they want on the default screen, or from the default screen with the minimum number of operations. Consumer Focus referred to a supplier trial (unreferenced because of confidentiality) which suggested that consumers rarely look beyond the first or second screen on an IHD, and the focus group research carried out for the EST similarly concluded that users want key information to be retrievable from the default screen or with one button press.<sup>102</sup>

Research directly into consumer preferences for IHDs has concluded that the default screen should include as a minimum a visual representation of rate of consumption,<sup>103</sup> and for this a speedometer graphic using colours was favoured in a test of preferences following a trial of use of IHDs.<sup>104</sup>

Other research among those who have existing IHD models shows that an ambient display of current consumption (in this case as ‘traffic lights’) is cited by consumers, together with the monetary figure for cumulative consumption, as being the two most useful functions.<sup>105</sup>

**Relevant findings from digital television:** Further points on the software interface again come from digital television usability guidelines:<sup>106</sup>

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<sup>97</sup> van Dam SS, Bakker CA and van Hal JDM (2010), *Home energy monitors: impact over the medium-term*, *Building Research & Information*, 38: 5, 462

<sup>98</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>99</sup> King E and Kear D (2009), *Smart Metering – Qualitative research presentation*, Kaleidoscope Research, November 2009; Grundy E, *et al* (1999) *Disability in Great Britain: results from the 1996/7 Disability Follow-up to the Family Resources Survey*, Department of Social Security, London

<sup>100</sup> 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, 6111–6119; Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009; Ipsos MORI (2011) *CERT Real Time Display Evaluation*, for the ERA, February 2011 (draft); Grundy E, *et al* (1999) *Disability in Great Britain: results from the 1996/7 Disability Follow-up to the Family Resources Survey*, Department of Social Security, London

<sup>101</sup> Ipsos MORI (2011) *CERT Real Time Display Evaluation*, for the ERA, February 2011 (draft)

<sup>102</sup> Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010; Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>103</sup> 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, 6114; Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>104</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>105</sup> Ofgem PowerPoint presentation March 2011, summary of a trial

<sup>106</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

- The interface should use best practice from web design, for example menus should use clear terminology, highlight the current position, use sans-serif fonts at a suitable size, mixed case letters or lower case, not italic or underlined or condensed. Text and graphics should show with sufficient contrast, and colours should have maximum 85 per cent saturation
- Pure red and white, and combinations of red and green should be avoided
- Numerals should be Arabic ie 1, 2, 3 etc
- Text on screen should have generous inter-linear spacing, and good space round words. Flashing or scrolling text, or text where the user has to scroll to read it all, should be avoided
- On screen text should be left-aligned

Research into digital television equipment, which included a usability audit, highlighted the need to avoid complicated menu structures. From the user's standpoint, the predictability of the system is important and this is particularly so for some groups of users:

'When users press a button, they expect to complete a certain function or be taken to a certain destination in the menu structure. If they find themselves in an unexpected and perhaps unfamiliar location, then they become confused. Older users expressed concern that their button presses could break the equipment. The combination of confusion and fear of damaging the equipment led on some occasions to self-doubt and hesitancy in using the functionality available'.<sup>107</sup>

**Relevant findings from mobile phones:** Research into the usability of mobile phones<sup>108</sup> adds the following:

- Software could allow options to customise, including to on-screen text sizes, also to different colours for text, graphics and background (which may help with different needs according to type of visual impairment)
- There should be a hardware or software option to increase backlighting (but the default setting should not be too bright because of increased energy costs)
- Some visually impaired people may prefer text to icons which are harder to differentiate

**Relevant ISO standard:** Part 3 of the ergonomic standard ISO 9241<sup>109</sup> provides general guidance on the height of characters for all interface designers, to allow for optimal viewing. It states a character should subtend the eye at an angle of 20 to 22 minutes of arc for most tasks performed using a visual display terminal (equivalent to 3.5mm to 4mm based on a viewing distance of 600mm), a minimum angle of 16 minutes of arc (2.8mm from 600mm).

Standards are designed for voluntary use and do not in themselves impose any mandatory legal requirements. They represent a consensus view of the rules, guidelines and/or definitions that should apply to a service or product.

## Installation, information and instructions

This section summarises guidance and evidence from the review of literature that may be helpful in designing and delivering:

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<sup>107</sup> Klein JA, Karger SA and Sinclair KA (2003), *Digital Television For All*. Prepared for the DTI Digital Television Project, September 2003, 36

<sup>108</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011

<sup>109</sup> ISO 9241-3:1992 Ergonomic requirements for office work with visual display terminals (VDTs)

- The installation of IHDs
- Information and instruction about their use, taking into account a wide range of users and user needs
- Other support or advice

These are potentially very important to ensure that IHDs are usable and used. Consumer Focus's PPM research found that of four key areas that consumers felt needed to be most improved, two related to:

- Better information about how to use the PPM (especially if they had 'inherited' one) – few participants said they had ever seen instructions about how to use of manage their meter
- Lack of ongoing support from suppliers – some users felt that once their PPM had been installed, suppliers 'stopped listening'<sup>110</sup>

## Installation

- The Energy Demand Research Project (EDRP) trials found that staff involved in the installation of IHDs need the right technical skills but that 'softer' skills are also essential to enable installers to explain the new technology to customers<sup>111</sup>
- Staff involved in installing IHDs should have sufficient disability training<sup>112</sup> to understand the needs of different users, and involve customers when deciding:
  - Where to locate IHDs<sup>113</sup>
  - What settings to use for those aspects of the device that are adjustable, for example possibly the brightness of backlighting, the volume of any audio features<sup>114</sup>
- DIY installation should be as easy as possible for those who do not want a home visit, including people with different kinds of impairment and levels of ability, especially addressing any safety concerns; telephone follow-up should be offered to check that installation has been successful and to talk through how to use the device<sup>115</sup>

<sup>110</sup> Consumer Focus (2010), *Cutting back, cutting down, cutting off: Self-disconnection among prepayment meter users*, July 2010

<sup>111</sup> OFGEM, Energy Demand Research Project, <http://bit.ly/qwp5H4>

<sup>112</sup> Possibly with accreditation.

<sup>113</sup> One study found that customers who developed a long term habit of checking a simple electricity monitor mostly did so last thing at night and suggested locating monitors where checking them could be linked to another bedtime routine eg setting an alarm system (see van Dam SS, Bakker CA and van Hal JDM (2010), Home energy monitors: impact over the medium-term, *Building Research & Information*, 38: 5, 458-469).

<sup>114</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011; Klein JA, Karger SA and Sinclair KA (2003), *Digital Television For All*. Prepared for the DTI Digital Television Project, September 2003; Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010

<sup>115</sup> Vulnerable customers who may be tempted to under-heat their homes as a consequence of being able to monitor their energy consumption should be advised by installation staff about the importance of adequate home heating. In addition, since vulnerable customers are more likely to be among those who decline installation at first, the free installation offer should still stand if they change their mind at a later date (see Consumer Focus (2010), *Response to Smart Metering Implementation Programme: In-Home Display*, October 2010; Consumer Focus (2010), *Cutting back, cutting down, cutting off: Self-disconnection among prepayment meter users*, July 2010)

## Instructions and information for users

- Information and instructions delivered verbally need to be tailored to the household and the individuals in it rather than adopting a 'one size fits all' approach. The EDRP, in its report sections concerning 'real time displays' (IHDs), has highlighted that in all trials some participants report difficulty using the devices. It concludes that having devices installed, rather than sent with instructions for self-installation, is a crucial factor in success (in terms of ultimate energy savings). As noted above, installers need to be able to explain the devices to customers with different needs<sup>116</sup>
- Instructions should cover accessibility features and options<sup>117</sup>
- A supplier telephone number should be provided (freephone for all consumers from landlines and mobile phones) for further information and advice<sup>118</sup>
- Language should avoid abbreviations and jargon and be chosen with awareness of Plain English Campaign guidelines,<sup>119</sup> possibly seeking the Plain English Campaign's Crystal Mark or equivalent
- Provide information in alternative formats, including screen readable via personal computer<sup>120</sup> or DVD<sup>121</sup>
- Avoid glossy paper on printed instructions to cut down glare and improve grip,<sup>122</sup> and paper thick enough to prevent show through<sup>123</sup>
- Diagrams and pictures in addition to text are helpful but should be next to the relevant text and show enough of the device to provide visual context for the feature under discussion; text should not be printed over images<sup>124</sup>
- High contrast is needed between text and background, and the background should be plain<sup>125</sup>
- Information layout should be simple, consistent and uncluttered<sup>126</sup>

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<sup>116</sup> OFGEM, Energy Demand Research Project, <http://bit.ly/qwp5H4>

<sup>117</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>118</sup> Consumer Focus (2010), *Cutting back, cutting down, cutting off: Self-disconnection among prepayment meter users*, July 2010

<sup>119</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>120</sup> Ibid; <http://bit.ly/qWlq6d> (PDF 697KB), 284; Etchell L and Yelding D (2004), Inclusive design: products for all consumers, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 188; RNIB, <http://bit.ly/r73ekR>

<sup>121</sup> Ipsos MORI (2011) *CERT Real Time Display Evaluation*, for the ERA, February 2011 (draft)

<sup>122</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010; Etchell L and Yelding D (2004), Inclusive design: products for all consumers, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 189; RNIB, <http://bit.ly/r73ekR>

<sup>123</sup> RNIB, <http://bit.ly/r73ekR>

<sup>124</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>125</sup> Ibid; Etchell L and Yelding D (2004), *Inclusive design: products for all consumers*, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 189; RNIB, <http://bit.ly/r73ekR>

<sup>126</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010; Etchell L and Yelding D (2004), *Inclusive design: products for all consumers*, *Consumer Policy Review* Nov/Dec 2004, Vol 14, No 6, 189

- Simple sans serif typefaces are commonly recommended.<sup>127</sup> However the RNIB website makes the point that – beyond using a clear, non-stylised font – more important than the particular typeface choice is ensuring a good font size. The size should be at least 12 preferably 14. Also the weight of character is important; it should be a medium weight – not too thin or thick<sup>128</sup>
- Printed instructions should be concise (preferably no more than four pages long)<sup>129</sup>

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<sup>127</sup> Digital TV Group (2010) UK Digital TV Receiver Recommendations and Usability Guidelines Including Text to Speech Draft Version 2.07, November 2010

<sup>128</sup> RNIB, <http://bit.ly/r73ekR>

<sup>129</sup> FDS International (2010), *Consumers' views of Smart Metering*, report for Ofgem, July 2010

# General design principles by impairment group

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According to the Government's *Life Opportunity Survey*<sup>130</sup> almost one third of adults in Great Britain have an impairment.

Literature covered by this review highlights some of the broad principles in designing for people with specific types of impairment, much of it taken from the Inclusive Design Toolkit website developed by the University of Cambridge, Engineering Design Centre and sponsored by BT<sup>131</sup> and Ricability's research on central heating controls.<sup>132</sup> Only guidance likely to be relevant to the development of IHDs is covered:

## Hearing impairment

- With any audio features (eg associated with pressing buttons or keys) provide adjustable volume levels where possible, otherwise sufficient loudness for the ambient noise level
- Use frequencies within the range 800 to 1,000 Hz in order to maximise the number of people able to detect them
- If speech is built in, use:
  - natural recorded speech in preference to synthesised speech
  - avoid high pitches
  - use intonation, an appropriate word rate and clear pronunciation to help speech recognition
- Consider assisting those with hearing impairments by supplementing information through visual or tactile means, with due consideration for information overload<sup>133</sup>

## Vision impairment

- Consider potential issues with glare, linked especially to the:
  - surface finish of any screen
  - main light source
  - angle of view
- Think about using colours to help convey information as well as presenting the information in alternative ways (eg shapes and text)
- Consider using colour contrast to help make things stand out, but ensure there is also sufficient brightness contrast

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<sup>130</sup> Source: *Life Opportunities Survey – Interim Wave One Results*, 2010 Statistical Bulletin.

<sup>131</sup> University of Cambridge, Engineering Design Centre, BT sponsored: Inclusive design toolkit, [www.inclusivedesigntoolkit.com](http://www.inclusivedesigntoolkit.com)

<sup>132</sup> Ricability Consumer Reports – Digital Programmers, <http://bit.ly/pCnwFw>

<sup>133</sup> University of Cambridge, Engineering Design Centre, BT sponsored: Inclusive design toolkit, [www.inclusivedesigntoolkit.com](http://www.inclusivedesigntoolkit.com)

- Check that the product remains usable when its image is converted to grey scale
- Think about assisting those with vision impairments by supplementing information through auditory or tactile means
- Arrange design so that it remains visible and usable for those who have some loss of visual field
- Choose text of suitable size, font and brightness contrast for comfortable reading given the likely viewing distance and potential difficulties caused by ambient lighting
- Be careful with the use of text on a patterned or picture background, with due consideration for legibility
- Avoid italicised or decorative font styles for blocks of text or signs
- Carefully consider the line thickness, line spacing and overall size when designing graphical symbols or logos

In tests of central heating controls, people with visual impairments were critical of models where:

- Colour contrast on the LCD screen was not good enough
- Information on the screen and on the unit was too small
- Screen layout was confusing and it was hard to tie up what was happening on the screen with the buttons<sup>134</sup>

## Impaired reach and stretch

- Provide the option to operate the product by either reaching out the left or right arm, and try to avoid requiring both arms to be reached out at the same time
- Ensure the product can be installed at heights that people can reach to, including those in wheelchairs
- Avoid requiring users to reach above their head, where possible, and note that the ability to exert forces will be greatly diminished when the arms are in this position<sup>135</sup>

## Impaired dexterity

- Try to facilitate product interaction that only requires the user to generate pushing forces
- Note that controls requiring simultaneous movements in different directions (such as combined pushing and twisting) are particularly difficult for those with reduced motor control
- Enable easier gripping by providing a slightly deformable surface, and maximising the available contact area where possible
- Try to ensure the product can be used left or right handed, and one or two-handed<sup>136</sup>

In tests of central heating controls, people with impaired dexterity were critical of models where:

<sup>134</sup> Ricability Consumer Reports – Digital Programmers, <http://bit.ly/pCnwFw>

<sup>135</sup> University of Cambridge, Engineering Design Centre, BT sponsored: Inclusive design toolkit, [www.inclusivedesigntoolkit.com](http://www.inclusivedesigntoolkit.com)

<sup>136</sup> Ibid

- They had to keep a constant pressure on the time button
- Sliders for setting timing operations were stiff and/or awkwardly shaped or too close together
- Select buttons were too small
- It was hard to tell if buttons had been pressed<sup>137</sup>

## Impaired memory and learning ability

- Use structure to assist memory and learning
- Reduce the number of information chunks that need to be kept in mind at any given time, and try not to exceed five as the best practice
- Where hierarchy is used, ensure the current location within the overall hierarchy is always evident and try not to exceed three levels
- Assist learning and recall through distinctive spatial positions for menu options, and be wary of the potential confusion if these positions change
- Provide an obvious mechanism that allows users to get back to their previous location or home when navigating any menu structure
- Consider the memory implication of unseen content if scrolling is required to obtain more menu items
- Support learning by ensuring that all possible actions generate suitable feedback that guides the user
- Try to ensure all actions are easily and immediately reversible, and try to constrain the availability of actions that would result in undesirable or irreversible outcomes<sup>138</sup>

## Impaired perception and attention

- Use shapes, colours and alignment to assist visual grouping of features that share some kind of similarity, thereby reducing the time and working memory required to locate a desired feature
- Align controls in a spatial orientation that matches the devices they affect, or provide an obvious link between controls and the corresponding devices
- Consider the increased demand on spatial ability if left and right are used to represent up and down (or vice versa), and avoid this situation wherever possible
- Use the visual form of the device to help users understand what areas they can interact with, and the correct way to interact with them
- Try to use simple language, and supplement textual information with images and icons
- Be wary of potential problems that can result if multiple actions have to be completed within a certain time period
- Try to ensure that attention is only required to be directed in one place at any one time<sup>139</sup>

<sup>137</sup> Ricability Consumer Reports – Digital Programmers, <http://bit.ly/pCnwFw>

<sup>138</sup> University of Cambridge, Engineering Design Centre, BT sponsored: Inclusive design toolkit, [www.inclusivedesigntoolkit.com](http://www.inclusivedesigntoolkit.com)

<sup>139</sup> Ibid

# Usability testing and development

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This review has identified some principles that may help in the development of IHDs to ensure they are usable by as many people as possible, irrespective of their age, ability or impairment status. User testing at different stages during development is nonetheless essential, from conception and early prototyping of IHDs to the process of installation, user training and user support, and trouble-shooting. In February 2005 the British Standards Institution (BSI) launched a new standard<sup>140</sup> BS 7000-6 which provides a guide to managing inclusive design (rather than technical specifications for any actual products) that drew attention to the need to involve users of products.<sup>141</sup>

Appropriately designed, testing and development procedures involving diverse potential users will help in:

- the specification of IHDs that meet a wide range of needs<sup>142</sup>
- piloting of early prototypes
- resolving any conflicts between the needs (and preferences) of different user groups, for example by distinguishing between features that would bring great benefit to some groups of users while being acceptable to the rest and others where there is no such overlap. For example, in mobile phone testing younger users liked touch screens but older and disabled people did not, and buttons/keys on the side of phone were liked by younger users because of ease of access, but older people preferred them on the front<sup>143</sup>
- estimating the percentage of people who would be excluded from using different models or designs, to help in decision making and cost-benefits analysis. This could be approached using a large sample representative of end users to test IHDs,<sup>144</sup> or based on a small sample of carefully selected users. For example, a usability audit of set top boxes for digital television used ONS data to extrapolate from small-scale test results in order to derive estimates of the numbers of people with different kinds of impairment who would be excluded from using the product<sup>145</sup>

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<sup>140</sup> Standards are designed for voluntary use and do not in themselves impose any mandatory legal requirements. They represent a consensus view of the rules, guidelines and/or definitions that should apply to a service or product.

<sup>141</sup> Lennard, L and George M (2007), *Ease of use issues with domestic electronic communications equipment*, A research audit, OFCOM, July 2007

<sup>142</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>143</sup> Communications Consumer Panel (2011), *Making phones easier to use: views from consumers*, Research Report January 2011; Fashion and aesthetics may be less important for IHDs than for mobile phones and mobile phones and the potential for compromise between different user groups is therefore likely to be higher.

<sup>144</sup> ISO 9241 parts 11–14 (not up to 19 as on original list); Nokia: *Making mobile devices accessible to all*, <http://bit.ly/nl8a7n>

<sup>145</sup> Klein JA, Karger SA and Sinclair KA (2003), *Digital Television For All*. Prepared for the DTI Digital Television Project, September 2003

- In 'real life' testing of IHDs in the home at later stages in the design process, including the process whereby IHDs are installed, customers instructed in their use and follow up support is provided<sup>146</sup>

Testing is needed that collects both objective and subjective data on usability. Some may also be appropriately carried out where the household is the main unit of analysis, rather than the individual; to reflect the fact that use of different appliances in many households tends to be the domain of key individuals.<sup>147</sup>

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<sup>146</sup> Anderson W and White V (2009), *The smart way to display*. For the EST by the Centre for Sustainable Energy, September 2009

<sup>147</sup> 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, 6115

# Conclusions

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This review discovered that while research has been carried out on in home displays, no study has focused directly on their usability, or the needs of the most vulnerable within our communities.

While IHDs are a relatively new appliance and manufacturers are still reacting to changes in functional specifications, there is a substantial amount of design guidance in the form of standards and best practice from mature industries with design similarities such as mobile phones and digital TVs that may be applicable. This study recognises that some design elements would be almost directly transferable. This study does not directly address the issue of the cost of these design elements but it is clear that many elements carry no or negligible cost, such as font type and the positioning of a button label.

It is not clear whether manufacturers and/or suppliers have performed their own usability evaluations, however, the literature suggests that an IHD will have the best chance of being both accessible and usable if inclusive design principles are followed and designs are evaluated and refined through user testing.

Of course it is not simply the IHD that must be accessible and usable for users to get the most out of the smart metering programme, the whole service is only as accessible as its weakest part. This means instructions, information, bills etc all have to be provided in a way that is accessible and easy to understand.

# Next steps

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The literature review revealed a number of gaps in the existing research, where further work is needed to understand the impact on particular consumer segments, to explore what impact a new functionality might have on consumer behaviour and to assist manufacturers and suppliers develop inclusively designed products. It is suggested that further work should include:

- User trials for prepayment and TOU customers – until now few user trials have looked at the needs of customers who use prepay energy or TOU tariffs. As noted, while it is likely that they also only use a few core functions regularly, they may have slightly different needs
- Exploring the added complexity of providing a dual fuel IHD
- The effect, if any, that real-time feedback on energy consumption has on low income and vulnerable consumers, for example, could it prompt them to under heat their homes?
- Design guidance specific to the industry to support an inclusively designed product/service

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