Commission for Energy Regulation
An Coimisiún um Rialáil Fuinnimh

Electricity Smart Metering Customer Behaviour Trials (CBT) Findings Report

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CER – Information Page

Abstract:

This customer behavior trials (CBT) findings report delivers the results of a set of trials that were undertaken to provide robust statistical information on the impact of electricity smart metering enabled initiatives (in the form of time of use tariffs in combination with various demand side management informational stimuli) have on overall and peak electricity usage for residential and small business consumers.

Target Audience:

This paper is for the attention of members of the public, the energy industry, energy consumers and all interested parties.

For further information on this Information Paper, please contact Gary Martin (gmartin@cer.ie) at the CER.

Related Documents:

- Smart Metering Information Paper 4 – CER/11/080 – 16th May 2011
- Electricity Smart Metering Technology Trial Findings Report – CER/11/080b – 16th May 2011
- Electricity Smart Metering Cost-Benefit Analysis (CBA) Findings Report – CER/11/080c – 16th May 2011
- Consultation Papers and Responses:
  - Responses to Consultation Paper 2 – CER/11/033 – 18th February 2011
  - Consultation Paper 2 – CER/10/197 – 11th November 2010
  - Responses to Consultation Paper 1 CER/10/161 – 9th September 2010
  - Consultation Paper 1 – CER/10/082 – 11th June 2010

Executive Summary

i. Introduction

The National Smart Metering Plan is a commitment in the Government's Energy Policy Framework and the development of a smart grid is outlined in the Programme for Government 2011 to 2016.

Following consultation with the industry, the Commission for Energy Regulation (CER) established the Smart Metering Project Phase 1 in late 2007 with the objective of setting up and running smart metering trials and assessing their costs and benefits and information required for the full rollout of an optimally designed universal National Smart Metering Plan.

The project was managed by the CER and consisted of representatives from the Department of Communications, Energy and Natural Resources (DCENR), Sustainable Energy Authority of Ireland (SEAI), the Northern Ireland Authority for Utility Regulation (NIAUR) and Irish Gas and Electricity Industry Participants. There were three distinct strands to the work; technology trials, customer behaviour trials and a cost-benefit analysis for the rollout of smart meters. This document is one of three reports and sets out the detail and results of the customer behaviour trials for residential and non-profile meters consumers (SMEs).

The Irish CBT is one of the largest and most statistically robust smart metering behavioural trials conducted internationally to date and thus provides a wealth of insightful information on the impact of smart metering enabled initiatives on electricity consumers.

The statistical evidence from the Residential Customer Behaviour Trial is that the deployment of Time of Use tariffs in combination with other Demand Side Management stimuli results in a change in energy consumption. Specifically, the residential trial participants achieved reductions in electricity consumption, both overall and at times of peak usage.

ii. The Customer Behaviour Trials

Pilot Objectives

The overall objective of the Customer Behaviour Trial was to ascertain the potential for smart metering technology, when combined with time of use tariffs and different DSM stimuli, to effect measurable change in consumer behaviour in terms of reductions in peak demand and overall electricity use.

The Residential Customer Behaviour Trial included the additional objective of seeking to identify a "Tipping Point" that is a point at which the price of electricity will significantly change usage.

Duration of the SME and Residential Customer Behaviour Trials

The Customer Behaviour Trial had two distinct periods:

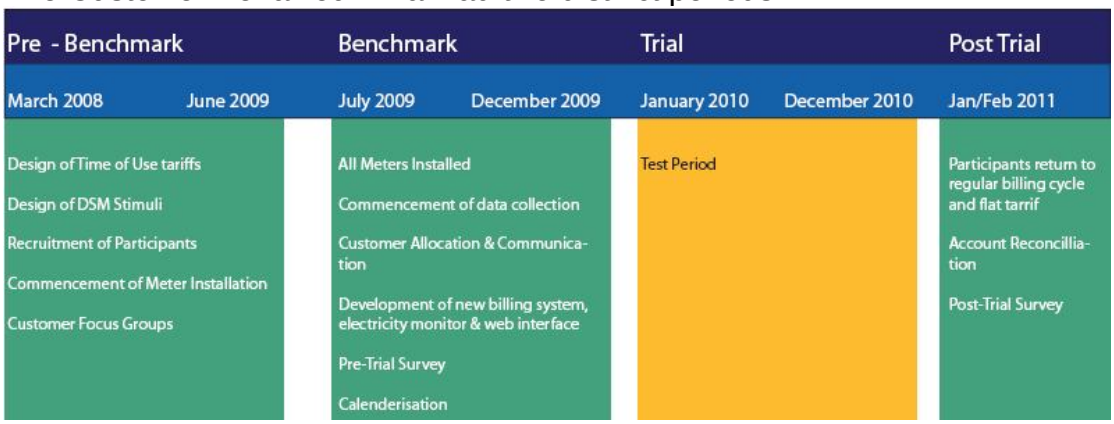

Figure 1: Electricity Customer Behaviour Trial Timeline

a) **The Benchmark period** - 1st July to 31st December 2009. All meters were installed prior to the start of the benchmark period and data was collected in order to establish a benchmark level of use. Participants were also allocated to a test or control group (see **Table 1** below).

b) **The Test period** - 1st January to 31st December 2010. During the test period participants trialled different time of use tariffs and demand side management stimuli (see below).

Test and Control Groups

At the end of the benchmark period participants in the Residential and SME Trials were divided into test and control groups. The test groups were asked to trial different time of use tariffs and DSM stimuli. The control group was billed on their normal electricity supplier (Electric Ireland[1]) tariff and saw no changes to their bill. They received none of the DSM stimuli and were requested to continue using their electricity as normal.

Design of the Time of Use Tariffs

Time of use tariffs were trialled during the Customer Behaviour Trial. A weekend tariff was also included for Residential participants. The following principles were used in the design of the ToU tariffs to ensure that the key objectives of cost neutrality and cost reflectivity were achieved:

- The time of use tariff would be neutral in comparison with the standard Electric Ireland tariff to ensure that the "average" participant who did not alter their electricity consumption pattern was not penalised financially.
- The base ToU tariff would reflect the underlying cost of energy transmission, distribution, generation and supply as per standard tariffs.
- The time-of-use structure (time bands) would be based on system demand peaks.
- Tariffs would be based on the cost inputs used in the 2009/10 regulated tariffs.

	Day Rate	Peak Rate	Day Rate	Night Rate
Timeband	8am – 5pm	5pm – 7pm	7pm – 11pm	11pm – 8am
Unit Rate (excl. VAT)				

Figure 2: Time of Use Bands

Customer Research

Research into electricity consumers and Trial participants represented a fundamental aspect of the Customer Behaviour Trial. This consisted of a series of surveys and consumer focus groups, summarised as follows:

- Pre-trial survey of participants in the Trial. Information gained from this survey provided insights which informed the participant allocation and provided a benchmark for any subsequent change in behaviour which might be measured at the end of the Trial.
- Post-trial survey of the same participants in January 2011, comparing change in attitude, equipment or electricity use to the pre-trial findings.

[1] As per the decision on the Roadmap for Deregulation (CER/10/058), a criterion for deregulation is the provision of a satisfactory commitment to re-brand. ESB Customer Supply and ESB Independent Energy have now commenced their re-branding process with the launch of their new name, Electric Ireland. As is fitting, the CER will hence with adopt this name in all its publications.

- Non-response survey of those who chose not to respond to the invitation letter and of those who left the Trial for various reasons before it had ended.
- Focus groups with non-Trial participants in order to assist in design of the ToU tariffs, DSM stimuli and some selected communications.

Participants in the Residential pre- and post-trial survey received a thank you payment of €25 for each survey (credited to their bill in December 2009 and January 2011).

iii. The Residential Customer Behaviour Trial

The optimal sample size for the Trial was determined to be 4,300 participants. Allowing for attrition during the Trial, 5,375 were initially recruited with 5,028 still on the Trial when allocation commenced in November 2009.

Recruitment of Participants
In order to ensure that the outcome of the Trial would be robust and representative of the national population, the recruitment process was phased. After each phase the respondents who opted in were profiled to confirm that they representative of the national profile. Once recruitment was completed, the set of consumers who had accepted was compared to the set of those who had not (captured through a non-response survey) in order to check and confirm for representivity.

Participant selection and recruitment followed a voluntary "opt-in" model using a tear off slip and achieved an average response rate of 30%.

Time of Use Tariffs and Demand Side Management (DSM) Stimuli
Time of use tariffs and demand side management stimuli were specifically developed for use in the Customer Behaviour Trial. These may be summarised as follows:

- Four specific time of use tariffs A, B, C and D offering different unit prices for the night time, day time and peak times, in combination with;
- specific DSM initiatives, which included:
    - bi-monthly electricity bill with detailed energy statement
    - monthly electricity bill with detailed energy statement
    - electricity monitor
    - an Overall Load Reduction (OLR) incentive
- A weekend tariff

Supporting information
Participants also received supporting information in the form of a fridge magnet and sticker. The fridge magnet outlined the different timebands and cost per band, customized for each tariff group.

The sticker provided details of the time bands.

Test and Control Groups

At the end of the benchmark period participants were allocated to either a test or control group:

Tariff	Bi-monthly bill and energy usage statement	Monthly Bill, and energy usage statement	Bi-monthly bill, energy usage statement and electricity Monitor	Bi-monthly bill, energy usage statement plus Overall Load Reduction	Total
Tariff A	342	342	342	342	1,368
Tariff B	127	129	127	128	511
Tariff C	342	342	343	343	1,370
Tariff D	127	129	126	127	509
Weekend					100
Control Group					1,170
	938	**942**	**938**	**940**	**5,028**

Table 1: Residential Matrix allocation as of 13 November 2009

Time of Use Tariffs

Four different time of use tariffs were developed for the Customer Behaviour Trial. A weekend tariff was also included. These may be summarised as follows:

Residential Tariffs

Domestic Time of Use Tariff				
		Night 23.00 – 08.00	**Day** 08.00 – 17.00 19.00 – 23.00 weekdays 17.00-19.00 weekends and bank holidays	**Peak** 17.00 – 19.00 (Monday to Friday), excluding bank holidays
Tariff A	Cents per kWh	12.00	14.00	20.00
Tariff B	Cents per kWh	11.00	13.50	26.00
Tariff C	Cents per kWh	10.00	13.00	32.00
Tariff D	Cents per kWh	9.00	12.50	38.00

Table 2: Residential Time-of-Use tariffs 1st January to 31st December 2010

Weekend Tariff

Weekend Tariff				
		Night 23.00 – 08.00 and all weekends	**Day** 08.00 – 17.00 19.00 – 23.00 excluding bank holidays	**Peak** 17.00 – 19.00 (Monday to Friday) excluding bank holidays
Monday to Friday	Cents per kWh	10.00	14.00	38.00
Saturday & Sunday		10.00	10.00	10.00

Table 3: Weekend tariff 1st January to 31st December 2010

Balancing Credit

Throughout the Trial all participants testing time-of-use tariffs were guaranteed that they would not pay more for their electricity than if they had been on the normal Electric Ireland tariff (14.1c per unit ex VAT). Accordingly, all participants received a *balancing credit* at the end of the benchmark period and in January 2011. The small number of individuals who incurred costs above this average were recompensed on a case by case basis.

Residential	Total Amount	Paid December 2009	Paid January 2011
Tariff A	**€30**	**€15**	**€15**
Tariff B	**€50**	**€25**	**€25**
Tariff C	**€70**	**€35**	**€35**
Tariff D	**€90**	**€45**	**€45**

Table 4: Residential Balancing credits as of 1st January 2010

Residential Customer Behaviour Trial Findings

The main findings of the Trial may be summarised as follows:

Response to tariffs and DSM stimuli

- the deployment of ToU tariffs and DSM stimuli are found to reduce overall electricity usage by 2.5% and peak usage by 8.8%;
- the combination of bi-monthly bill, energy usage statement and electricity monitor is found to be more effective than other DSM stimuli in reducing peak usage with a peak shift of 11.3%;
- overall energy reduction is linked with the level of usage: Households with higher consumption tended to deliver greater reductions in usage;

- analysis of the load distribution suggests shifting of load from peak to the post-peak period and in general to night usage from peak;
- of the tariff groups tested, no single one in combination with DSM stimuli stands out as being more effective than the others.
- the peak and overall load reductions detected for all the stimuli tested proved to be statistically significant with the exception of the overall load reduction detected for the bi-monthly bill and detailed energy statement stimulus, although the peak load reduction for this stimulus was statistically significant;
- the data from the Trial provides no evidence of a tipping point, with demand for peak usage estimated as being highly inelastic relative to price.

Demographic, behavioural and experiential conclusions

- Participants adapted usage to realise the potentially positive impact of the tariffs on their bills. 82% of participants made some change to the way they use electricity due to the Trial with 74% stating major changes were made by their households;
- Simple information can also be effective: The fridge magnet and stickers achieved 80% recall with 75% finding the magnet useful and 63% finding the sticker useful;
- The electricity monitor was deemed to be effective as a support to those achieving peak reduction (91% rated it as an important support) and shifting to night rates (87% deemed it an important support).
- Barriers to peak reduction relate to the difficulty of linking behaviour change to bill reduction. These perceptions may have contributed to the current recorded reduction. This may be hard to address due to exaggerated expectations of savings and similar exaggerated expectations of consequences if reduction is not achieved;
- Barriers to shifting to night usage relate to safety and convenience.
- The OLR incentive was impacted by a low recall rate (58%). However, the scores for communications, reasonableness of the target and effectiveness of the OLR incentive in motivating change were all very good.
- The detected benefits of the Trial are focused on behaviour changes in response to the price signals and DSM stimuli applied. No secondary benefits were identified in increased awareness of general energy efficiency or investment in energy efficiency enhancements for the home;
- The Trial succeeded in making participants more aware of energy usage (54% agreed) which is in keeping with the reduction in usage recorded. Only 18% stated that there had been no impact on the way their household uses electricity;

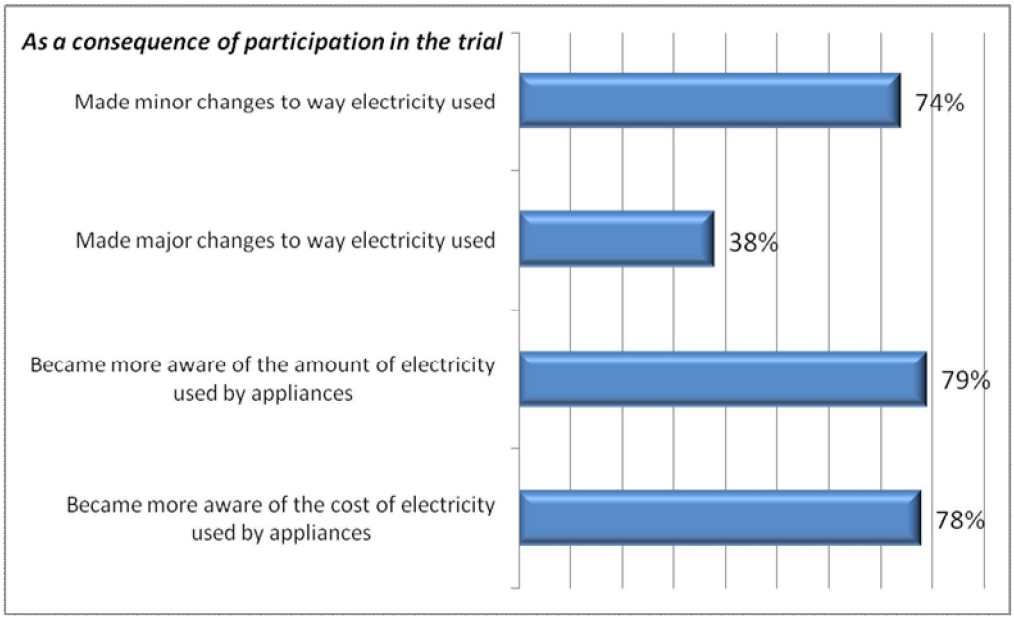

Figure 3: Perceived impact of participation on usage and awareness

- Households headed by individuals with greater educational achievement or social grade achieved higher levels of reduction than those with lower levels. This was in part related to the typically higher level of usage associated with these households. Therefore, the impact of education or social grade on the ability to gain benefit from the tariffs is limited
- The impact of the time of use tariffs on recipients of FEA (Free Electricity Allowance) shows that these individuals exhibited the same level of change as other households and therefore do not appear to be disadvantaged over other groups;
- Fuel poor households (which lack financial means to adequately heat their homes) also benefit from the deployment of time of use tariffs.

iv. The SME Customer Behaviour Trial

The overall sample size for the SME Customer Behaviour Trial was specified at 728 participants and was broadly representative of the population of electricity users eligible to participate in the Trial. Representivity was limited to that of the relative SME base, as reflected in the customer bases of the two participating suppliers. At the start of the benchmark the total number of SMEs still participating with meters installed was 723 with 650 remaining when allocation took place in November 2009.

Recruitment of Participants
The Trial focused on commercial organisations with a single site and reasonable payment history over the previous 12 months. The organisations with multiple sites were included within the separate multi-site study. Finally, participants were drawn from the customer bases of Electric Ireland and Bord Gáis Energy Supply. Recruitment was completed in a similar manner to the residential trial with an invitation letter which was then followed up by a phone call.

Time of Use Tariffs and Demand Side Management (DSM) Stimuli
Time of use tariffs and demand side management stimuli were specifically developed for use in the Customer Behaviour Trial. These may be summarised as follows:

- Time of use tariffs offering different unit prices for the night time, day time and peak times, in combination with;

- specific DSM initiatives, which included:
    - bi-monthly electricity bill with detailed energy statement
    - monthly electricity bill with detailed energy statement
    - electricity monitor
    - web access to energy usage information

Test and Control Groups
At the end of the benchmark period participants were allocated to test and control groups:

	Bi-monthly bill, energy use statement + Electricity Monitor	Bi-monthly bill energy use Statement + Web access	Monthly bill energy use statement	Bi-monthly bill energy use statement	Bi-monthly bill energy use statement	Total
Sector	**Electric Ireland**	**Electric Ireland**	**Electric Ireland**	**Electric Ireland**	**Bord Gáis Energy**	
Retail	31	31	29	16	33	140
Small Industrial	13	17	19	8	19	76
Entertainment	19	19	17	8	18	81
Office/Professional	20	17	20	11	17	85
Total	**83**	**84**	**85**	**43**	**87**	**372**
Retail		67 40 34 39 **180**			33	103
Small Industrial					19	59
Entertainment					18	54
Office/Professional					18	62
Total					**88**	**268**
			475		**175**	**650**

Table 5: SME Matrix allocation as of 15 November 2009

Time of Use Tariffs

Time of use tariffs were developed for the SME Behaviour Trial. Electric Ireland tested two different tariffs with two groups, Tariff A and Tariff B. Tariff B had a slightly higher unit charge during Day and Peak, but was almost half Tariff A for night use. Bord Gáis Energy continued to price participants on an individual basis and introduced a customised time of use tariff for each participant. The relativities developed for the Electric Ireland tariffs were maintained by Bord Gáis Energy in the development of their tariff. The final tariffs may be summarised as follows:

Domestic Time of Use Tariff				
		Night 23.00 – 8.00	**Day** 8.00 – 17.00 19.00 – 23.00	**Peak** 17.00 – 19.00 (Monday to Friday), excluding bank holidays
Electric Ireland				
- Tariff A	Cents per kWh	14.00	15.00	22.00
- Tariff B	Cents per kWh	7.50	16.00	22.50
Bord Gáis Energy	Cents per kWh	Tariff applied varied by individual participant		

Table 6: SME Time-of-Use tariffs as at 1st January 2010

Balancing Credit
Similar to the Residential Customer Behaviour Trial, participants also received a *balancing credit* one in December 2009 and the second in January 2011. The small number of individuals who incurred costs above this average was recompensed on a case by case basis.

SME	Total Amount	Paid December 2009	Paid January 2011
Tariff A	**€ 100**	**€50**	**€50**
Tariff B	**€ 100**	**€50**	**€50**
Bord Gáis Energy	**€ 100**	**€50**	**€50**

Table 7: SME Balancing Credits as at 1st January 2010

SME Customer Behaviour Trial Findings
The main findings of the SME Trial may be summarised as follows:

Response to tariffs and DSM stimuli

- the deployment of ToU tariffs and DSM stimuli are found to reduce overall electricity usage by 0.3% and peak usage by 2.2%, although neither result is found to be statistically significant;;
- there is no tariff, DSM stimulus or tariff/DSM stimulus group which reduced overall electricity usage or peak usage by a statistically significant amount;

Empirical, behavioural and experiential conclusions

- 41% of participants believed that they reduced overall usage with 59% stating they reduced peak usage. The tariffs were regarded as effective in supporting this reduction with 71% stating the peak cost forced their business to attempt to reduce usage at this time.
- Participants have an increased level of regular monitoring of their electricity usage with 13% reporting this to be the case compared to 8% among the control group with 45% stating that they reviewed usage to identify ways of reducing it;
- The main barrier to reduction was the perception that it was not possible to move the usage to other times. This was stated as a very important reason by 72% of businesses who stated they did not reduce peak usage and 61% of those who did not reduce overall usage;
- Among the participants who had an overall load reduction the level of reduction was on average 8.51% with an average peak reduction of 8.33%. Among the participants who had a peak load reduction the level of overall reduction was on average 5.74% with an average peak reduction of 10.25%.
- Among participants who reduced either peak or overall usage, the electricity monitor was deemed to be effective with 93% of those reducing overall usage stating it was important and 85% of those reducing peak usage stating it was important;
- In contrast, the web-site information was rated as important to overall usage by 24% of reducing businesses with access to the stimulus. This reflects the low level of usage of the system (at 15% stating they logged in).

v. Prepayment User Trial

The Prepayment User Trial aimed to conduct a proof of concept pilot to test whether a Smart Meter could be used as a Prepayment Meter without physical modification. A key requirement of the Trial was to test real prepayment as opposed to debt recovery and to test whether the meter could facilitate debits and credits, with the electronic purse resting with the supplier. It was initially proposed that the Trial would last six months. This was later extended by a number of months to allow for additional technical testing.

Once the consumer opted in to the Trial, ESB Networks installed the new smart meter. This meter returned daily readings similar to the Customer Behaviour Trial. The daily reads and daily payments were uploaded manually to the system and the account balance was calculated daily.

The daily balance was made available to participants by phone (IVR) and by text message (SMS). The balance also incorporated any arrangement due for outstanding payment of arrears.

Participants could make payments to Electric Ireland through all the existing payment channels i.e., on-line and billpay.ie, at AIB or Bank of Ireland, by Laser card or an Ulster Bank visa debit card, through the National Contact Centre and at all Paypoint, Payzone, Postpoint and An Post outlets.

An off-line debt management process monitored account balances and compliance with any account arrangements. Accounts found to be in breach of agreed thresholds received a reminder by SMS.

Participant Distribution and Profile

A total of 60 participants was recruited for the Prepayment Trial. This was made up of 35 staff members of Electric Ireland, one CER staff member and 24 customers.

Focus Group Findings

Feedback on the Prepayment Trial was collected by means of focus groups. Two focus groups were conducted in total and their attendance comprised over 63% of the participants in the Trial.

In general participants had a very positive assessment of the Trial. Over 85% declared themselves happy with the concept of prepaying their electricity bill as a result of their experience of participating in the Trial. In addition over 85% indicated that the Trial itself was either helpful or very helpful in helping them pay for their electricity.

Behaviour changes occurring during the Trial

Participants fell into a pattern of fixed payments after the first two weeks. A total of 86% decided to make weekly payments in the range of €15-€30.

The reminder texts were an effective mechanism for motivating payment action. All participants who received texts read them and sought to specifically understand what they were being advised. Over 50% paid on the same day of receiving the text and the remaining participants waited a short period until money became available.

Improvements to the Prepayment Trial

When asked to suggest improvements to the Prepayment Trial, participants would value real-time payment options, where payments would be immediately credited and texts would relate to late payment or change in credit status. They would also value a meter providing real-time data on their usage and credit status, thus reducing the need for texts and mitigating mobile phone access issues. 89% of focus group participants indicated that they would chose the option of remaining in prepayment:

vi. Multi-site User Trial

The Multi-site Trial was designed as a qualitative assessment. In all four organisations spread across 11 locations took part in the Trial. Participants were provided with energy statements that consisted of detailed information on time of use energy consumption. Additionally, participants with internet connectivity had access to an on-line system providing further usage information.

While smart meter data was available, the reporting of potential reductions in overall or peak usage is not appropriate due to the relatively small number of organisations included. Organisations with multiple sites having at least two and, on occasion, three types of stakeholders were included within the research.

The research included up to three in-depth interviews of each stakeholder (one prior to the start of the Test period, potentially an additional one during the Test period and a final interview at the completion of the Trial).

Participants were provided with energy usage statements which provided additional information on time of use data. Participants with office internet connectivity also had access to an on-line system providing further usage information. In the research conducted during or after the completion of the Trial, the emphasis was on determining the degree to which processes and behaviours related to electricity usage were impacted by the stimuli.

The energy usage statement was not examined in any greater detail than the regular bill provided prior to the Trial by the site manager. This reflects:

- A lack of process change as site managers perceive themselves to have little or no defined role in the analysis of energy usage. In addition, the energy usage statement did not change the perception among some site managers that there is limited opportunity to reduce usage (beyond generic behaviours such as switching off lights).

- The energy statement was deemed useful and effective by a minority of site managers already actively engaged in usage review. One suggestion from the research was to separate the energy usage statement from the bill and send it directly to the site manager as part of a separate communication.

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Glossary

CBT	Customer Behaviour Trial
CER	Commission for Energy Regulation
DSM	Demand Side Management
ERGEG	European Regulators' Group for Electricity and Gas
ESRI	Economic and Social Research Institute
FAQ	Frequently Asked Questions
FEA	Free Electricity Allowance
OLR	Overall Load Reduction
SEAI	Sustainable Energy Authority of Ireland
SME	Small and medium enterprise
TOU	Time of Use (tariffs)

Acknowledgements

The Smart Metering Project is a collaborative project managed by the Commission for Energy Regulation (CER) with the support of multiple energy industry stakeholders. The electricity customer behaviour trial conducted in Ireland is one of the largest and most statistically robust smart metering behavioural trials completed internationally to date. The CER would like to acknowledge and commend the valuable contributions made by the following organisations involved in making the design, implementation and reporting of the Irish smart meter electricity customer behaviour trials a success:

- The Sustainable Energy Authority of Ireland (SEAI) led the customer behaviour work stream which developed and oversaw the trial design, implementation and reporting.
- ESB Networks implemented and maintained the smart metering systems (meters, communications technology and back-end systems) and electricity monitors.
- Electric Ireland (formerly ESB Customer Supply) recruited customers to the residential and SME trials, devised time of use tariffs in conjunction with the CER, delivered customer communications, provided customer support and produced detailed time of use billing.
- Bord Gáis Energy recruited customers to the SME trial, delivered customer communications, provided customer support and produced detailed time of use billing.
- ESB Independent Energy (now part of Electric Ireland) recruited customers for the SME multi-site case studies, delivered customer communications, provided customer support and produced detailed time of use billing.
- Airtricity, Energia, Vayu and EirGrid contributed to the design of the trials.
- A number of consultants contracted to SEAI provided specialist services to the trials:
    - The Research Perspective acted as statistical advisors in designing and implementing statistically robust trials, coordinated customer recruitment, conducted qualitative research (interviews and focus groups), conducted statistical analysis, testing and reporting of the socio-economic and consumption data and contributed to drafting the findings report.
    - Insight Statistical Consulting developed the statistical methodology for comparing interventions, managed the individual meter level data streams, provided group level aggregate summaries of consumption data and contributed to drafting the findings report.
    - Fresh Perceptions Consulting acted as customer communications advisor and coordinated the development of customer communications and the drafting of the findings report.
    - Dandelion coordinated the development of the DSM stimuli, ie energy usage statement, fridge magnet, stickers and the electricity monitor.

1 Introduction

1.1 The Commission for Energy Regulation (CER)

The Commission for Energy Regulation ('the CER') is the independent body responsible for overseeing the regulation of Ireland's electricity and gas sectors. The CER was initially established and granted regulatory powers over the electricity market under the Electricity Regulation Act, 1999. The enactment of the Gas (Interim) (Regulation) Act, 2002 expanded the CER's jurisdiction to include regulation of the natural gas market, while the Energy (Miscellaneous Provisions) Act 2006 granted the CER powers to regulate electrical contractors with respect to safety, to regulate to natural gas undertakings involved in the transmission, distribution, storage, supply and shipping of gas and to regulate natural gas installers with respect to safety. The Electricity Regulation Amendment (SEM) Act 2007 outlined the CER's functions in relation to the Single Electricity Market (SEM) for the island of Ireland. This market is regulated by the CER and the Northern Ireland Authority for Utility Regulation (NIAUR). The CER is working to ensure that consumers benefit from regulation and the introduction of competition in the energy sector

1.2 Purpose of this paper

The purpose of this paper is to provide a detailed outline of the design, delivery and outcomes of the Electricity Customer Behaviour Trial (CBT, or "The Trial), which formed a key part of Phase 1 of the CER Smart Metering Project. The CBT covered electricity smart metering for residential and all non-profile metered business customers (SMEs). The CBT conducted in Ireland is one of the largest and most statistically robust smart metering behavioural trials conducted internationally to date and thus provides a wealth of insightful information on the impact of smart metering enabled initiatives on electricity consumers.

The findings from the Customer Behaviour Trial have been used inform the cost-benefit analysis for smart metering in Ireland, which is being published along with this report. The cost-benefit analysis delivers a robust economic assessment of all the long-term costs and benefits to the market and the individual consumer of a national electricity smart metering rollout and will inform decisions to be made regarding the rollout of smart metering in Ireland.

The findings from the CBT also provide a rich source of information which will be used to inform energy policy decisions in Ireland relating to smart metering enabled initiatives such as time of use tariffs, more detailed and frequent billing, electricity monitors and prepayment metering. The CBT drew upon a representative sample of Irish electricity consumers and as such the findings provide a robust indication of the impact of an introduction of smart metering enabled initiatives nationally, including distributional impacts among different categories of consumers.

1.3 Background Information

1.3.1 What is Smart Metering?

"An intelligent metering system or 'smart meter' is an electronic device that can measure the consumption of energy, adding more information than a conventional meter, and can transmit data using a form of electronic communication. A key feature of a smart meter is the ability to provide bi-directional communication between the consumer and supplier/operator. It should also promote services that facilitate energy efficiency within the home. The move from old, isolated and static metering devices towards new smart/active devices is an important issue for competition in energy markets. The implementation of smart meters is an essential first step towards the implementation of smart grids."[2]

It is important to note that 'smart metering' encompasses more than just the meter itself. Smart metering should be viewed as a system rather than a single device. It is essentially a hybrid technology consisting of three high level layers:

- Physical meters and associated devices
- Communications layer covering data transport and communications network management
- IT systems which manage the data, applications and services

The following diagram illustrates the general structure of a smart metering system.

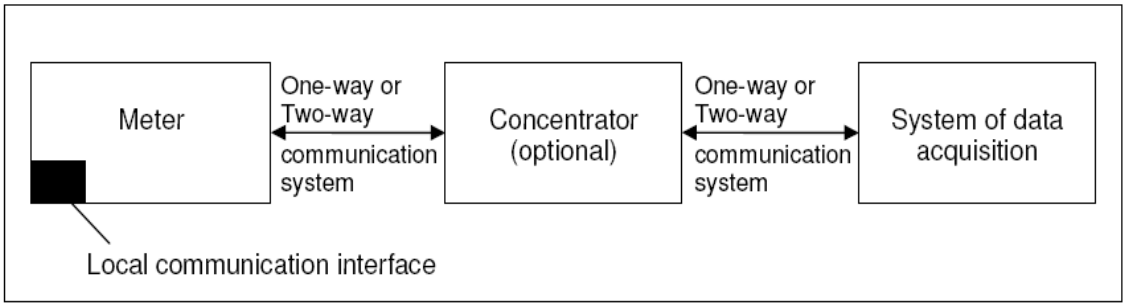


Figure 4: General structure of a smart metering system (Source: Figure 6, ERGEG Status Review of Regulatory Aspects of Smart Metering[3])

Smart meters are the next generation of meters, which can replace existing electro-mechanical meters and offer a range of benefits for both the individual electricity and gas consumer and for the electricity and gas systems in general.

[2] Commission staff working paper - interpretative note on directive 2009/72/EC concerning common rules for the internal market in electricity and directive 2009/73/EC concerning common rules for the internal market in natural gas - retail markets - 22 January 2010 (Pg 7)
http://ec.europa.eu/energy/gas_electricity/interpretative_notes/doc/implementation_notes/2010_01_21_retail_markets.pdf

[3] Ref: E09-RMF-17-03 www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_ERGEG_PAPERS/Customers/Tab/E09-RMF-17-03_SmartMetering-SR_19-Oct-09.pdf

The existing standard mechanical meter records the total amount of electricity/gas used over time. These meters are read manually and the information is sent to the network company and then used to calculate customer bills. If a meter reader does not have access to the customer's meter, estimated consumption information (or a reading provided by the customer) is used to calculate the bill. If the estimated consumption is higher or lower than the actual meter read, this is corrected for when the meter is next read by the customer or the meter reader.

A smart meter is much more sophisticated. It records customers' actual use of electricity/gas over short intervals (e.g. every 30 minutes). These meters are connected by a communications system to the network company / meter data collector providing the operator with automated, up-to-date information on the amounts of electricity/gas used by customers. Access to this information provides opportunities to reduce network operation costs, including reduced costs of visiting customer premises to manually read the meter and carrying out any necessary connections and disconnections. There are also savings due to reductions in technical losses and theft.

The data collected from smart meters can be used by electricity and gas suppliers (subject to data protection requirements) to deliver useful information to their customers regarding their electricity and gas consumption and costs. In particular, the installation of smart metering will allow electricity suppliers to create innovative pricing arrangements that can be offered to customers to support the efficient use of electricity, such as time-of-use electricity tariffs. This is where the price of electricity varies at different times of the day to reflect the changes in the costs of producing electricity. This will allow customers to manage their consumption of electricity in line with price movements and demand patterns.

Smart meters can facilitate improving energy efficiency by empowering consumers with more detailed, accurate and timely information regarding their energy consumption and costs, thus helping consumers reduce any unnecessary energy usage and shift any discretionary electricity usage away from peak consumption times.

1.3.2 EU Legislation

There are a number of key EU legislative instruments promoting smart metering, which include:

a) Third Legislative Package for Further Liberalisation of the Electricity and Gas Markets [4]

The 3rd Package contains provisions regarding intelligent metering systems, with the aim of better informing customers of their consumption and helping to increase awareness of energy consumption. The implementation of those metering systems may be subject to an economic assessment of all the long-term costs and benefits to the market and the individual consumer

[4] http://ec.europa.eu/energy/gas_electricity/third_legislative_package_en.htm

or of which form of intelligent metering is economically reasonable and cost-effective and which timeframe is feasible for their installation.

The general principle is that consumers must have access to their consumption data. National Regulatory Authorities (NRAs) must ensure access to customer consumption data, and the existence of a nationwide harmonised format for consumption data and a process for suppliers and consumers to access the data must be defined.

Intelligent metering systems are promoted twice in the Directives: first, with the aim to promote energy efficiency and demand side management measures; second, with the aim to ensure active participation of consumers in the market. Different provisions apply for electricity and for gas – details below. There are also a number of EU Interpretive Notes which cover smart metering published on these directives.

i) Electricity - Directive 2009/72/EC (Annex 1) [5]

This directive states that:

1. (i) [Member States shall ensure that customers] *are properly informed of actual electricity consumption and costs frequently enough to enable them to regulate their electricity consumption'*

2. *'Member States shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the electricity supply market. The implementation of those metering systems may be subject to an economic assessment of all the long-term costs and benefits to the market and the individual consumer or which form of intelligent metering is economically reasonable and cost-effective and which timeframe is feasible for their distribution.*

   Such assessment shall take place by 3 September 2012'.

   Subject to that assessment, Member States or any competent authority they designate shall prepare a timetable with a target of up to 10 years for the implementation of intelligent metering systems.

   Where roll-out of smart meters is assessed positively, at least 80 % of consumers shall be equipped with intelligent metering systems by 2020.

An EU Retail Markets Interpretive Note[6] on Electricity Directive 2009/72/EC highlights a European Commission Declaration[7] which clarifies that:

[5] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0072:EN:NOT

"It is understood that in the case no economic assessment of the long-term costs and benefits is made, at least 80% of all consumers have to be equipped with intelligent metering systems by 2020."

ii) **Gas - Directive 2009/73/EC (Annex 1)**[8]

This directive states that:

1. *(i)* [Member States shall ensure that customers] *are properly informed of actual gas consumption and costs frequently enough to enable them to regulate their own gas consumption.*

2. *Member States shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the gas supply market. The implementation of those metering systems may be subject to an economic assessment of all the long-term costs and benefits to the market and the individual consumer or which form of intelligent metering is economically reasonable and cost-effective and which timeframe is feasible for their distribution.*

   Such assessment shall take place by 3 September 2012.

   Subject to that assessment, Member States or any competent authority they designate, shall prepare a timetable for the implementation of intelligent metering systems.

b) Directive 2006/32/EC - Energy End-use Efficiency and Energy Services[9]

It has been estimated that EU energy consumption is around 20% higher than can be justified on economic grounds. This has led to the view that there is a large potential for unrealised economic energy savings which can be realised through energy services and other end-use efficiency measures. In pursuit of this objective the European Commission adopted EU Directive EC 2006/32 on 5th April 2006. Article 13 of this Directive requires that:

"Member states shall ensure that, in so far as is technically possible, financially reasonable and proportionate in relation to the potential energy savings, final customers for electricity … are provided with competitively priced individual meters that accurately

[6] Commission staff working paper - interpretative note on directive 2009/72/EC concerning common rules for the internal market in electricity and directive 2009/73/EC concerning common rules for the internal market in natural gas - retail markets - 22 January 2010 http://ec.europa.eu/energy/gas_electricity/interpretative_notes/doc/implementation_notes/2010_01_21_retail_markets.pdf

[7] Council document 10814/09 ADD 1 REV 1 http://register.consilium.europa.eu/pdf/en/09/st10/st10814-ad01re03.en09.pdf

[8] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0073:EN:NOT

[9] Article 13 of DIRECTIVE 2006/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0064:0064:en:pdf

reflect the final customer's actual energy consumption and that provide information on actual time of use"

"Appropriate information shall be made available with the bill to provide final customers with a comprehensive account of energy costs. Billing on the basis of actual energy consumption shall be performed frequently enough to enable customers to regulate their own energy consumption".

c) Directive 2005/89/EC – Security of Supply[10]

This Directive specifies that member states may encourage *"the adoption of real-time demand management technologies, such as advanced metering systems"* to maintain balance between electricity demand and supply.

d) Directive 2004/22/EC - Measuring Instruments[11]

The Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments (MID) establishes the requirements that measurement devices and systems have to satisfy before being put on the market and/or put into use. Each measuring instrument must meet the essential requirements (laid down in Annex I of the Directive) and in the relevant instrument-specific Annex.

1.3.3 EU Initiatives

There are currently a number of EU coordinated smart metering initiatives underway which include.

- On 8th February 2011 ERGEG (European Regulators' Group for Electricity and Gas) published its final Guidelines of Good Practice (GGP) on Regulatory Aspects of Smart Metering for Electricity and Gas (E10-RMF-23-03)[12]. These final recommendations aim to provide guidance regarding the European Commission's 3rd Energy Package provisions on the installation of intelligent metering systems for electricity and gas, focusing on customer services, roll-out of smart meters, cost benefit analysis and data security and integrity.
- European Standards organisations are progressing **Mandate M/441[13]** for the development of an open architecture for utility meters involving communication protocols and functionalities enabling interoperability. The Mandate has the general objective to highlight or to harmonise European standards that will enable

[10] Article 5 (2.d.) of DIRECTIVE 2005/89/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 January 2006 concerning measures to safeguard security of electricity supply and infrastructure investment www.energy.eu/directives/l_03320060204en00220027.pdf

[11] DIRECTIVE 2004/22/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 31 March 2004 on measuring instruments http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:135:0001:0080:EN:PDF

[12] ERGEG final Guidelines of Good Practice (GGP) on Regulatory Aspects of Smart Metering for Electricity and Gas (E10-RMF-23-03) http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_ERGEG_PAPERS/Guidelines%20of%20Good%20Practice/Other/E10-RMF-29-05_GGP_SM_8-Feb-2011.pdf

[13] Mandate M/441 http://www.openmeter.com/documents/m441en.pdf

interoperability of utility meters (water, gas, electricity, heat). This can then improve the means by which customers' awareness of actual consumption can be raised in order to allow timely adaptation to their demands. According to Mandate M/441, the implementation of this provision requires the definition of new functionalities for smart meters – in addition to those in the Measuring Instruments Directive (MID)[14] and as stated by the European Commission in the Mandate M/441.

- The **Open Meter Project** began in January 2009 with the main objective to specify a comprehensive set of open and public standards for advanced metering infrastructure (AMI), supporting electricity, gas, water and heat metering. This project is due to conclude in June 2011.
- In January 2010 a **Task Force on Smart Grids** was launched whose mission is to advice the European Commission on policy and regulatory directions at European level and to coordinate the first steps towards the implementation of smart grids under the provision of the 3rd Package. The initial duration of the Task Force is 20 months to May 2011.

1.3.4 Smart Metering Roll-out Status in Europe

The status of smart metering for electricity and gas in Europe is diverse and changing at a rapid pace.

The last publicly available official report on the status of each country is the *ERGEG Summary of Member State experiences on cost benefit analysis (CBA) of smart meters* published 2nd February 2011[15] but this document focuses on smart metering cost benefit analysis development rather than specific meter rollout status. The table below is an excerpt from this report and indicates that, out of the 24 member states that responded to the ERGEG survey, as of 1st January 2011 eleven had completed an electricity CBA & six had completed a gas CBA.

[14] Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0022:en:NOT

[15] Summary of Member State experiences on cost benefit analysis (CBA) of smart meters 2 February 2011 http://www.energyregulators.eu/portal/page/portal/EER_HOME/EER_CONSULT/CLOSED%20PUBLIC%20CONSULTATIONS/CUSTOMERS/Smart%20metering/CD/C11-RMC-44-03_CBA%20SM_2-Feb-2011.pdf

Status of CBA in CEER countries	Electricity	Gas
Countries have conducted a CBA	11[1]	6[2]
Positive result of CBA	7[3]	5[4]
Countries plan (or ongoing) to conduct a CBA (in some cases for the 2nd time – France, Hungary, Poland, Portugal)	12[5]	14[6]
Countries do not plan a CBA	2[7]	5[8]
Countries with no CBA, but no longer relevant (yes/no of roll-out already decided)	3[9]	0

1: Austria, Denmark, France, Hungary, the Netherlands, Norway, Poland, Portugal, Slovenia, Sweden, United Kingdom
2: Austria, France, Hungary, Italy, the Netherlands, United Kingdom
3: Austria, France, the Netherlands, Norway, Poland, Portugal, United Kingdom (Poland – study was TSO, not gov't authority. In Sweden, although result was negative, roll-out for electricity proceeded.)
4: Austria, France, the Netherlands, Italy, United Kingdom
5: Belgium, Czech Republic, Germany, France, Greece, Hungary, Ireland, Luxembourg, Latvia, Poland, Portugal, Romania (Belgium - each region conducting its own, no federal one planned) (Portugal - to be decided by gov't)
6: Belgium, Czech Republic, Germany, Spain, Finland, Greece, Hungary, Ireland, Latvia, Luxemburg, Lithuania, Portugal, Slovenia, Sweden (Portugal - to be decided by gov't)
7: Lithuania, Slovak Republic
8: Denmark, Norway, Poland, Romania, Slovak Republic (Norway has no gas)
9: Spain, Finland, Italy

Table 8: General structure of a smart metering system
Source: Page 2, ERGEG Summary of Member State experiences on cost benefit analysis (CBA) of smart meters published 2nd February 2011)

The *ERGEG Status review on regulatory aspects of smart metering* report, published October 2009[16] is still the last publicly available official report on the status of each country regarding trials and rollouts of smart metering. Because of the fast pace of development in the area of smart metering it should be noted that the national situations which are reflected in the status review may no longer provide a complete and accurate picture.

- Generally in electricity only two countries have undertaken a large scale meter installation programme for customers - these early adopters are Italy and Sweden with full roll-outs. In addition, some other countries have decided to undertake a large scale rollout of smart meters, such as Britain which mandated a national roll-out of smart electricity and gas meters.[17]. Other countries are considering roll-out plans with some undertaking smart metering trials to inform their decisions.

- In gas, there are fewer uptakes of smart meters, with Italy and Britain having planned roll-outs, while a small number of countries are discussing the possibility.

[16] E09-RMF-17-03 ERGEG Status review on regulatory aspects of smart metering as of May 2009 www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_ERGEG_PAPERS/Customers/Tab/E09-RMF-17-03_SmartMetering-SR_19-Oct-09.pdf
[17] www.decc.gov.uk/en/content/cms/what_we_do/consumers/smart_meters/smart_meters.aspx

The *ERGEG Status review on regulatory aspects of smart metering* report also found that the most important policy objectives for supporting and encouraging a roll-out of smart meters in both electricity and gas are energy efficiency, peak load management and more frequent meter readings. Please see the previous smart metering consultation CER/10/082[18] published in June 2010 which contains further detail from the ERGEG report on the smart metering roll-out status in Europe.

1.3.5 Smart Metering Progress in Ireland

1.3.5.1 Government Policy and Legislation

The National Smart Metering Plan is a key Government priority in the context of enabling the development of a Smart Grid, facilitating more efficient use of energy and underpinning smart and sustainable economic growth.

The importance of Smart Metering within the Government's energy policy, and indeed within its wider economic strategy, reflects the fact that, at EU level, Smart Metering is seen as a critical tool in managing energy demand in the interests of consumers and businesses.

On 22nd December 2009, the Energy Services Directive (Directive 2006/32/EC) was transposed into Irish law under the European Communities (Energy End Use Efficiency and Energy Services) Regulations 2009, **Statutory Instrument No. 542 of 2009**[1]. These Regulations also amend the Electricity Regulation Act 1999 to allow the Commission for Energy Regulation to place requirements on energy undertakings in relation to informative billing.

.

> *"(5) The Commission may, by direction under subsection (1), require an energy undertaking to do any or all of the following—*
> *(a) provide bills to its final customers, based on actual energy use, at such frequency as may be specified by the Commission to enable those customers to regulate their own energy consumption in a timely manner,..."*

In May 2009 the first **National Energy Efficiency Action Plan (NEEAP)**[2] was adopted in line with EU requirements. The first NEEAP set out the key targets to met in order to achieve our 2020 commitments, including Action 33:

> *"We will encourage more energy efficient behaviour by householders through the introduction of smart meters".*

[18] CER/10/082 Consultation on Possible National Rollout Scenarios for the Smart Metering Cost Benefit Analysis www.cer.ie/en/information-centre-reports-and-publications.aspx

The second NEEAP, due to be published in June 2011, will reiterate the importance of smart metering as a key tool for realising long term energy demand management objectives.

1.3.5.2 CER Smart Metering Project

In March 2007 the Commission for Energy Regulation (CER) issued a *Demand Side Management and Smart Metering Consultation Paper (CER/07/038)*[19] in which the case for providing domestic and small business customers with time-of-day electricity prices and smart metering arrangements was made. This was followed in November 2007 with the publication by the CER of an information paper, *Smart Metering - The Next Step in Implementation (CER/07/198)*[20], which outlined a proposed framework in which the future scope of smart metering arrangements can be established.

Following on from the conclusions reached in the smart metering information paper CER/07/198 the CER established the Smart Metering Project Phase 1 in late 2007 with the objective of setting up and running smart metering trials and assessing their costs and benefits. This will inform decisions relating to the full rollout of an optimally designed universal National Smart Metering Plan.

In order to draw on the experience and expertise of the electricity and gas market a Steering Group and a Working Group was established by the CER for the Smart Metering Project Phase 1. Both groups were chaired by the CER and consisted of representatives from the Department of Communications, Energy and Natural Resources (DCENR), Sustainable Energy Authority of Ireland (SEAI), the Northern Ireland Authority for Utility Regulation (NIAUR) and Irish Gas and Electricity Industry Participants.

[19] www.cer.ie/en/electricity-retail-market-current-consultations.aspx?article=01b6318d-3876-4630-8bb5-f54fb368be16
[20] www.cer.ie/en/electricity-retail-market-current-consultations.aspx?article=01b6318d-3876-4630-8bb5-f54fb368be16

Figure 5: Smart Metering Project Phase 1 – Overview of Participants

To achieve its objectives the Smart Metering Working Group was divided into four Work Streams each focusing on separate aspects of the Smart Metering Project Phase 1:

- **Networks**: Technical design and rollout of Smart Metering infrastructure.
  Lead: ESB Networks (electricity) and Bord Gáis Networks (gas).
- **Customer Behaviour**: Mainly focusing on the design and implementation of all aspects of the customer behavioural trials, including participant selection, communications and analysis of results.
  Lead: Sustainable Energy Authority of Ireland (SEAI).
- **Tariffs**: Mainly focusing on design of Tariffs (Time of Use) and development of a Prepayment Market Model.
  Lead: Electric Ireland (formerly ESB Customer Supply).
- **Billing / Data**: Mainly focusing on data flows from the Smart Metering infrastructure to Suppliers for customer behaviour trial billing options.
  Lead: Bord Gáis Energy Supply.

The CER was responsible for undertaking a Smart Metering Cost Benefit Analysis (CBA), which is published alongside the CBT report, and worked with the Economic and Social Research Institute (ESRI) in this regard. As part of this work, the CER identified all information requirements for a CBA, the parties responsible for providing such information and coordinated the transfer of the required information to the ESRI for their modelling. The

CER also arranged for an independent audit of the supplier and network operator cost and benefits included in the CBA, which was conducted by Frontier Economics.

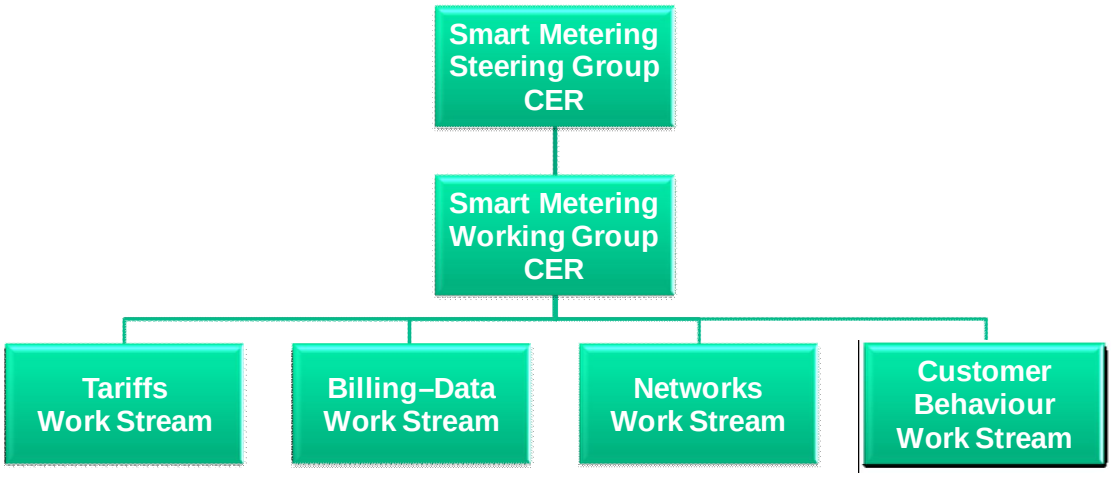


Figure 6: Smart Metering Project Phase 1 – Governance Structure

The key deliverables of the Smart Metering Project Phase 1 are depicted below:

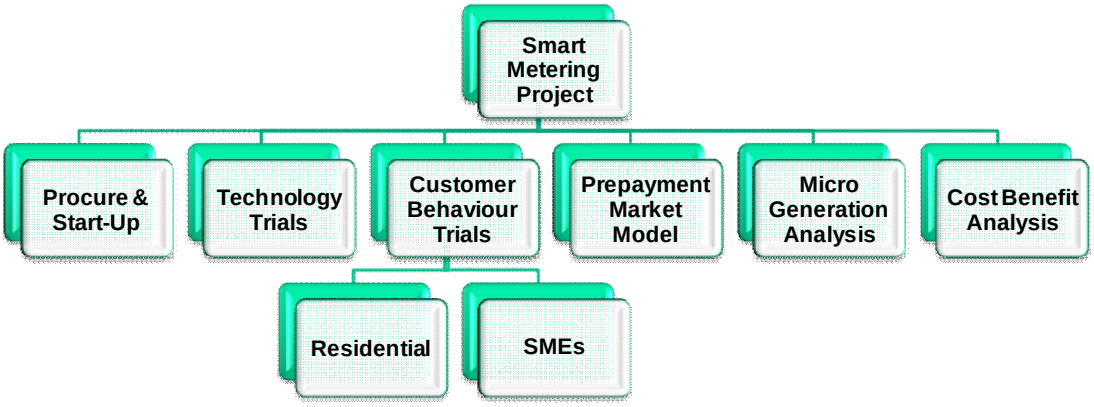


Figure 7: Smart Metering Project Phase 1 – High-Level Work Breakdown Structure (WBS)

Overall, project progress has been very positive with all key milestones having been achieved. The main highlights to date have been the:

- Completion of the electricity technology trials in September 2010, the detailed report of which is published alongside this CBT report
- Completion of the electricity customer behaviour trials (CBT) for residential and SME customers in December 2010. Associated analysis and reporting was completed in April 2011
- Completion of the 'smart prepayment' trial in February 2011, the findings of which are included in this CBT report.

- Initiation of the gas customer behaviour trials (CBT) for residential and SME customers which will be completed in May 2011. Associated analysis & reporting is due to be completed by September 2011.
- Completion of the electricity cost benefit analysis in April 2011, which is published alongside this CBT report. An addendum to the CBA for gas is due to be completed by September 2011.

1.4 Structure of this paper

This report summarises the results and findings from the Electricity Customer Behaviour Trials. It is structured in the following manner:

- **Sections 2.0 to 7.0** outline the detail of the Residential Electricity CBT, its design and outcomes
- **Sections 8.0 to 12.0** outline the details of the SME and multi-site Electricity CBT, its design and outcomes
- **Sections 13.0 to 15.0** outline the details of the Prepayment CBT. The prepayment CBT was carried out as a separate, small scale Trial with relevant residential consumers
- **Appendices 1 to 11** provide more detail on the design, implementation and outcomes of the Customer Behaviour Trial.
- **Appendix 12** contains samples of communications which issued during the Trials.

1.5 Commenting on this paper

This report is for provided as an information source on the Electricity Customer Behaviour trials. Any queries or comments on its contents should be forwarded, preferably in electronic format to:

Gary Martin
Commission for Energy Regulation,
The Exchange, Belgard Square North,
Tallaght,
Dublin 24.
E-mail: gmartin@cer.ie

2. The Electricity Customer Behaviour Trial – Residential

2.1 Introduction

The Customer Behaviour Trial included residential consumers and small and medium enterprises (SMEs). It was managed by the Commission for Energy Regulation in Ireland with support from the Department of Communications, Energy & Natural Resources, the Sustainable Energy Authority of Ireland, (formerly Sustainable Energy Ireland), Electric Ireland[21] (formerly ESB Customer Supply), Bord Gáis Energy, ESB Independent Energy (now part of Electric Ireland) and ESB Networks.

The Trial had two distinct periods:

a) **The Benchmark period** - 1st July to 31st December 2009. All meters were installed prior to the start of the benchmark period. Data was collected on a half-hourly basis from meters during this period in order to establish a benchmark level of use for participants.

Also during the Benchmark, participants were allocated to either a test or control group, and were advised their bills would be issued on a calendar month basis ("calendarised"). These communications issued towards the end of the Benchmark period so as to minimise any impact such communications might cause. A pre-trial survey was also conducted in the Benchmark period.

b) **The Test period** - 1st January to 31st December 2010. During the test period participants were in either a test group (i.e., each group tested a different Time of Use (ToU) tariff and selected Demand Side Management (DSM) stimuli) or the control group (billed on their existing flat rate, with no DSM stimuli). Participants in the test groups received a bill, combined with an energy usage statement. Some of the groups also tested an electricity monitor or an overall load reduction incentive.

Further detail on all of these initiatives is contained in the following pages and in the Appendices.

2.2 Pilot Objectives

The overall objective of the Customer Behaviour Trial was to ascertain the potential for smart metering technology, when combined with time of use tariffs and different DSM stimuli, to

[21] As per the decision on the Roadmap for Deregulation (CER/10/058), a criterion for deregulation is the provision of a satisfactory commitment to re-brand. ESB Customer Supply and ESB Independent Energy have now commenced their re-branding process with the launch of their new name, Electric Ireland. As is fitting, the CER will hence with adopt this name in all its publications.

effect measurable change in consumer behaviour in terms of reductions in peak demand and overall electricity use.

The Residential Customer Behaviour Trial included the additional objective of seeking to identify a “Tipping Point” that is a point at which the price of electricity will significantly change usage.

3 Design of the Residential Trial

3.1 Introduction

The Customer Behaviour Trial aims to measure consumer response (behaviour change) to a range of time of use tariffs (ToU) and demand side management (DSM) stimuli over the period of the Trial.

The ToU tariffs and DSM stimuli were:

- Specific price points (*Time of Use (TOU) tariffs* A, B, C and D), combined with
- specific DSM initiatives (electricity monitor, detailed energy statement (monthly and bi-monthly, an Overall Load Reduction (OLR) incentive)
- A weekend tariff

Further details are included in Appendices 1 to 11.

3.2 Trial Matrix

The optimal sample size for the Trial was determined to be 4,300 participants. Using an opt-in approach and allowing for a 20% attrition rate 5,375 participants were recruited by Electric Ireland. As Electric Ireland represented 100% of the residential electricity market (by number of customers) at the time (mid 2008), this was representative of the population of electricity users eligible to participate in the Trial (see para 4.2. below) At the start of the benchmark period, the total number still participating with meters installed was 5,279. By allocation stage (**see Table 9**) this number had fallen to 5,028. The main reasons for this participant attrition during the Trial were changes of tenancy and change of supplier.

Tariff	Bi-monthly bill and energy usage statement	Monthly Bill, and energy usage statement	Bi-monthly bill, energy usage statement and electricity Monitor	Bi-monthly bill, energy usage statement plus Overall Load Reduction	Total
Tariff A	342	342	342	342	1,368
Tariff B	127	129	127	128	511
Tariff C	342	342	343	343	1,370
Tariff D	127	129	126	127	509
Weekend					100
Control Group					1,170
	938	**942**	**938**	**940**	**5,028**

Table 9: Residential Matrix allocation as of 13 November 2009

3.3 Tariff Design and Development

The installation of smart metering allows electricity suppliers to create innovative pricing, such as time of use tariffs, which can be offered to customers to support the efficient use of electricity. Time of use tariffs are tariffs which vary according to the time of day in order to reflect changes in the cost of producing electricity. This allows customers to manage their use of electricity in line with price movements and demand patterns.

Four different time of use tariffs were developed for the Customer Behaviour Trial. A weekend tariff was also included. The following principles were used in the design of the ToU tariffs to ensure that the key objectives of cost neutrality and cost reflectivity were achieved:

- The time of use tariff would be neutral in comparison with the standard Electric Ireland tariff to ensure that the "average" participant who did not alter their electricity consumption pattern was not penalised financially.
- The base ToU tariff would reflect the underlying cost of energy transmission, distribution, generation and supply as per standard tariffs.
- The time-of-use structure (time bands) would be based on system demand peaks.
- Tariffs would be based on the cost inputs used in the 2009/10 regulated tariffs.

	Day Rate	Peak Rate	Day Rate	Night Rate
Timeband	8am – 5pm	5pm – 7pm	7pm – 11pm	11pm – 8am
Unit Rate (excl. VAT)				

Figure 8: Time of Use Bands

The methodology and principles used in calculating the ToU tariff prices for 2010 were developed by Electric Ireland in conjunction with the CER and the electricity industry at the smart metering tariff forums. The final agreed set of ToU tariffs were approved by the CER on 2nd October 2009[22].

The draft tariffs which were developed as part of this process were tested with customer focus groups before being finalised. The final tariffs[23], which applied from 1st January to 31st December 2010 may be summarised as follows:

3.3.1 Residential Tariffs

Domestic Time of Use Tariff				
		Night 23.00 – 08.00	**Day** 08.00 – 17.00 19.00 – 23.00 weekdays 17.00-19.00 weekends and bank holidays	**Peak** 17.00 – 19.00 (Monday to Friday), excluding bank holidays
Tariff A	Cents per kWh	12.00	14.00	20.00
Tariff B	Cents per kWh	11.00	13.50	26.00
Tariff C	Cents per kWh	10.00	13.00	32.00
Tariff D	Cents per kWh	9.00	12.50	38.00

Table 10: Residential Time-of-Use tariffs 1st January to 31st December 2010

Weekend Tariff

Weekend Tariff				
		Night 23.00 – 08.00 and all weekends	**Day** 08.00 – 17.00 19.00 – 23.00 excluding bank holidays	**Peak** 17.00 – 19.00 (Monday to Friday) excluding bank holidays
Monday to Friday	Cents per kWh	10.00	14.00	38.00
Saturday & Sunday		10.00	10.00	10.00

Table 11: Weekend tariff 1st January to 31st December 2010

3.3.2 Balancing Credit

Throughout the Trial all participants testing time-of-use tariffs were guaranteed that they would not pay more for their electricity than if they had remained on the normal Electric

[22] Smart Metering Customer Behaviour Trials: Electricity Time of Use Tariffs 2nd October 2009 www.cer.ie/en/electricity-retail-market-decision-documents.aspx?article=bae6c058-11d5-49a6-ade0-2aa1aa3ba17c

[23] Smart Metering Customer Behaviour Trials: Electricity Time of Use Tariffs, CER, 25th September 2009 and Smart Metering Trial Electricity (ToU) tariffs to apply from 1st Oct-31st Dec 2010, CER, 3rd September 2010

Ireland tariff (14.1c per unit). Based on analysis of average historic profile usage a balancing credit was calculated such that 95% of customers would not be 'out of pocket' at the end of the Trial. The small number of customers who incurred costs above the balancing credit were compensated on a case by case basis after the Trial completed.

Participants in the tariff groups received the balancing credit in two instalments. To control for any impact receipt of credits may have had on behaviour, they were made outside of the test period i.e., the first in December 2009 and the second in January 2011. These are outlined below.

Residential	Total Amount	Paid December 2009	Paid January 2011
Tariff A	**€30**	**€15**	**€15**
Tariff B	**€50**	**€25**	**€25**
Tariff C	**€70**	**€35**	**€35**
Tariff D	**€90**	**€45**	**€45**

Table 12: Residential Balancing credits as of 1st January 2010

3.4 Stimulus Design and Development

All of the ToU pricing and DSM stimuli in the Customer Behaviour Trial (the time of use tariffs, the energy usage statement, the electricity monitor and the overall load reduction incentive) were designed specifically for the Trial using learnings from other international trials and consumer feedback. The ToU pricing and DSM stimuli were initially developed by the Customer Behaviour Workstream Group based on their combined experience in the electricity industry and using learnings from international trials. Consideration was also given to the requirements of the EU Directive EC 2006/32 which states where technically possible and financially reasonable, energy metering should record the time of use and customer billing should be sufficiently comprehensive so as to enable the self regulation of energy consumption. Specific billing options include more detailed information for customers and more frequent billing.

3.4.1 Consumer Involvement in the Design of ToU pricing and DSM Stimuli

Based on these inputs and consideration, draft tariffs and layouts for the energy statement and the electricity monitor were developed and presented to customer focus group participants for additional insight and feedback. The research sought to explore a number of complexities for consumers including:

- Introduction of time of use pricing
- Introduction of different time bands
- Calculations across three time bands
- Tracking historical use against current performance
- Tracking of savings against previous performance

Following these focus groups the time of use tariffs and design of the energy usage statement and the electricity monitor were finalised. Further details on this research and the items trialled are contained in **Appendix 5**, Outcome of Focus Groups conducted during the Customer Behaviour Trial.

3.4.2 Energy Usage Statement Bi-Monthly

During the Trial all participants in the stimulus test groups received a bill, combined with an energy usage statement. The first page (the bill) was similar to the existing supplier's bill (with additional lines for time of use tariffs). The second page, the energy usage statement, provided additional detail on usage and tips on energy reduction.

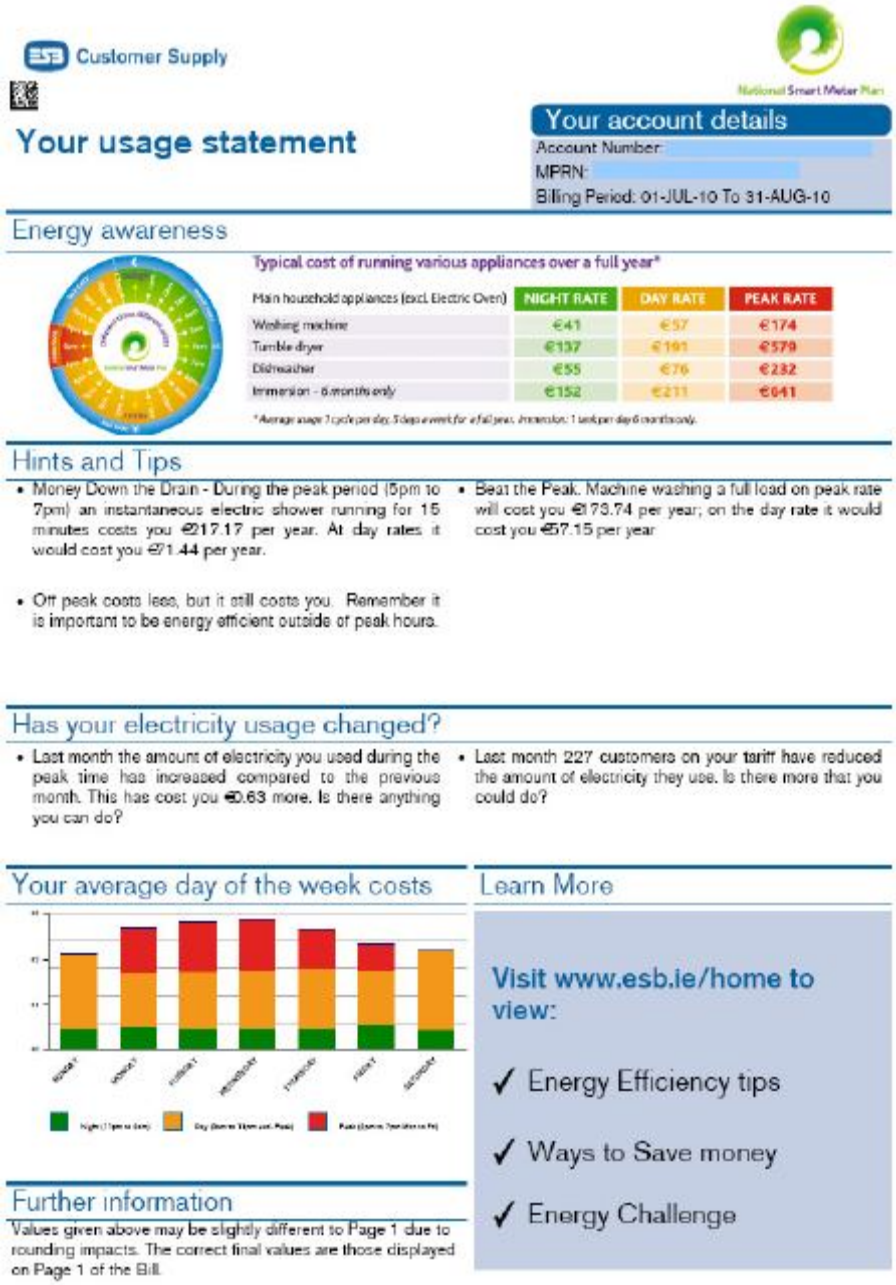


Figure 9: Energy Usage Statement

Three test groups received the bill and accompanying energy usage statement on a bi-monthly basis. Frequency was, therefore, consistent with their normal bill frequency. However, due to the need to calendarise all bills in the course of the Trial, the payment date changed for some of this group. See 3.5 below.

3.4.3 Energy Usage Statement Monthly

One of the test groups received a more frequent bill during the Trial i.e., their bill and accompanying energy usage statement issued on a monthly basis. This meant they received 12 smaller bills over the course of the Trial with consequently more frequent payments.

3.4.4 Electricity Monitor

The electricity monitor was designed by industry and members of the Customer Behaviour Workstream Group and developed specifically by ESB Networks for the Customer Behaviour Trial.

Its aim was to help consumers be more energy efficient by providing additional information on how much electricity they were using and how much it was costing them. The electricity monitor also included a budget setting mechanism, where consumers could decide the maximum they wanted to spend on electricity per day. A usage gauge on the home screen, showed consumers their usage against their daily budget. On installation of the electricity monitor participants were provided with a default budget from Electric Ireland which could be adopted or replaced by the participant.

Figure 10: Electricity Monitor

Prior to deployment of the electricity monitor, the historical daily consumption of each participant was calculated and converted to a monetary value based on the new tariffs. On installation of the electricity monitor, participants were advised of this daily budget estimate and given the option to use this figure or an alternative for budget setting in the monitor.

3.4.5 Overall Load Reduction (OLR) Incentive

One of the DSM stimulus groups was asked to test the Overall Load Reduction (OLR) Incentive. This involved the setting of a target reduction in electricity usage for the participant. This target was based on an analysis of the participant's previous actual usage, less 10%. As it required actual data the OLR incentive did not commence until May 2010,

which was the earliest time benchmark data was available. The target was an eight month target and rewarded participants with €20 (in addition to their energy savings) if they were successful. Participants were updated on their progress with each bi-monthly bill.

3.5 Calendarisation of Billing

In order to assist in comparability, a decision was made to place all participants in the Trial (excluding the Control Group) on a calendar month bill cycle with the majority continuing to receive bi-monthly bills and one group receiving monthly bills.

Prior to the Trial, participants were on a two-monthly billing cycle with bills issuing to consumers on a phased basis over a two-monthly period. From 1st January 2010 all participant bills were "calendarised" i.e., their bills covered discrete months and issued approximately 10 days after the month end. The transition to calendarisation involved all participants receiving a final 'part' bill up to 31st December 2009 which covered the period from their last bill until that date. This also meant that that bills issued in 2010 related only to usage in 2010. The change to calendarisation also meant payment due dates changed for some participants. (See **Appendix 1**, Experimental Design of the Customer Behaviour Trial).

4 Residential Trial Participants

4.1 Recruitment Approach and Outcome

In order to ensure that the outcome of the Trial would be robust and representative of the national population, the recruitment process was phased. After each phase the respondents who opted in were profiled to confirm that they representative of the national profile. When deviations were observed during the process, for example a lower proportion of C_2D[24] respondents, subsequent phases were structured to correct for this. In the case of C_2D representation there was an increase in the proportion of likely C_2D customers receiving an invitation to participate letter, thereby correct for their proportionate under representation at the earlier phases of recruitment.

This approach required the development of a stratified random sampling framework, from which potential participants were mailed and invited to participate in the Trial. Recruitment was phased in order to allow for correction of emerging over or under representation of types of consumers (thus ensuring representivity). Once recruitment was completed, the set of consumers who had accepted was compared to the set of those who had not (captured through a non-response survey). Finally, throughout the trial period consumers who were deemed to attrite were also surveyed to determine if attrition was a response to participation in the Trial or co-incidental (e.g. opted out or changed supplier). If the former was true, this would require an adjustment to be made to take account of the attrition. Reasons for attrition included change of supplier and changer of tenancy. They are discussed in greater detail in 4.5 below.

Participant selection and recruitment followed a voluntary "opt-in" model using a tear off slip at the bottom of the invitation letter. This communication was carefully designed to minimise any potential bias from the opt-in of participants who are more interested in the topic and thus might be more inclined to participate. See **Appendix 3**, Profile of Residential Participation.

Participants were allocated to test groups (and exposed to one tariff and one stimulus) or the control group. The objective of allocation was to ensure that the profile of the set of participants in each experimental cell was approximately the same across behavioural, demographic and attitudinal perspectives. This leveraged available usage data (from the benchmark period) and the results of the pre-trial survey.

The detail of the recruitment approach and the representivity of the sample, recruited and installed to date is outlined in **Appendix 3**, Profile of Residential Participation.

[24] The classification is based on the occupation of the head of household and is maintained the Market Research Society in the UK (www.mrs.org.uk).

4.2 Participant Recruitment

Recruitment to the Customer Behaviour Trial was on a voluntary basis (with a small financial incentive of €25 per survey associated with the completion of the survey). It has been noted in other smart meter trials and more generally in trials of technical innovation in the energy field, that there is a significant risk of over-representation of more highly educated or affluent consumers. The developed recruitment framework attempted to maximise the representivity of the participants in the pilot by analysing each wave of acceptances and correcting through modification of the composition of subsequent recruitment waves. Dimensions included in the analysis were overall usage and location as well as a combination of other factors. A total of five waves of invitations issued.

4.2.1 Exclusions from the Trial

Some constraints were put on selection of those participating in the Trial i.e.:

- Participation was limited to customers of Electric Ireland: As Electric Ireland represented 100% of the residential electricity market (by number of customers) at the time of recruitment, this limitation did not impact on the representivity of the Trial. However, during the Trial competition in the residential electricity market increased with associated implications on attrition. The implications of this attrition on the ongoing representivity are dealt with in the **Appendix 3**, Profile of Residential Participation.
- Participation was limited to those who had been at their current address for at least 12 months prior to the recruitment. This restriction was put in place to exclude residential consumers most likely to move during the period of the Trial and hence attrite.
- Consumers who had opted out of sales and marketing contact from their supplier. It should be stressed that this was done as a precaution as invitation letters would not be considered part of this opt-out.
- Consumers who used Night Saver rate electricity and who had, therefore, to some extent modified their behaviour. (Nightsaver is typically associated with storage heaters which charge using cheaper night-rate electricity measured by a second meter).
- Consumers classified by Electric Ireland to be in arrears or liable to disconnection were also excluded.

4.3 Participant Distribution and Profile

All participants, (including participants who were later allocated to both control and test groups), were required to participate in a Computer Assisted Telephone Interviewing (CATI) based survey. The survey included a wide range of questions about household demographics, the home, presence and use of different electrical appliances, investment in energy efficiency enhancements as well as expectation of the impact and outcomes from the Customer Behaviour Trial itself.

The analysis of the participant responses determined that the households were broadly representative of the national population. The exclusion of short term tenancies reduces the proportion of apartments included. This also reduced the proportions of younger age profiles. However, the distribution of household size and other socio-economic indicators (such as social grade and unemployment) indicates that participant population was broadly representative of the total population of householders and did not need to be corrected.

The research also gathered extensive information on participants' ownership and use of electrical appliances as well as the attitudinal information. The information gathered was used in the allocation of participants to both control and test groups to ensure that participants within the control group and within each combination of tariff and stimulus were representative of the national population. The information was also used in the analysis of the behavioural aspects of the Trial.

4.4 Non-respondent profile

The recruitment was on the basis of a voluntary response to an invitation letter. The process corrected to any bias across the profile data available during the recruitment process. To ensure that the recruitment process did not introduce bias it was necessary to research the profiles of invited individuals who did not respond to the invitation.

The non-response survey was conducted using Computer Assisted Telephone Interviewing (CATI) and completed after recruitment in July 2009.

The analysis found that:

- The two populations (i.e., those who did and those who did not respond) were similar across social grade, employment status, house type, age and bedroom count and uses of electricity by appliance ownership and usage
- Demographic differences did exist with fewer female participants than among the non-respondents, fewer younger participants and fewer participants who live alone. With regard to gender differences, this is not likely to introduce a bias because the behaviours are at a household and not an individual level and hence the gender of the bill payer is less relevant. The reduced representation of participants who live alone and who are younger reflect the exclusion of recent tenancies.
- The level of potential and actual engagement with energy reduction is similar across both populations. There are differences between the participants and non-respondents with regard to attitudes toward energy. However, the analysis found no evidence to suggest that engagement and attitudes were a significant factor in the decision by recipients to accept or refuse the invitation to participate.

The most commonly reported reason for not participating (45% of non-respondents) was the belief that there was no benefit for the participant. Concern about the inconvenience associated with installing a new meter was listed as a reason for the decision not to participate by 40%.

4.5 Attritor profile

Attrition was deemed to have occurred if:

1. The participant moved home
2. The participant switched to another electricity supplier
3. Supply was disconnected from the home
4. The participant contacted their supplier and requested to withdraw from the Trial

The original sample design size was 5,375 participants. This allowed for a 20% attrition rate (with an expectation of some participant attrition for multiple reasons). The provisions for attrition were as follows:

	Residential
Change of tenancy	10%
Change of supplier	10%
Disconnection	0.5%
Non specific attrition	3%

Table 13: Provision for attrition

The first and second reasons were deemed to be sufficient to cause a change in usage pattern and therefore make comparison of usage across trial and benchmark periods inappropriate. The profile of the attritors was analysed from the results of a phased CATI survey.

The analysis found that change of supplier and change of tenancy was the most common reason for attrition with 89% of attritors falling into these categories. This should be noted in the context of the Irish residential market which featured a significant increase in competition and switching activity during the period of the Trial. Of those attritors who had switched suppliers, none stated that the trial tariffs contributed to the decision to switch. Therefore, the act of attrition is unlikely to be associated with the Trial (further details on the attrition research are included in **Appendix 3**, Profile of Residential Participation).

Finally, the level of attrition did not vary significantly across tariff or DSM stimuli groups (levels ranged from 12% to 14%). While a higher level of attrition was exhibited in the control group (at 19%), this reflects the competitive activity in the market and the natural lack of incentive to remain in the Trial (apart from the final payment for the survey). However, the higher level of attrition in the control group does not impact on the results of the analysis.

The final level of attrition reached is shown in the table below and across the test groups is within the original target of 20%:

Tariff	Bi-monthly bill and energy usage statement	Monthly bill and energy usage statement	Bi-monthly bill , energy usage statement and electricity Monitor	Bi-monthly bill, energy usage statement plus Overall Load Reduction Incentive	
Tariff A	23.4%	21.4%	19.8%	20.9%	21.4%
Tariff B	17.9%	19.8%	14.9%	21.5%	18.0%
Tariff C	19.0%	19.6%	20.3%	19.3%	19.5%
Tariff D	17.8%	14.9%	23.0%	18.7%	18.6%
Weekend					14.9%
Control Group					24.7%

Table 14: Levels of attrition during the Trial

4.6 Allocation of Participants to Stimulus and Tariff Groups

The allocation of participants to tariff and stimulus groups was completed in November 2009 in order to allow communication and implementation of the allocated tariff and stimulus. The allocation to particular tariffs and stimulus was on the basis of profiling of participants across all available survey and usage data. It was essential that the set of participants allocated to each cell was similar to the allocation in every other cell.

The quantity of data available on each participant from the usage data required a methodology which could identify factors or a combination of factors which could be used as the basis of allocation. The impact of the time of use tariffs and DSM stimuli was expected to vary across many dimensions - reflecting different demographic, household, socio-economic parameters as well across different level of discretionary usage (measurable in terms of the total level of ownership and use of electrical appliances).

In order to identify these combinations of factors, the allocation methodology used a proper orthogonal decomposition (also known as principal component analysis) to categorise the variability in usage in terms of combinations of the available data. Data included demographic and household information, usage information (including usage and variability splits between peak, night and day), engagement in energy investment and reduction, and an analysis of discretionary usage (using a categorisation of appliance usage and discretionary potential). The identified predictors of usage were centred around a combination associated

to home profile, a combination linked to usage profile, a combination linked to interest and engagement with energy reduction and a combination associated with appliance usage profile. Using these combinations, participants were randomly allocated to each experimental cell. After the initial allocation, corrections were made to ensure representivity across all data measures through a process of rebalancing the allocation by moving participants from one cell to another. Further details are included in **Appendix 4:** Allocation of participants.

5 Participant Communication and Involvement

5.1 Introduction

A comprehensive communications programme to support the Customer Behaviour Trial was put in place. The aim of this programme was to successfully recruit a nationally representative sample of participants as outlined above and to provide them with details of the time of use tariffs and DSM stimuli they were to test.

5.2 Recruitment Communications

Participants were recruited through a voluntary "opt-in" approach, using an invitation letter and a supporting Frequently Asked Questions (FAQ) brochure. Given the importance of the letter in securing opt-in from a nationally representative group, focus groups of consumers who had not been invited to participate in the Trial were conducted in order to obtain their comments and insights on the communication. (See **Appendix 5:** Outcome of Focus Groups conducted during the Customer Behaviour Trial). Following their feedback the letter was finalised. This approach resulted in an average 30% opt-in response rate, significantly above average for this type of communication. Samples of the final letter and other trial communications are contained in Error! Reference source not found.

5.3 Trial Communications

As outlined above participants in the Trial were divided between Test and Control Groups. In order to control for the effect of the ToU tariffs and DSM stimuli on behavioural change the design of the Trial precluded any energy efficiency campaigns specifically targeted at the Trial participants during the Test phase of the Trial. This was necessary in order to observe in as controlled a manner as possible the effect of the time of use tariffs and DSM stimuli on the behaviour of the test groups when compared with that of the control group and the behaviour of the control group versus the National population.

It should also be noted that a decision was made to exclude cooking and oven use in the communication of any energy reduction or peak shifting tips. This was to avoid any sensitivities that might later emerge with regard to prescribing when people should cook meals.

In common with the general population participants were exposed to energy efficiency campaigns being run nationally by various organisations in Ireland during the Trial. Any effect was controlled for through use of the Test and Control groups.

Communications with participants occurred at agreed times during the benchmark period providing them with information on what would happen during the Trial, advising them with

regard to calendarisation of billing (see 3.5 above) and arranging installation of the communications unit with the electricity monitor.

The final communication advised participants of which group they had been allocated to (test or control) and the tariff and DSM stimulus to be tested. This took place at the end of the benchmark period, just before the start of the Trial. The next communication received by participants (apart from the bill and energy statement) was in December 2010, when they were advised that their billing would return to the normal two-monthly cycle driven by meter reads. The OLR Incentive Group was an exception to this as they received a further letter in April 2010 to advise them of the commencement of the OLR incentive and target, which they would see on their bill in May 2010.

The final communications to all participants were in December 2010 advising the end of the Trial and the return to uncalendarised billing and February/March 2011 providing a reconciliation of the trial bills versus what participants would have paid had they remained on the normal "flat" tariff.

A schedule of the main communications is included in **Appendix 9**. Samples of the main communications are included in **Appendix 12**.

5.4 Participant Incentives

All participants in the pre- and post-trial surveys received a "thank-you" payment for their participation. This amounted to €50 paid in two instalments as a credit on their bill at the start of the Trial in November 2009 and at the end of the Trial in January 2011.

5.5 Fridge Magnet and Stickers

All of the test groups received a Fridge magnet, tailored to their particular time-of-use price and stickers showing the different time bands. As electricity time-of-use prices were a new concept for participants, it was hoped that prominent placing of this magnet and stickers would act as an "aide memoire" to the household of the day, night and peak times. Samples of the Fridge magnet and stickers are included in **Appendix 12**.

Figure 11:
Sticker showing different timebands

5.6 Consumer Research

Research of electricity consumers and Trial participants represented a fundamental aspect of the Customer Behaviour Trial.

At a primary level a pre-trial survey was carried out of participants in the Trial. Information gained from this survey provided insights which informed the participant allocation and provided a benchmark for any subsequent change in behaviour which might be measured at the end of the Trial.

A post-trial survey was carried out of the same participants in January 2011, comparing change in attitude, equipment or electricity use to the pre-trial findings.

Finally, surveys were also carried out of a select group who chose not to respond to the invitation letter and of those who left the Trial for various reasons before it had ended.

Focus groups with non-Trial participants were conducted in order to assist in design of the ToU tariffs, DSM stimuli and some selected communications. This was necessary given the importance of effecting behavioural change and securing active engagement by participants in the Trial. The findings from this research were used to inform the development of the ToU tariffs, DSM stimuli and participant communications used in the Trial and are outlined in more detail in **Appendix 5**, Outcome of Focus Groups conducted during the Customer Behaviour Trial.

5.7 Participant Queries and Feedback

Throughout the Trial, Electric Ireland monitored participant contact in order to identify whether the introduction of the smart meters, the time of use tariffs and the DSM stimuli had an impact on call volumes.

There was no significant increase in calls as a result of the Customer Behaviour Trial. However, where calls did take place, they tended to be of longer duration than calls from those not participating in the Trial. This effect was noted for the duration of the Trial.

6 Approach to Data Analysis

6.1 Overall Approach

The analysis of the outcome of the Trial seeks to quantify the extent to which Time of Use prices and DSM stimuli impact on overall and peak-time residential electricity consumption.

This requires the use of statistical techniques to test a number of hypotheses, specifically testing for evidence that the following lead to a reduction in both overall and peak electricity usage:

- ToU pricing in conjunction with DSM stimuli;
- Bi-monthly bill and energy statement; monthly bill and energy statement; bi-monthly bill, energy statement combined with an electricity monitor; and bi-monthly bill, energy statement and the OLR incentive in conjunction with ToU pricing;
- Individual ToU tariffs A, B, C and D in conjunction with DSM stimuli; and
- A weekend tariff (tariff W/E).

It is also necessary to look at cross-effects of tariffs and DSM stimuli to ascertain if a specific DSM stimulus that stands out as being more effective than others in reducing overall and peak electricity usage for a given ToU tariff; or if a specific ToU tariff that is more effective for a given DSM stimulus.

The Customer Behaviour Trial was initially designed to detect changes in behaviour in relation to overall usage and peak time usage and to detect a minimum effect of a 2% change in usage over the whole sample of participants and between Tariff A and Tariff C. A change of 3% would be detected at the level of Tariffs B and D and the DSM stimuli and a reduction of 4% would be detected at a Tariffs A and C and at a cellular level. A 90% confidence level is applied to all tests conducted.

In addition to the above, the analysis will look at the relationship between usage and the associated tariff groups A, B, C and D and attempt to identify the price point at which consumption is most reduced (ie a tipping point).

6.2 Treatment of Data

Data was collected for every meter participating in the Trial during the period July 2009 to December 2010. This comprised half-hourly reads of electricity consumption and the time of day during which the read was taken.

A strategy was put in place to deal with missing data (were it to occur). Where possible, multiple imputation was used to obtain reliable estimates for missing values. Further details are provided on this within **Appendix 2**, Methodology for Analysis of Customer Behaviour Trial Data.

The cleaned data set consists of 4,225 meters, each with 48 half-hourly meter reads per day over 536 days. During the benchmark period (up to 31st December 2009) all participants were charged the same tariff (14.1 cent) and received the same billing information on a bi-monthly basis. The test groups, consisting of 3,296 meters, were assigned ToU tariffs and provided with DSM stimuli from 1st January 2010 up to 31st December 2010. The tariff and billing information for the control group of 929 meters remained unchanged throughout the duration of the Trial. The average daily usage for the duration of the Trial (Benchmark and Test period) was 12kWh per day.

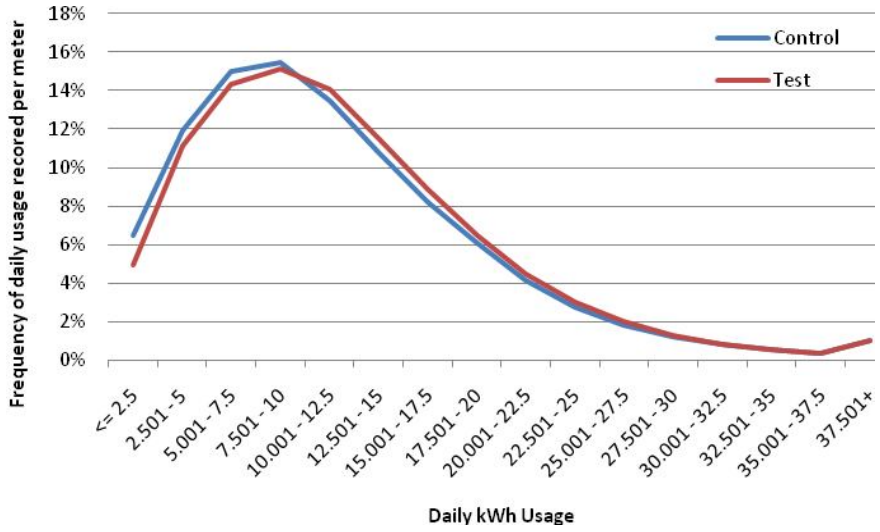


Figure 12: Frequency distribution of daily usage (kWh)

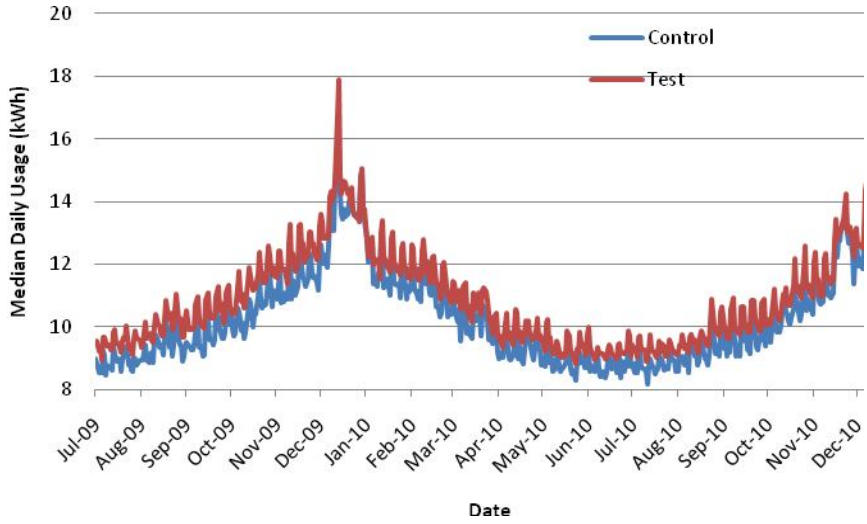


Figure 13: Median daily usage (kWh) during the Trial

Details on tariff/stimulus combinations used during the Trial are provided in **Table 15.** Each meter in the data set is assigned an allocation for its corresponding ToU tariff/DSM stimuli combination, which allows the data to be grouped according to tariff.

ToU Tariff	DSM stimulus			
	Bi-monthly bill and Energy statement	Monthly bill and energy statement	Bi-monthly bill, energy statement and electricity monitor	Bi-monthly bill, energy statement and overall load reduction incentive (OLR)
Tariff A	A1	A2	A3	A4
Tariff B	B1	B2	B3	B4
Tariff C	C1	C2	C3	C4
Tariff D	D1	D2	D3	D4

Table 15: Tariff/Stimulus Allocation Matrix

6.3 Methodological Approach

Using the data, the usage behaviour of participants in the test groups was compared to the control group during the trial period. The extent to which this behaviour was different to the benchmark period was also investigated. At an overall level, the ratio of total volume of electricity usage for the test groups during the trial period relative to the benchmark period is calculated (R_T). This is then compared to the corresponding ratio for the control group (R_C). The formula used to calculate the ratio is as follows:

$$R_j = \frac{\sum \alpha_{i,j}}{\sum \beta_{i,j}}$$

where $\alpha_{i,j}$ is the volume of usage for meter i in group j during the trial period and $\beta_{i,j}$ is the volume of usage for meter i in group j during the benchmark period.

This ratio is also calculated for the ToU tariff/DSM stimuli groups within the test groups and compared to the ratio for the control group. It is repeated for the time periods night, day and peak. For tariff groups A, B, C and D:

Night is defined as usage during the period 23.00 to 07.59 Monday to Sunday and,

Peak is 17.00 to 18.59 Monday to Friday excluding public holidays.

Day is 08.00 to 16.59 and 19.00 to 22.59 Monday to Sunday and 17.00 to 18.59 Saturday, Sunday and public holidays (i.e. there was no peak tariff applied on Saturdays, Sundays and public holidays).

The calculation is slightly different for the weekend tariff group as the Night rate was applied all day Saturday, Sunday and public holidays. The bands are as follows:

Night is 23.00 to 07.59 Monday to Sunday and 08.00 to 22.59 Saturday, Sunday and public holidays;

Day is 08.00 to 16.59 and 19.00 to 22.59 Monday to Friday excluding public holidays; and,

Peak is 17.00 to 18.59 Monday to Friday excluding public holidays.

A summary of this classification is provided in **Table 16**.

	23.00-07.59		08.00-16.59 and 19.00-22.59		17.00-18.59	
	Mon-Fri (excl holidays)	Sat & Sun (incl. holidays)	Mon-Fri (excl holidays)	Sat & Sun (incl. holidays)	Mon-Fri (excl holidays)	Sat & Sun (incl. holidays)
Tariffs A-D	Night	Night	Day	Day	Peak	Day
Tariff W/E	Night	Night	Day	Night	Peak	Night

Table 16: Classification of night, day and peak ToU tariffs

The percentage difference in the ratios between the test and control groups quantifies the extent to which the ToU tariffs and DSM stimuli impact on electricity usage for those meters participating in the Trial.

Statistical procedures and tests are required to make inferences about the likely impact on the wider residential consumer population. The first step in this requires estimating a measure of variance around the total volume usage figures using a statistical procedure known as

bootstrapping. The second step is to formally test the hypotheses detailed above. This was done directly using the bootstrap replicates.

A more detailed description of the methodological approach is contained in **Appendix 2**.

7. Outcome of the Residential Trial

7.1 Summary

The following details the main findings of the data analysis. A more detailed presentation of the results from the statistical tests is contained within **Appendix 2**.

7.2 Impact of ToU Tariffs in conjunction with DSM Stimuli on Overall and Peak Usage

The data gathered from the Trial shows a reduction of **2.5%** in overall electricity usage and **8.8%** in peak electricity usage for residential participants on ToU tariffs and DSM stimuli relative to the control group. Both results are statistically significant at the 90% confidence level.

The implementation of time of use pricing is found to reduce both overall and peak electricity usage across all ToU tariff groups for participants in the Trial. Excluding the weekend tariff, the largest reductions occur for Tariff B (-3.4%) and Tariff D (-10.9) for overall and peak electricity usage respectively. All results for overall and peak usage are statistically significant at the 90% confidence level.

Usage	All Tariff Groups and DSM Stimuli	All DSM Stimuli by Tariff Group				
		Tariff A %	Tariff B %	Tariff C %	Tariff D %	W/E Tariff %
Overall	-2.5*	-2.7*	-3.4*	-1.9*	-2.4*	-3.7*
Peak	-8.8*	-7.2*	-9.8*	-9.0*	-10.9*	-11.6*
* denotes results which are statistically significantly different from control group using a 90% confidence level.						

Table 17: Percentage change in overall and peak electricity usage relative to the control group by tariff group

There is no single tariff group that stands out from the others as being superior in terms of reducing overall or peak electricity usage. However, statistical tests find evidence to suggest that tariff group B is more effective than tariff group C in reducing overall electricity usage and tariff group A is not as effective as tariff groups B, C, D and the weekend tariff in reducing peak usage.

Looking across the DSM stimuli, (**Table 18**) the bi-monthly bill, energy statement and electricity monitor is most effective at reducing both overall (-3.2%) and peak (-11.3%) usage for participants in the Trial. Relatively similar reductions in overall and peak usage are found for the monthly bill and energy usage statement and for the bi-monthly bill, energy usage statement and OLR incentive. All results for overall and peak usage are statistically

significant at the 90% confidence level, with the exception of the bi-monthly bill and energy usage statement for overall usage. It should be stressed that these tests are for the DSM stimuli as deployed: The analysis determines whether the combination of bi-monthly bill, energy usage statement and either the electricity monitor or OLR incentive is effective. It is not possible to determine the benefit of the electricity monitor or the OLR incentive independent of the energy usage statement (as distinct from the incremental benefit when combined) as the combination may have additional interaction effect which impacts on the reduction achieved.

Usage	All Tariff Groups and DSM Stimuli	Tariff Groups A-D by DSM Stimulus			
		Bi-monthly Bill and energy usage statement (*Stimulus 1*) %	Monthly Bill and energy usage statement (*Stimulus 2*) %	Bi-monthly Bill, energy usage statement and electricity monitor (*Stimulus 3*) %	Bi-monthly Bill, energy usage statement and OLR incentive (*Stimulus 4*) %
Overall	-2.5*	-1.1	-2.7*	-3.2*	-2.9*
Peak	-8.8*	-6.9*	-8.4*	-11.3*	-8.3*
* denotes results statistically significantly different from control group using a 90% confidence level.					

Table 18: Percentage change in overall and peak electricity usage relative to the control group by stimulus

Statistical tests find evidence to suggest that Stimulus 1 (the bi-monthly bill combined with the energy usage statement) is not as effective at reducing overall electricity usage as the other three DSM stimuli. Apart from Stimulus 1 there is statistically no single DSM stimulus that stands out above the others as being more effective in reducing overall electricity usage. However, the statistical tests do support evidence that the combination of the bi-monthly bill, energy usage statement and electricity monitor (Stimulus 3) is more effective at reducing peak electricity usage than the other DSM stimuli.

The analysis is further extended to look at the impact of the individual ToU tariff and DSM stimulus combinations. While Tariff D combined with a bi-monthly bill, energy usage statement and the electricity monitor yields the biggest reduction for peak usage (D3=-13.9%), it is the combination of Tariff B and the OLR incentive that results in the biggest reduction in overall electricity usage (B4 = -4.3%) for residential participants in the Trial.

ToU Tariff Groups	DSM Stimulus			
	Bi-monthly Bill and energy usage statement (*Stimulus 1*) %	Monthly Bill and energy usage statement (*Stimulus 2*) %	Bi-monthly Bill, energy usage statement electricity monitor (*Stimulus 3*) %	Bi-monthly Bill, energy usage statement and OLR incentive (*Stimulus 4*) %
Tariff A	-1.4	**-2.7***	**-3.2***	**-3.6***
Tariff B	**-3.0***	**-3.9***	-2.5	**-4.3***
Tariff C	-0.2	**-2.5***	**-3.3***	**-1.8***
Tariff D	-0.8	-2.0	**-3.9***	**-3.2***
* denotes results statistically significantly different from control group using a 90% confidence level.				

Table 19: Percentage reduction in overall electricity usage relative to the control group by tariff/stimulus combination

ToU Tariff Groups	DSM Stimulus			
	Bi-monthly Bill and energy usage statement (*Stimulus 1*) %	Monthly Bill and energy usage statement (*Stimulus 2*) %	Bi-monthly Bill, energy usage statement electricity monitor (*Stimulus 3*) %	Bi-monthly Bill, energy usage statement and OLR incentive (*Stimulus 4*) %
Tariff A	-6.4*	-5.5*	-10.1*	-6.7*
Tariff B	-8.7*	-10.6*	-8.9*	-10.8*
Tariff C	-6.5*	-9.0*	-12.5*	-8.2*
Tariff D	-7.8*	-11.8*	-13.9*	-10.4*
* denotes results statistically significantly different from control group using a 90% confidence level.				

Table 20: Percentage reduction in peak electricity usage relative to the control group by tariff/stimulus combination

In the case of overall electricity usage, the statistical tests fail to find evidence of a particular DSM stimulus being superior within each of the tariff groups and equally no particular tariff group is found to be more effective within of the DSM stimuli.

The statistical tests find evidence that the bi-monthly bill, energy usage statement and electricity monitor is more effective at reducing peak electricity usage for tariff groups A and C. However, no other DSM stimuli stands out as being more effective than the others within each of the tariff groups and equally no particular tariff group is found to be more effective within the DSM stimuli. Finally, to explore a subset of ToU tariffs and DSM stimuli of interest, the Tariff A and Tariff B across the monthly bill and bi-monthly bill and electricity monitor stimulus groups were combined into a single group for analysis. This analysis is shown in the table below:

	Night %	Day %	Peak %	Total %
Combination of tariff A/B with either monthly energy usage statement or bi-monthly energy statement and electricity monitor	-0.51	-3.09	-8.42	-3.02

Table 21: Analysis of Tariff A and Tariff B across monthly and bi-monthly bill with electricity monitor stimuli and percentage reduction

7.3 Impact of Time of Use Tariffs (in conjunction with DSM stimuli) over time

The degree to which the impact of Time of Use tariffs or DSM stimuli changes over the period of the Trial provides insight into the potential long term impact of smart meters. It might be of concern if the impact declines after an initial period as that might represent the long term response to Smart Metering. Similarly, if the impact increases over time that might indicate potential incremental increases the benefit of the initiatives possible through the deployment of smart meters.

A comparison of the change in usage during the first six months and the second six months is shown in **Table 22.**

ToU Tariff Groups		Overall	All Tariff Group (in conjunction with DSM stimuli)			
			Tariff A %	Tariff B %	Tariff C %	Tariff D %
Overall	1st six months	-2.6	-2.4	-3.7	-2.4	-2.2
	2nd six months	-2.4	-3.1	-3.1	-1.4	-2.7
Peak	1st six months	-8.3	-6.6	-9.6	-8.9	-9.7
	2nd six months	-9.3	-7.8	-10.0	-9.2	-12.0

Table 22: The percentage change in overall and peak usage in the first and second six month periods of the Trial across tested tariffs

This analysis shows that at the level of overall volume reduction, there is a minor deceleration in impact between the first and second six monthly periods from a 2.6% to 2.4% reduction. In contrast, in the case of Peak reduction, the impact of the ToU tariffs, in conjunction with the DSM stimuli deployed shows an increase in impact from an 8.3% to 9.3% reduction respectively.

This analysis does not show a clear picture in overall usage as two of the tariffs show an increase in overall usage reduction (Tariff A and Tariff D) while two other tariffs show a decline (Tariff B and Tariff C). Examining the four weekly trends in overall reduction (**Figure 14**) Tariff B exhibits a distinctive reduction pattern at both the start and end of the

Trial which cannot be directly explained from the structure of the tariff itself. However, it should be noted that tariff group B and D were smaller groups and, on that basis, are subject to higher levels of variability.

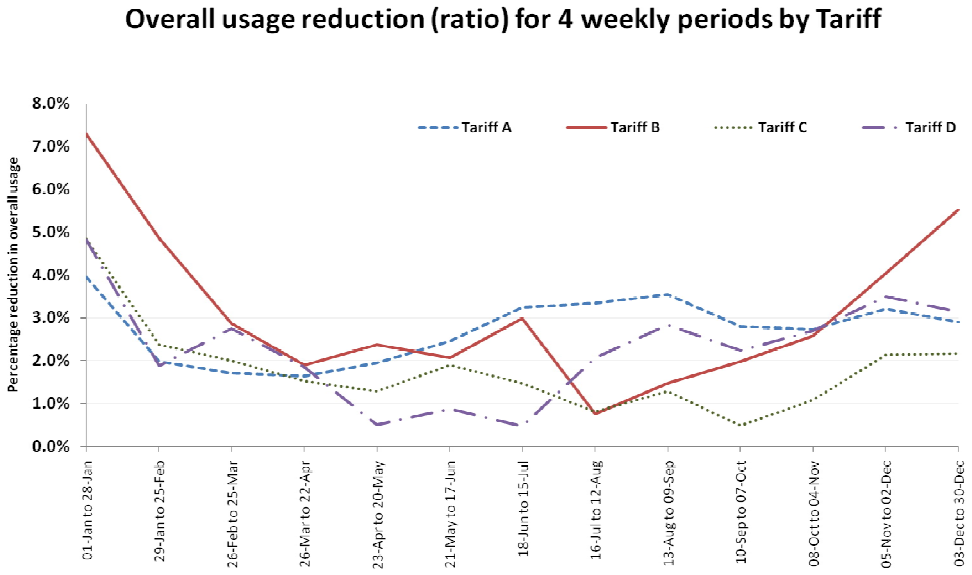


Figure 14: Trends in overall usage reduction for each tariff group (for 4 week periods)

Tariffs A and C are more stable in terms of their response over time. Tariff A loses momentum in terms of reduction initially, but regains that momentum steadily over the course of the Trial, with strong overall reductions of between 3% and 4% for the second half of the Trial. Notwithstanding its equal robustness in sample size terms, Tariff C is less stable over time and shows decreasing reduction ratios over the first nine months of the Trial, moving from 5% to less than 1% before returning to a 2% measure at the end of the Trial. Tariffs B and D exhibit a 'U' shaped response, where the overall reduction associated with these tariffs is higher during higher consumption periods with relative decreases during the middle six months of the Trial.

Considering the peak reduction trend, there is a non linear relationship of peak reduction to peak price escalation (**Figure 15**), with Tariff C exhibiting less impact considering the incremental rate of peak applied. It is interesting to note that Tariff C represents the point at which overall reduction is lowest, with day reduction levels mirroring overall reduction levels. In the case of Tariff D the overall reduction ratio and the day reduction ratios diverge, in contrast with Tariff C, notwithstanding the decrease in the cost of day units (13c for Tariff C and 12.5c for Tariff D).

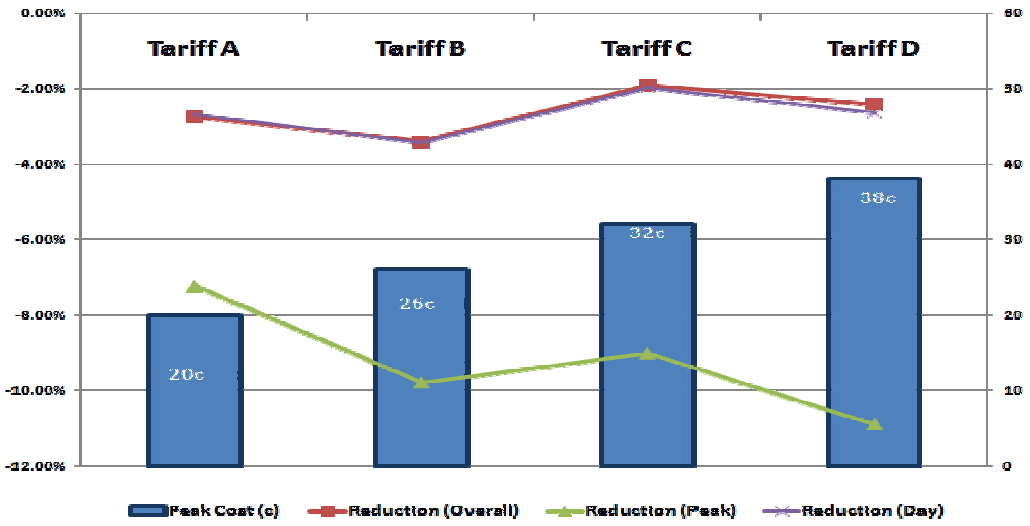


Figure 15: Relationship of peak price to overall, peak and day reduction

Considering the change over time for peak usage by tariff (in conjunction with DSM stimuli) monthly peak usage reduction exhibits more predictable trends (**Figure 16**) with the Tariff D group exhibiting the greatest peak usage reduction. This reflects the high peak cost of electricity on this tariff and the response escalates over time with the highest point being achieved in the September/October period. Both Tariffs B and C demonstrate very stable responses as the Trial continues. Tariff A's peak response is consistently lower than the other tariffs but rises to a level comparable with the others in the May to August period. It is noteworthy that all tariffs show a decline in peak reduction in the final quarter of the Trial. In all tariffs the end point reduction ratio is lower than its start point equivalent.

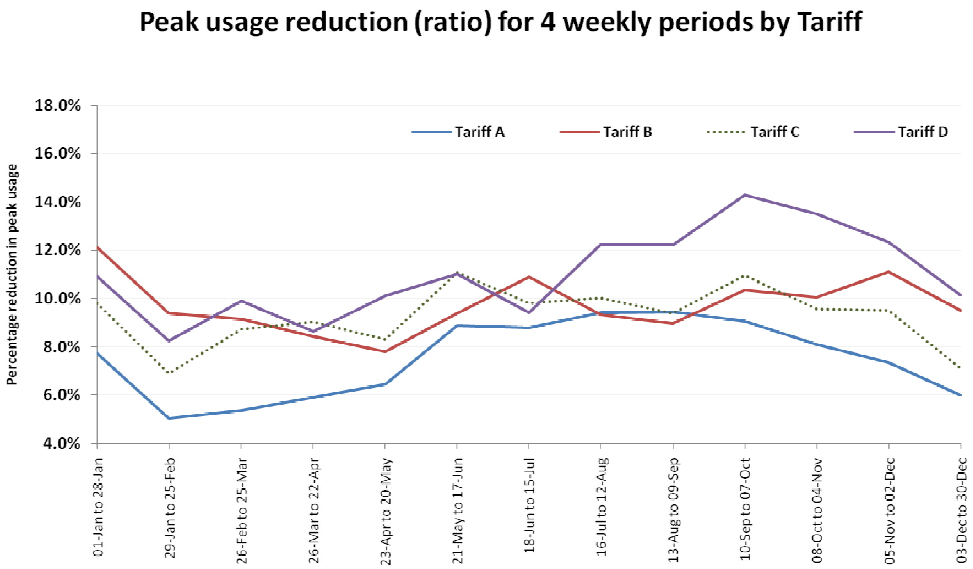


Figure 16: Trends in peak usage reduction for each tariff group (for four week periods)

7.4 Impact of DSM Stimuli (in conjunction with ToU Tariffs) over time

Examining the change in the impact of the DSM stimuli between the first six month period of the Trial and the second six month period shows improvement over time in the case of the bi-monthly bill and energy statement, monthly bill and energy statement and the bi-monthly bill, energy statement and OLR incentive (**Table 23**). However, while the electricity monitor group started with the largest overall and peak reduction, its impact is seen to decline through the Trial, although it remains the single most effective stimulus compared with the other DSM stimuli in the case of peak reduction.

Stimulus Groups		Overall	All DSM Stimulus groups (in conjunction with Tariffs))			
			Bi-monthly bill and energy usage statement %	Monthly bill and energy usage statement %	Bi-monthly Bill, energy usage statement and electricity monitor %	Bi-monthly Bill, energy usage statement and OLR incentive %
Overall	1st six months	-2.6	-0.8	-2.6	-4.0	-2.8
	2nd six months	-2.4	-1.3	-2.8	-2.4	-3.1
Peak	1st six months	-8.3	-6.4	-7.6	-11.7	-7.3
	2nd six months	-9.3	-7.5	-9.2	-10.9	-9.3

Table 23: The percentage change in overall and peak usage in the first and second six month periods of the Trial across tested DSM stimuli

However, examining the trend in the percentage of overall reduction across each four weekly period during the lifetime of the Trial (**Figure 17**), it is clear that the pattern of impact for the electricity monitor is more subtle. During the initial period of the Trial (up to April), the impact of the electricity monitor in combination with the bi-monthly bill and energy statement, was greater compared with all other DSM stimuli and remained so for the first five months of the Trial. The impact of the monthly bill and energy statement and bi-monthly bill, energy statement and the OLR was very similar up to the point at which the specific target associated with the OLR incentive and target was communicated. In the case of all DSM stimuli, the initial impact decreased incrementally for the first five months of the Trial, at which point the impacts began to stabilise.

In the case of the electricity monitor, the initial high level of overall usage reduction is unsurprising given the initial impact of the electricity monitor, as is the decline in its impact during the earlier stages of the Trial. The electricity monitor group showed a similar level of reduction to the monthly billing and energy statement group through the summer when overall usage is lower. However, the reduction increased significantly from November

onwards. This suggests that the impact of the electricity monitor is sustained over the course of the Trial, but that it is primarily relevant during periods of higher electricity usage.

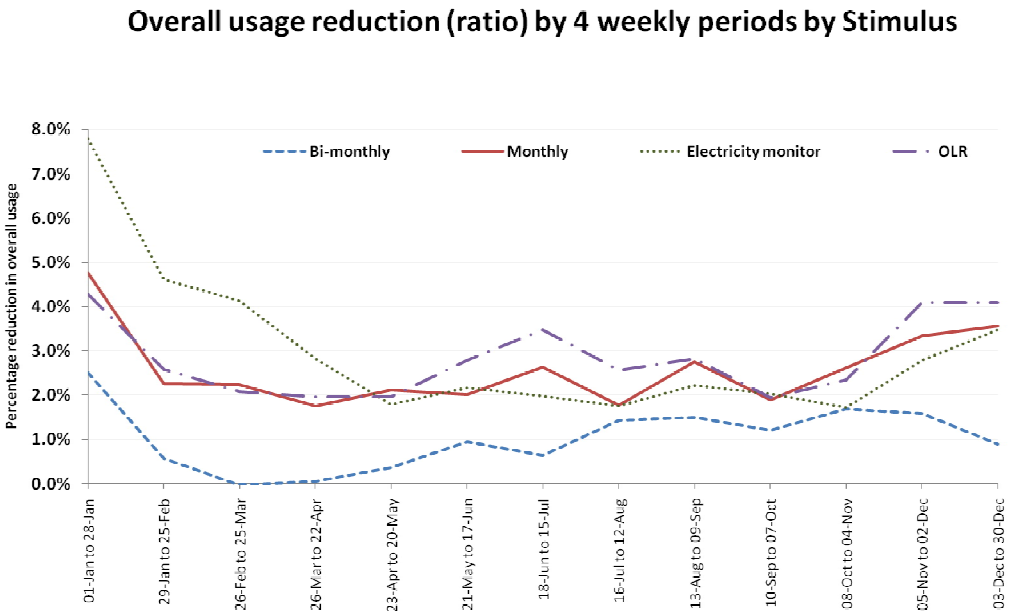


Figure 17: Trends in overall usage reduction for each stimulus group (for four week periods)

Considering the impact of the other DSM stimuli, it is clear that the bi-monthly bill and energy statement is consistently less effective than the others. It should be noted that the first bi-monthly bill did not arrive until the middle of March (due to calendarisation all participants in this group received their bills at the same time). Therefore, the initial reduction must be associated with the initial communications associated with the Trial and not the information communicated as part of the bi-monthly bill and energy statement stimulus.

The impact of the OLR incentive can be seen in May when there is an increased reduction in energy use after the target was communicated and a bill delivered with information on the target information. It is also notable that the level of reduction increased towards the end of the year in line with the completion date for the OLR target.

The monthly reduction in peak usage (**Figure 18**) shows greater consistency over time in terms of reduction ratio associated with the electricity monitor once the initial impact had dissipated. Reflecting the focus of the OLR incentive on overall usage reduction, the peak reduction associated with the OLR incentive and monthly billing and energy statement groups follow similar patterns. Finally, while the difference is less visible than with the overall usage reduction, the bi-monthly bill and energy statement group consistently reduced peak usage less than other groups up to the final month.

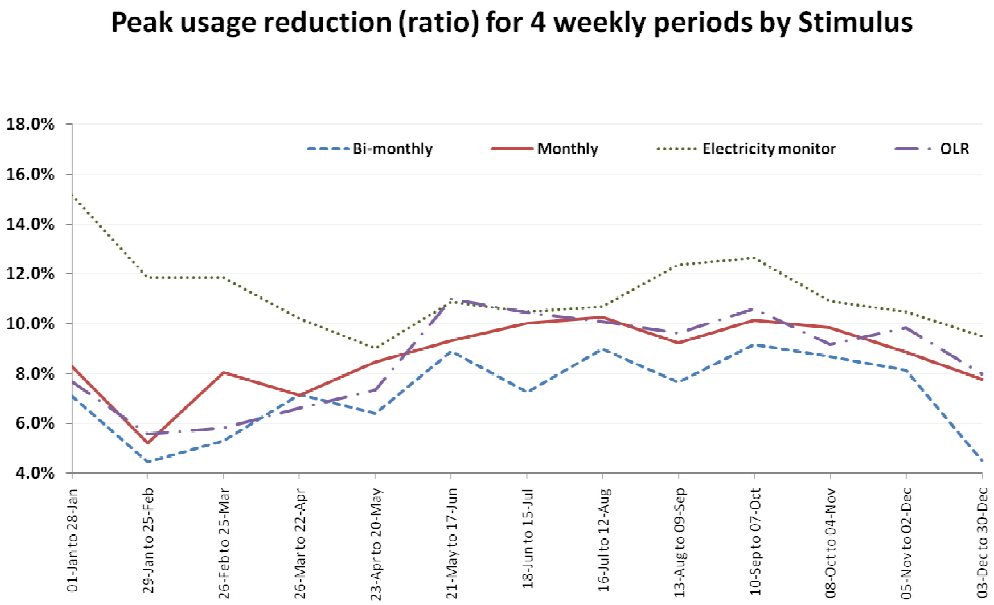


Figure 18: Trends in peak usage reduction for each stimulus group (for four week periods)

The usage changes between the first and second six months of the trial for those on ToU tariffs and different DSM stimuli were observed.

	FIRST SIX MONTHS OF SMART METER TRIAL			
	Night %	**Day %**	**Peak %**	**Total %**
Tariff A				
Bi-monthly bill and energy statement	0.4	0.3	-4.6	-0.1
Monthly bill and energy statement	-3.2	-2.2	-5.0	-2.6
Bi-monthly bill, energy statement and electricity monitor	-0.6	-3.8	-10.4	-3.6
Bi-monthly bill, energy statement and overall load reduction incentive (OLR)	-2.3	-2.9	-6.2	-3.0
Tariff B				
Bi-monthly bill and energy statement	1.1	-2.4	-7.8	-2.2
Monthly bill and energy statement	-3.2	-3.0	-9.7	-3.7
Bi-monthly bill, energy statement and electricity monitor	1.7	-4.1	-9.5	-3.3
Bi-monthly bill, energy statement and overall load reduction incentive (OLR)	-4.3	-5.0	-11.1	-5.5
Tariff C				
Bi-monthly bill and energy statement	0.9	-0.5	-7.1	-0.8
Monthly bill and energy statement	-2.2	-2.4	-8.4	-2.9
Bi-monthly bill, energy statement and electricity monitor	-1.6	-4.2	-13.2	-4.5
Bi-monthly bill, energy statement and overall load reduction incentive (OLR)	1.5	-1.9%	-6.9	-1.6
Tariff D				
Bi-monthly bill and energy statement	1.3	-1.2	-7.8	-1.4
Monthly bill and energy statement	4.2	-0.9	-9.7	-0.5
Bi-monthly bill, energy statement and electricity monitor	-3.6	-3.9	-14.4	-4.9
Bi-monthly bill, energy statement and overall load reduction incentive (OLR)	1.4	-2.8	-7.4	-2.4

Table 24: Usage Change first six months of the Customer Behaviour Trial

	SECOND SIX MONTHS OF SMART METER TRIAL			
	Night %	**Day %**	**Peak %**	**Total %**
Tariff A				
Bi-monthly bill and energy statement	-0.4	-2.6	-8.1	-2.6
Monthly bill and energy statement	-0.2	-3.0	-6.0	-2.7
Bi-monthly bill, energy statement and electricity monitor	0.9	-3.1	-9.9	-2.9
Bi-monthly bill, energy statement and overall load reduction incentive (OLR)	-2.8	-4.1	-7.2	-4.1
Tariff B				
Bi-monthly bill and energy statement	-0.3	-3.9	-9.6	-3.7
Monthly bill and energy statement	-0.3	-4.2	-11.5	-4.1
Bi-monthly bill, energy statement and electricity monitor	2.1	-1.8	-8.4	-1.6
Bi-monthly bill, energy statement and overall load reduction incentive (OLR)	0.5	-3.0	-10.4	-3.0
Tariff C				
Bi-monthly bill and energy statement	4.2	0.0	-5.9	0.3
Monthly bill and energy statement	1.2	-2.1	-9.5	-2.1
Bi-monthly bill, energy statement and electricity monitor	2.9	-2.3	-11.9	-2.1
Bi-monthly bill, energy statement and overall load reduction incentive (OLR)	3.4	-2.5	-9.5	-1.9
Tariff D				
Bi-monthly bill and energy statement	6.0	-1.0	-7.8	-0.2
Monthly bill and energy statement	2.8	-4.1	-13.8	-3.5
Bi-monthly bill, energy statement and electricity monitor	1.4	-2.8	-13.4	-3.0
Bi-monthly bill, energy statement and overall load reduction incentive (OLR)	2.5	-4.6	-13.3	-4.0

Table 25: Usage Change second six months of the Customer Behaviour Trial

7.5 Tipping Point Analysis

The tipping point is defined as the two price profiles between which the price premium causes a significant reduction in usage. **Figure 19** illustrates the relationship between average (median) daily peak usage and the four tariff groups A, B, C, D. This shows that average peak electricity usage is lower for the tariff groups on a higher peak rate. However, the graph suggests a relatively weak relationship exists between price (as defined by the Tariffs tested) and usage (as defined by the usage reduction observed). It is, therefore, concluded that the relationship between tariffs tested on this trial and usage reduction observed provides no evidence of a tipping point.

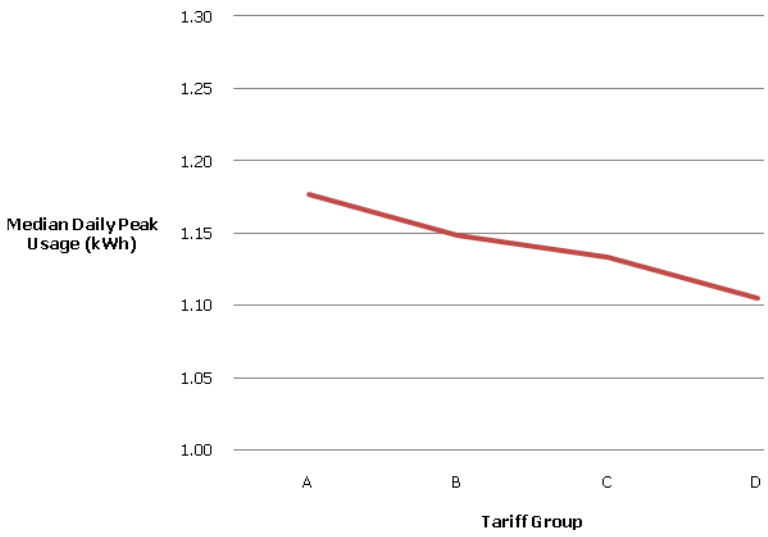
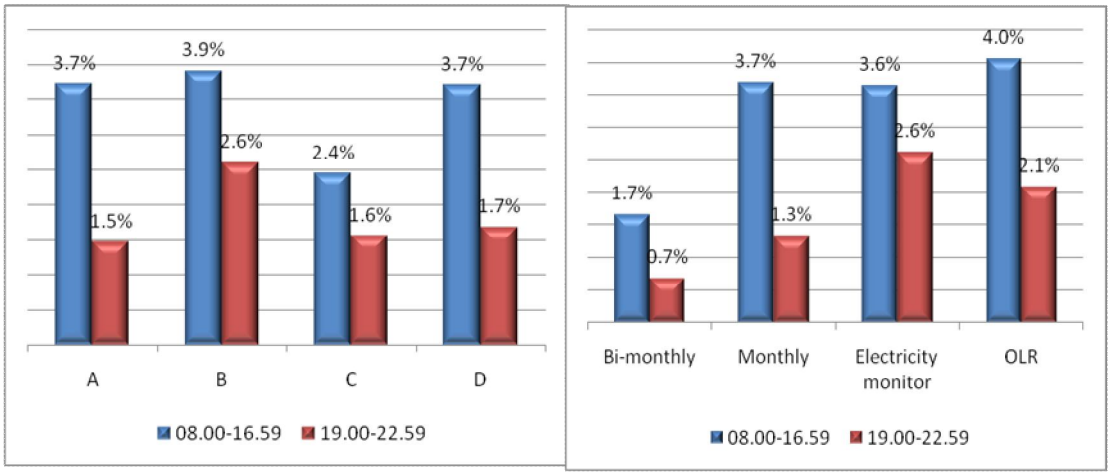


Figure 19: Median Daily Peak Usage for each Tariff Group

7.6 Analysis of change in volume distribution during the Trial

A clear objective of the Trial was to reduce usage during the peak period in addition to overall usage. The greater percentage reduction in peak usage compared to overall usage implies that some usage shifting occurred away from that period. Shifting can occur to any time period from more expensive periods. In the case of peak usage, it is possible that shifting occurs after peak (a deferral usage), before the peak (bringing forward usage) or at night time. When considering these figures, it should also be noted that hourly consumption during the post-peak period is 180% higher than hourly consumption in the pre-peak period. This means that while almost three times longer in duration than the pre-peak period, the total consumption is only approximately twice that in the post-peak period.

Figure 20 shows the percentage reduction in volume consumed in the pre-peak period (from 08:00 to 16:59) and post-peak period (from 19:00 until 22:59). This shows a significantly higher level of reduction in the pre-peak period compared to the post-peak period. This could



be accounted for by either deferral to the post-peak period (thereby reducing the level of reduction) or by a lower level of potential saving during the post-peak period.

Figure 20: Percentage reduction in volume consumed in the pre- and post- peak periods

Considering the absolute reduction in total consumption, **Figure 21 s**hows the breakdown of the reduction by 30 minute periods throughout the average weekday (Monday to Friday, excluding public holidays).

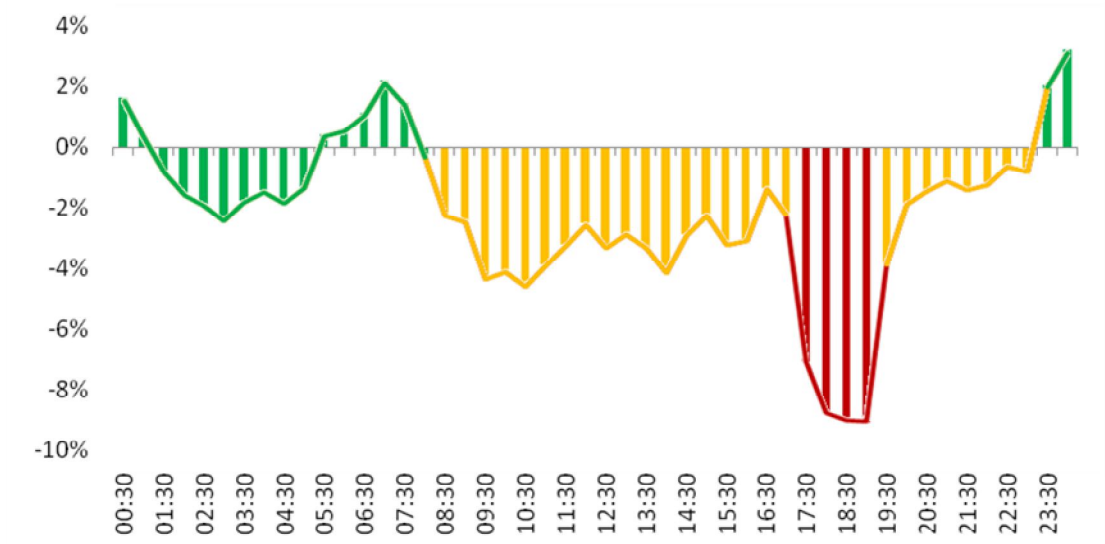


Figure 21: Change in total consumption across average day (Monday to Friday)

To better understand the profile of the shifting which occurs, it is necessary to look at the total consumption profile in more detail. **Figure 22** shows the shape of the load distribution of total consumption split across each 30 minute period throughout the Trial from Monday to Friday excluding public holidays (peak tariffs did not apply during weekends or public holidays).

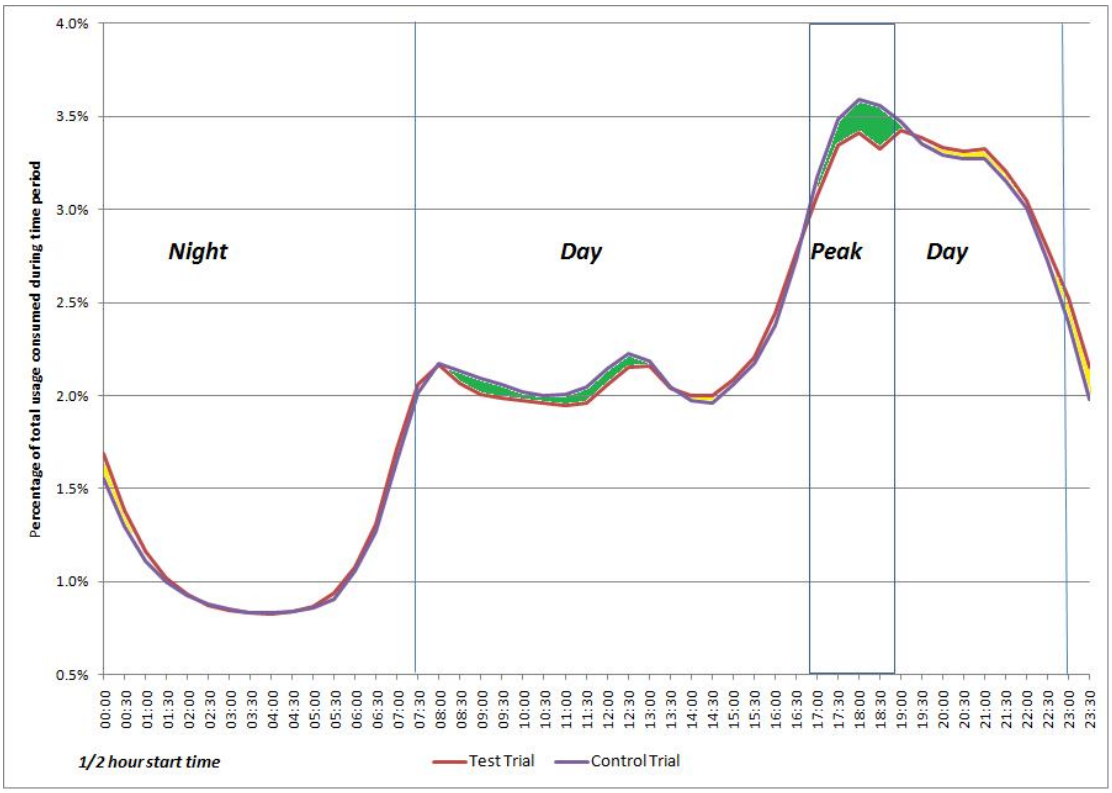


Figure 22: Changes in load distribution profile across average day (Monday to Friday) for test and control groups during the period

The distribution of usage for the test group during the trial period (in red) is compared with the distribution of usage for the control group during the same period (in blue) with the difference shown in green when the trial participants use less and yellow when they use more. The higher reduction in peak usage among trial participants is evident on this graph and it is also clear that some displaced usage moves to the post 19.00 period as well as throughout the night period. There is also a relative reduction during the day from 08.00 to 13.30 but there is no relative reduction in the period immediately before the peak.

Therefore, it can be deduced that three behaviours appear to occur:

- In response to the price signal at 08.00 (the transition to higher rate day-time rate), participants reduce usage more.
- In response to the peak price signal (between 17.00 and 19.00), participants reduce usage more and defer some of that usage to the immediate post-peak period (resulting in the proportion of usage during that period increasing)
- There is also some deferral of usage to the night period (between 23.00 and 08.00).

7.6.1 Impact on Participant Bills

The imposition of time of use tariffs can be assessed from three separate perspectives, each of which provides information on the overall impact. It should be noted that the tariffs were

designed to be cost neutral, therefore inherent in that structure is the expectation that savings would be modest.

Measure 1: Estimate of the reduction on the bill associated with the reduction in usage:
Comparison is between the bill based on actual usage during the Trial calculated using the tested tariff with the bill based on an estimate of usage if no reduction was achieved using the tested tariff. This estimate of usage was calculated by inflating the total volume used for peak, day and night for each cell in the experimental matrix in line with the calculated reduction in usage.

Measure 2: Estimate of the impact on the bill of participation in the Trial: The comparison between the bill, based on actual usage and the tested tariff and a bill calculated using an estimate of the usage if no reduction was achieved and using the cost of electricity at the start of the Trial (14.1c per kWh). The estimate of usage if no reduction was achieved was calculated for each individual based on the average reduction for the time period (i.e. day, night or peak) for the combination of tariff and stimulus applied to the individual participant. For example, if an individual has tariff A applied and was exposed to the electricity monitor, then that individual's peak usage is inflated by the average reduction for peak for participants with the combination of tariff A and the electricity monitor.

Measure 3: The impact of tariff on the bill: The comparison between the bill size with the tested tariff compared with the bill calculated using the same usage and the cost of electricity at the start of the Trial (14.1c per kWh).

Average annual saving	Tariff A	Tariff B	Tariff C	Tariff D
Measure 1 saving	€19.06	€26.08	€18.76	€25.47
Measure 2 saving	€18.22	€22.81	€17.75	€21.62
Measure 3 saving	€0.67	€1.11	€5.61	€6.79

Table 26: Impact on participant bills using different measures of saving

Measure 1 estimates the saving achieved by participants through behaviour change compared to the bill if no behaviour change was achieved (i.e. if the tariff is imposed but no behaviour change achieved). Measure 2 estimates the saving achieved by participants through behaviour change compared to the bill if no behaviour change was achieved and no tariff imposed (i.e. if the participant had not been part of the Trial). The Measure 2 estimates are slightly lower than Measure 1 estimates reflecting the impact of the Time of Use tariff on the cost of peak usage in Measure 1.

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Measure 3 is close to zero reflecting the fact that the tariffs were designed to have zero impact in that the overall cost of electricity was not increased while the relative cost of using electricity at different times was incentivised. However, as shown in **Figure 23** the distribution is highly centered to the average for the vast majority of participants with a minority of participants significantly impacted by the introduction.

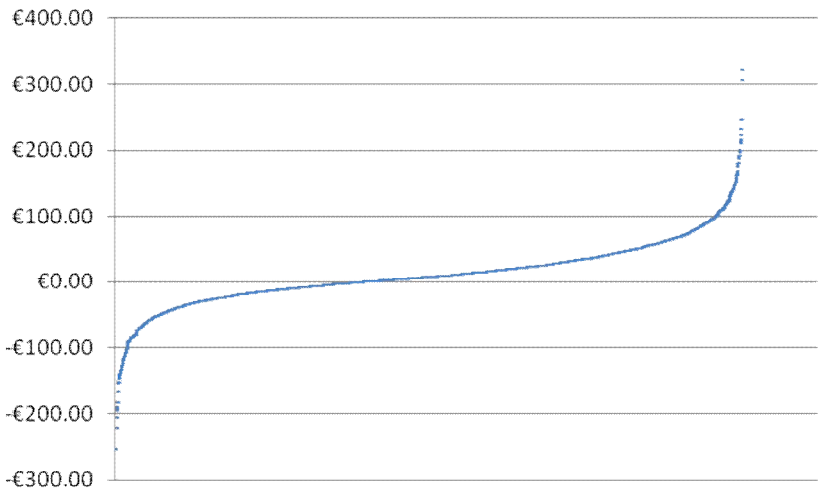

Figure 23: Financial impact of the introduction of time of use tariffs across the trial participants

Analysis of these findings suggests that

- On average participants made behaviour changes sufficient to neutralize the potential negative impact of the tariffs (as shown by the figures for Measure 3 which are close to zero).
- The level of savings under Measure 1 as a proportion of the estimated bill ranges from 2.96% (for tariff C) to 4.11% (for tariff D) which also suggests that consumers are adjusting usage to neutralise increases in the overall bill.

7.7 Analysis of change in usage across all participants

7.7.1 Understanding the impact of the Trial on the household

As well as determining the degree to which the total volume of electricity consumed overall and during peak hours was reduced, the pilot aimed to explore how consumer behaviours changed, collect feedback on the impact of the Trial on the participant's engagement and interest in energy reduction and collect feedback on the consumer experience of the tariffs and stimuli.

In order to achieve these goals it was necessary to collect and analyse experiential, behavioural and attitudinal data from the participants of the test and control groups. This data was collected in two surveys: one at the start of the pilot in the final quarter of 2009 and one

at the end of the pilot in the first quarter of 2011. These surveys were completed using Computer Telephone Assisted Interviewing (CATI). Participants were required to participate in these surveys as part of their involvement in the Trial and consequently the level of participation was high (79% of households which were part of the Trial completed the pre-trial survey; 80% of households which had completed the pre-trial survey also completed the post-trial survey).

When considering overall change by socio-economic group (as well as other demographic, attitudinal or experiential measures), the objective is to understand the impact of the Trial on the household unit rather than the entire population. Therefore, it is no longer appropriate to consider the volume of reduction across the entire population. Instead, the average usage reduction is the appropriate measure.

7.7.2 Impact of the Trial on household electricity usage

In this case, emphasis moves from measuring the change in the total volume of energy reduced to measuring the average reduction by individuals within specific sub-populations. The impact of the Trial on a household is calculated using the same method as for the overall group except that each household's reduction is calculated separately and then averaged across all the households in a given group (in contrast the overall estimates were based on the summation of all usage across all households in a given group and reductions calculated for that summation). The difference in these measures is attributable to the disproportionate contribution of some individuals both to the overall volume of usage and the eventual reduction (where large in volume) compared with the average. In the context of this measure, the average is defined by the median. **Figure 24** shows the relationship of participant to volume consumption and notes that a third of the participants account for over 50% of the usage (during the trial period).

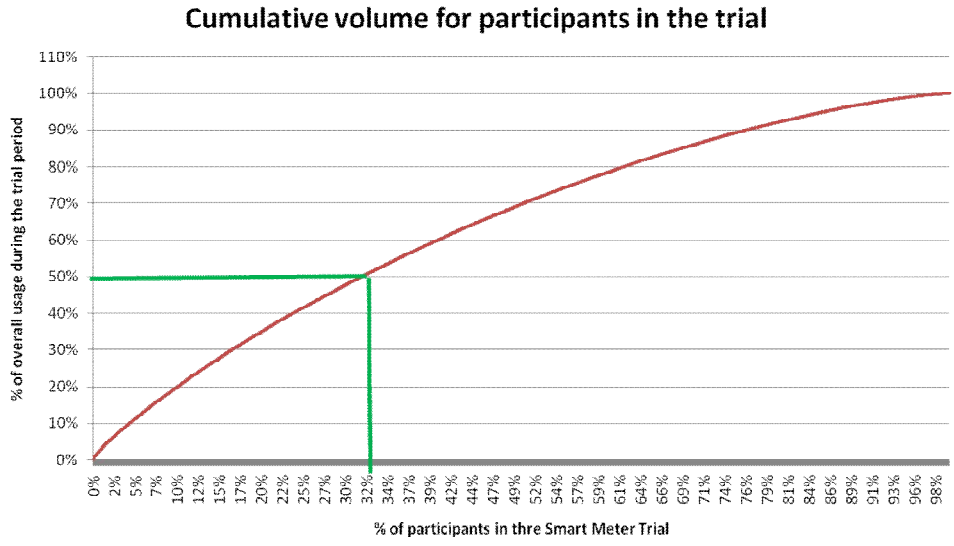

Figure 24: Cumulative Volume by % of Participants in the Trial

Table 27 and Table 28 summarise the overall and peak average reductions across individuals and by tariff and stimulus group. This can be compared with the changes among sub-groups such as fuel poor or more affluent.

ToU Tariff Groups (in conjunction with DSM stimuli)						
	Overall %	Tariff A %	Tariff B %	Tariff C %	Tariff D %	Weekend %
Overall	-1.4	-1.1	-2.4	-1.4	-1.1	-1.7
Peak	-7.58	-5.8	-8.7	-8.1	-9.7	-7.8

Table 27: Overall and Tariff (in conjunction with DSM stimuli) average percentage changes across individuals

Stimulus Groups (in conjunction with ToU tariffs)					
		Bi-monthly bill and energy statement %	Monthly bill and energy statement %	Bi-monthly bill, energy statement and electricity monitor %	Bi-monthly bill, energy statement and OLR incentive %
Overall		-0.3	-1.4	-1.0	-2.9
Peak		-6.0	-7.9	-8.2	-8.2

Table 28: Overall and DSM Stimuli (in conjunction with Tariff) average percentage changes across individuals

It should be noted that the individual average percentage reduction is smaller than the volume reduction both overall and during peak. This reflects the relationship between both overall usage and peak usage and the reduction achieved during the Trial (**Figure 25** and **Figure 26**). For both overall and peak, the percentage reduction increases as the total usage (either overall or during peak hours) increases. At the lowest levels of both overall and peak usage, there was an increase in usage during both peak and overall. This increase also occurs among control group participants with lower usage and must reflect influences external to the trial design such as weather conditions.

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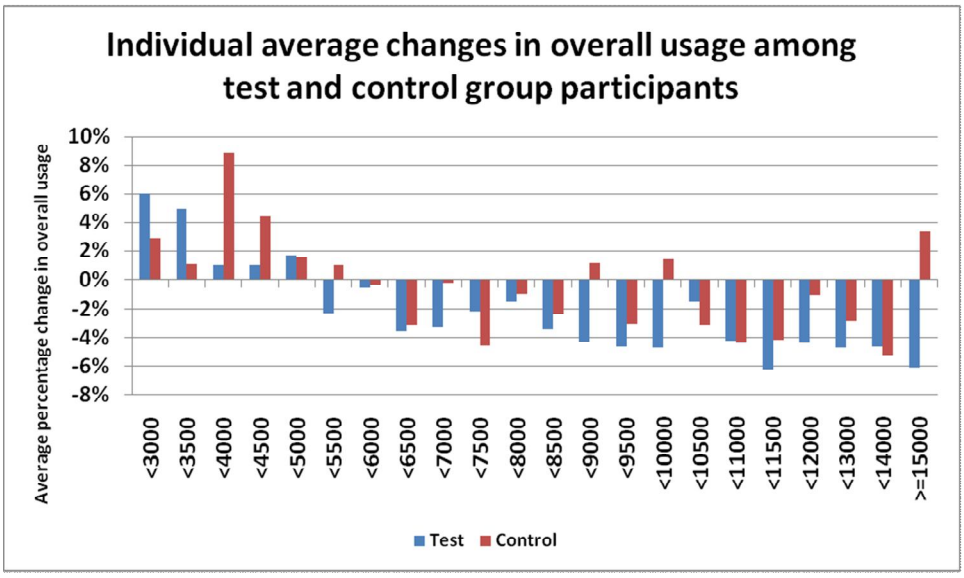

Figure 25: Individual average change in overall usage during trial by annualised usage during benchmark (participants with more than 1,000 kWh) – test group compared with control group participants

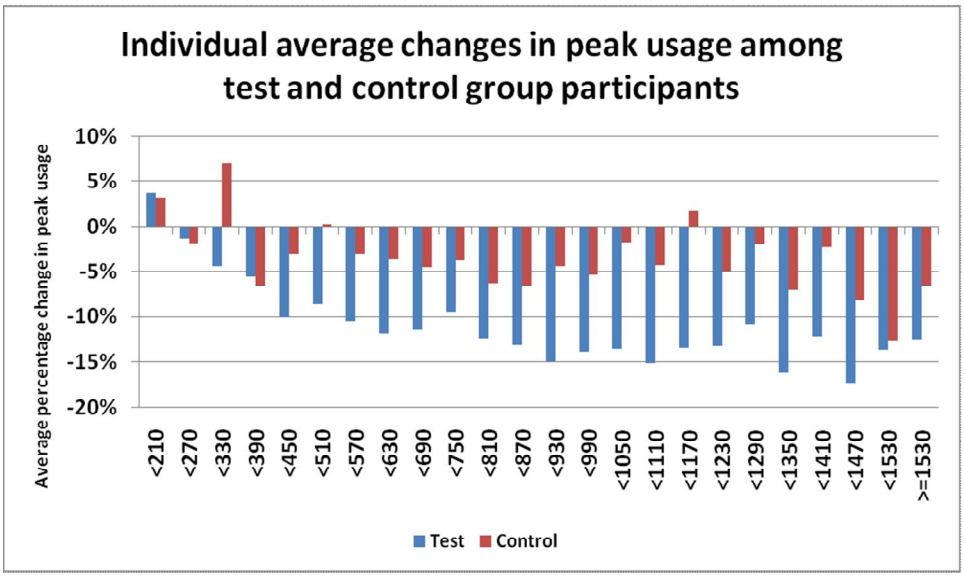

Figure 26: Individual average change in peak usage during the Trial by annualized usage during benchmark - test group compared with control group participants

7.7.3 Participants' perception of changes achieved

As has been shown in section 7.7.2 the average impact on test group participants' bill reflects an overall reduction of 2.5% and a peak reduction of 8.8%. The test group participants' stated estimate of the change in both bill and consumption is shown in **Table 29**.

	Overall bill %	Overall Consumption %	Peak Consumption %	Night Consumption %
Average estimated change during trial	-6	-6	-12	+4
Recorded change during trial	-3	-1.4	-7.58	+2.3

Table 29: Comparison of overall, peak and night percentage reductions estimated by participants and recorded

The match between bill reduction and overall consumption reduction in the participants' responses reflects the difficulty consumers experienced in differentiating between consumption and the bill, even with a time of use tariff. In particular, while the participant did shift usage away from peak times, they were not able to calculate the likely impact of the shift. If they had been able to do this, there would be a differential between their estimate of the impact on the bill and estimate of the impact of the reduction of overall usage to reflect their perceived additional reduction during peak times.

In general, the perceived reductions in bill and consumption overall and during peak were over-estimated by participants in the test groups with the reduction in night usage under-estimated. While precise estimates may be less accurate, participants tended to be directionally accurate. For example, 74% believed that they had reduced their peak usage with 68% actually reducing their peak usage. Further details are contained in **Appendix 7**, the Residential Post Trial Survey.

The implication for the inability of participants to accurately estimate usage was that 40% of those who believe that they reduced their usage stated that the bill did not reduce by the correct amount with the clear potential to undermine efforts in future to motivate reduction.

7.7.4 Change in usage by socio-economic measure

The analysis sought to determine if the introduction of time of use tariffs benefited particular groups in society over others and in particular if less affluent or otherwise socially disadvantaged participants responded in different ways. The overall relationship between overall and peak usage and the level of reduction achieved suggests that evidence to support this emerges from analysis of the trial data.

The analysis found that there was a link between socio-economic classification AB (using the widely used NRS demographic classification, which is managed by the UK Market Research

Society[25]) and the level of usage reduction as shown in **Figure 27.** The level of overall reduction declines in line with socio-economic groups where AB achieved greater overall reductions than C1, which in turn achieved greater overall reduction than C2 and DE. This relationship between social class and usage reduction is somewhat related to the level of overall usage as households with a chief income earner from a higher group tend to consume more electricity (also shown in **Figure 27)**. However, the pattern for peak reduction is not as structured. Related factors such as employment status or home ownership have a similar impact on the achievement of overall usage reduction and peak usage reduction.

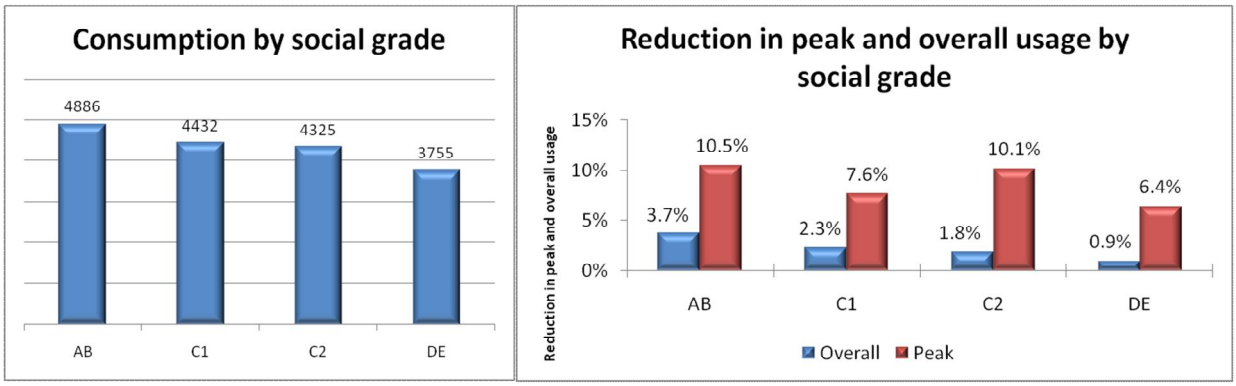

Figure 27: Average energy consumption by social grade (left) with the reduction in electricity usage by social grade with the comparison between test and control among those within each category (right).

The relationship between socio-economic measures and usage reduction during the Trial is broadly mirrored when considering level of education. Participants were asked to state the highest level of formal education of the chief income earner in the household and this self reported measure was used to establish if there was a relationship between education level and reduction. It is evident from **Figure 28** below that those who have spent more time in formal education beyond the level of Junior Certificate/Intermediate Certificate exhibit more success in terms of achieving reduction in energy usage during the Trial compared with those who left formal education before this stage. As was the case with social grade and usage, this relationship between level of education and usage reduction is also related to the level of overall usage as households with a chief income earner with greater levels of education tend to consume more electricity (shown in **Figure 28**).

[25] The classification is based on the occupation of the head of household and is maintained the Market Research Society in the UK (www.mrs.org.uk).

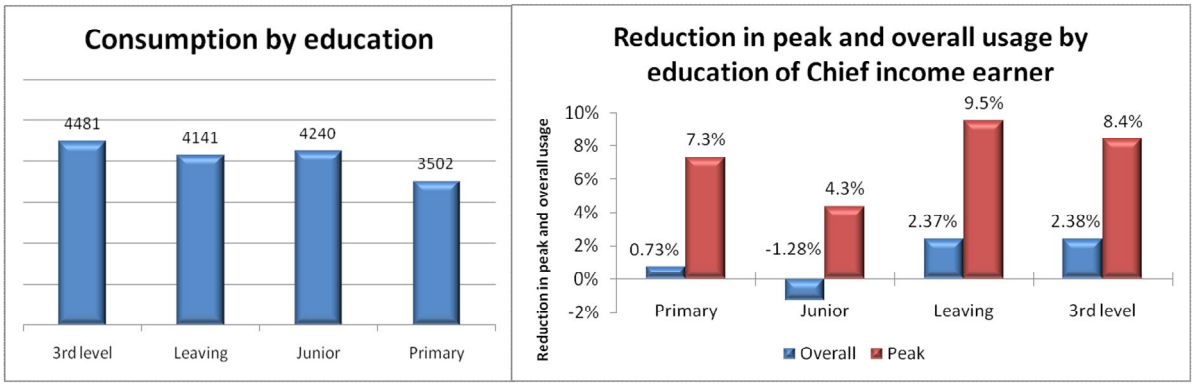

Figure 28: Average energy consumption by education of chief income earner (left) with individual reduction in electricity usage by level of education of the chief income earner (right)

However, the relationship between social grade, education and usage is not simple with individuals with Third level education spread across all social grades. Therefore, it is concluded that a combination of education and social grade contributes to the overall level of usage reduction. While efforts were made in the communications strategy to be inclusive, the difference may reflect more fundamental barriers to engagement among those with lower levels of educational achievement and those in lower social grades.

The consequences of the relationship between social grade or education and consumption on bill is small (**Table 30**), however, with the bill impact by Measure 1 varying between AB and DE social grades by €5.64 and the difference between AB and DE by the other measures varying by less.

Social Class	Bill impact - Measure 1	Bill impact - Measure 2	Bill impact - Measure 3
AB	-€ 24.00	-€ 21.60	-€ 3.18
C1	-€ 21.76	-€ 19.93	-€ 3.47
C2	-€ 20.93	-€ 18.14	-€ 2.14
DE	-€ 19.83	-€ 18.45	-€ 2.99

Table 30: Impact on the bill by social grade of chief income earner

Figure 29 shows a clear relationship between the presence of children in the household under the age of 15 and overall and peak hour reduction. This relationship is expected as focus groups have clearly indicated that children below the mid-teen years play a significant role in terms of motivating change and energy reduction in the household. Evidence from the focus groups conducted during the research suggests that that this is driven strongly be school based initiatives such as An Taisce's Green Schools programme.

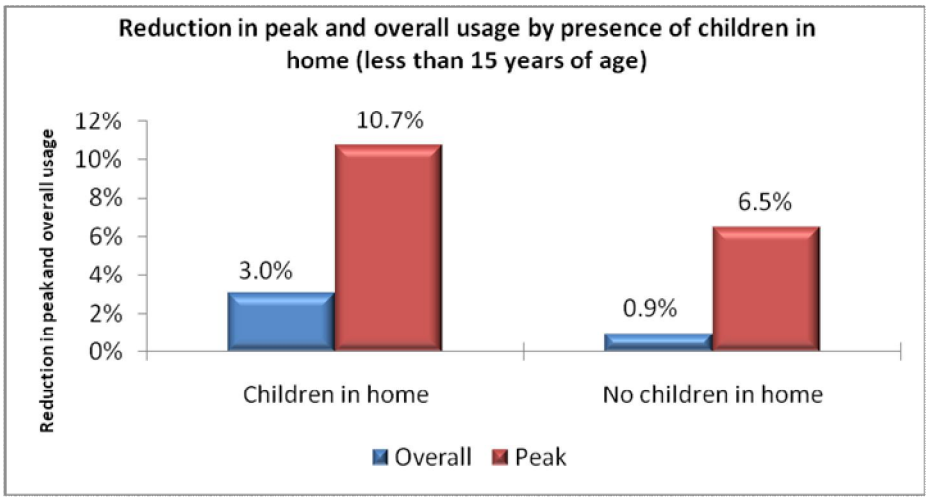

Figure 29: Reduction in electricity usage by presence of children (aged 15 or under) in the household.

More generally, the size of reduction in the bill is related to the number of persons in the household. **Table 31** shows the range of saving related to the number of persons in the home: Homes with more than 6 persons saved on average €19.14 more than those homes with a single resident.

Number of persons in home	Bill impact - Measure 1	Bill impact - Measure 2	Bill impact - Measure 3
1	-€12.97	-€16.15	-€ 6.29
2	-€19.54	-€17.86	-€ 2.69
3	-€23.76	-€19.88	-€ 1.73
4	-€27.28	-€24.21	-€ 3.58
5	-€29.58	-€21.74	€ 0.68
6	-€32.12	-€26.89	-€ 1.43
>6	-€12.97	-€16.15	-€ 6.29

Table 31: Impact on the bill by total number of persons in the household

7.7.5 Change in usage amongst potentially vulnerable groups

The response of potentially vulnerable groups was also assessed. One such group is those participants in receipt of the Free Electricity Allowance (FEA) which includes both elderly, carers in receipt of specified allowances and individuals in receipt of specified invalidity or disablement benefits. The operation of the FEA scheme means that to a large degree, recipients are sheltered from the impact of the tariffs as the FEA covers the cost of a portion of their energy costs. This is reflected in the level of reduction shown by such groups in the Trial, where **Figure 30 s**hows that behaviour change among these individuals is smaller relative to the overall population.

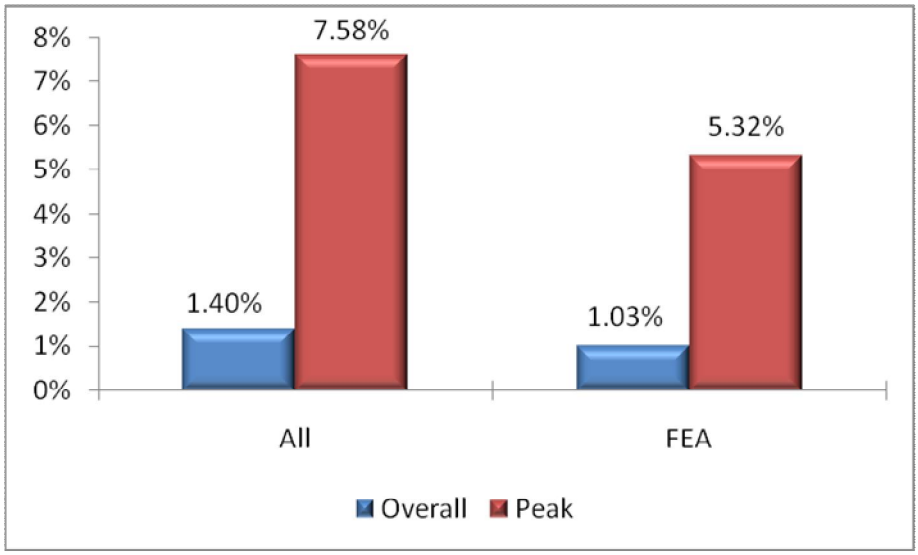

Figure 30: Comparison of electricity usage reduction among FEA and all participants

Another potentially vulnerable group is the Fuel Poor which were identified and classified from the pre-trial survey. This category has some overlap with the FEA recipient group but they are smaller in size. The self assessed fuel poor were defined as those who did not have the capacity to maintain an affordable level of warmth at a level required for the maintenance of health and comfort:

Where participants stated that they could not keep their home adequately warm, two questions were used to define Fuel Poor:

- First definition: "I cannot afford to have the house as warm as I would like"
- Second definition: "Have you had to go without heating during the last 12 months through lack of money".

Table 32 shows the comparison between the fuel poor (using either definition) and the total control group[26].

[26] It was not possible to reliably compare these groups to equivalent groups in the control due to the relatively small number of participants involved.

	Average change in overall consumption %	Average change in peak consumption %	Annual reduction of bill (among fuel poor)
Definition 1: Can't afford to keep house as warm as I would like	+0.7	6.8	Measure 1: €24.18 Measure 2: €27.38 Measure 3: €8.20
Definition 2: Gone without heating through lack of money	+0.8	10.7	Measure 1: €22.36 Measure 2: €24.37 Measure 3: €7.00

Table 32: Percentage reduction overall and during peak among fuel poor compared to overall control group

The analysis shows that the fuel poor did experience a reduction in their bill size and benefited from the introduction of time of use tariffs in the Trial. This reflects the reduction in peak usage which was achieved (with overall usage almost unchanged). This reduction in peak mitigates the negative impact of the time of use tariffs with participants categorised as fuel poor experiencing bill reductions compared with all three measures.

7.7.6 Reasons for lack of behaviour change

The effort required to reduce or shift usage counteracts the price signal delivered by the tariff. Therefore, it is important to understand the level of difficulty of behaviour change and to determine the factors which supported their successful change. Among participants who had successfully reduced or shifted usage, 25% found it difficult to shift peak usage, while 14% found it hard to shift usage to night-time.

The tables below show the degree to which participants who had not succeeded in reducing peak or overall usage agree that the stated reason applied. (It should be noted that these figures did not vary to a significant degree across the different tariff groups). In the case of peak usage reduction, the lack of apparent linkage to the bill was identified by 59% of those who had not reduced usage. This is a challenging problem because reduction in peak usage does not necessarily translate into a large reduction in the bill.

Reasons for not reducing peak	Agree	Disagree
We did not know enough about how and when we use electricity to reduce our usage during peak hours	29%	55%
The difference between the peak price and the other prices was not enough to get me [us] to move my [our] usage	28%	53%
I did not try to reduce because I did not think it would be possible as the peak price was too high	22%	56%
We tried to reduce but the bill seemed to be the same so we gave up	59%	21%

Table 33: Reasons for not reducing peak

In the case of switching to additional night usage, concerns about convenience (53% agree) and safety (53% agree) act as barriers.

Reasons for not switching to night usage	Agree	Disagree
It was too inconvenient to move usage to night time	53%	36%
We did not know enough about how and when we use electricity to move usage to night-time	24%	59%
I was concerned about the safety implications of using appliances at night-time	53%	38%
I was concerned about the noise associated with using appliances at night-time	31%	59%
The difference between the night time price and the other prices was not enough to move usage	25%	55%
We tried to reduce but the bill seemed to be the same so we gave up	15%	67%

Table 34: Reasons for not switching to night usage

7.8 Participant attitudinal and behavioural impact

The Trial succeeded in making participants more aware of energy usage (54% agreed) which is in keeping with the reduction in usage recorded. Only 18% stated that there had been no impact on the way their household uses electricity.

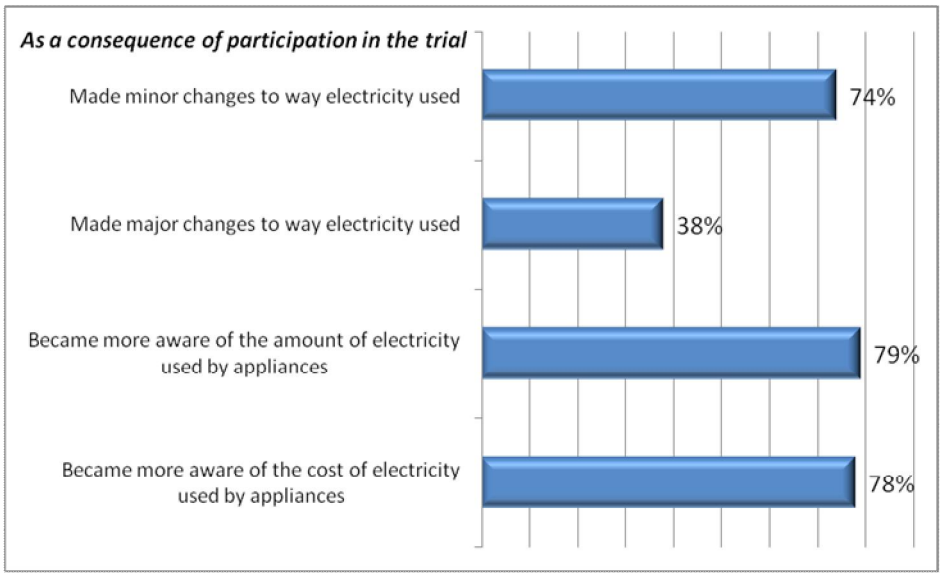

Figure 31: Perceived impact of participation on usage and awareness

However, there was a lower level of success in terms of motivating or enabling change with 22% agreeing they now knew more about how to reduce use and 24% stating that they were more interested in reducing their usage.

The attitudinal impact of participation in the Trial is less than expected with no significant difference between the attitudes of the control group when compared to those of the trial group. It should be recognised, however that majority of participants agreed with each statement (as shown in **Figure 32**).

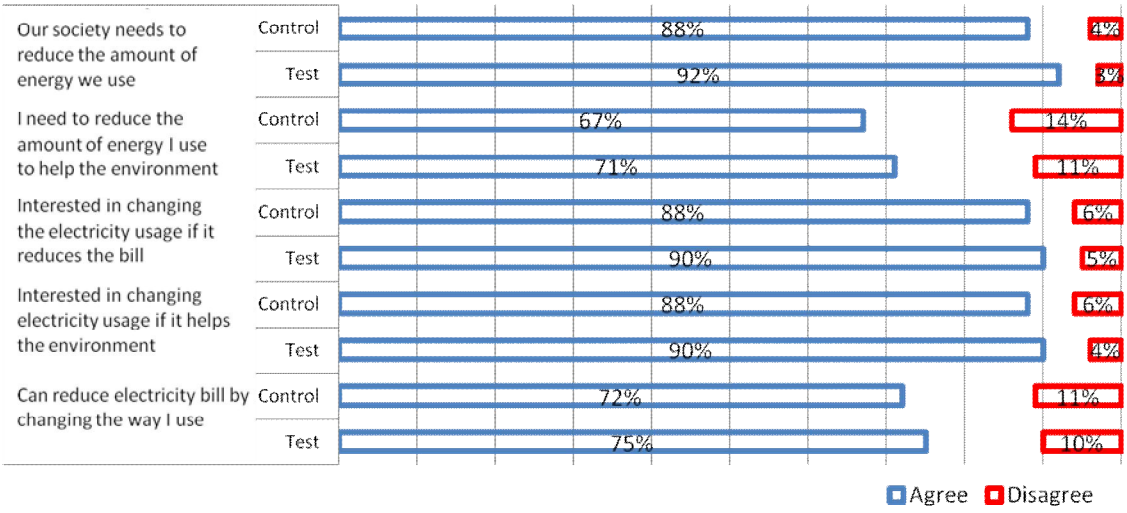

Figure 32: Comparison in attitudes towards energy reduction between control and test groups

Participants who perceived that they had not reduced their usage, gave very similar reasons to those given in the pre-trial survey for not reducing usage prior to the Trial with one exception: The proportion of non-reducers stating that lack of knowledge of appliance usage as a reason dropped from 46% pre-trial to 35% after the Trial and to 30% among those participants with an electricity monitor. This reduction can be attributed to the Trial as the score for the control group participants remained at pre-trial levels (46%). Therefore, in this area the Trial reduced the impact of one barrier to energy reduction.

7.9 Participant assessment of supporting information and stimuli

Fridge Magnet and Stickers

All participants were supplied with stickers and fridge magnets which highlighted the hours during which different prices applied. Participants were asked to assess these as well as the DSM stimuli they were exposed to in terms of effectiveness, comprehension, ease of use and functionality recalled and used.

When asked at the end of the Trial, 76% of participants recalled receiving both of these with another 4% recalling receiving one or the other. This is a good result for this type of communications. Of those who recalled the communications, 75% found the fridge magnet to be useful and 63% found the stickers useful.

DSM Stimuli

Participants were asked to assess each of the DSM stimuli in terms of effectiveness, comprehension, ease of use and functionality recalled and used.

The electricity monitor was found to be effective and easy to use by most participants with 84% stating that it helped them to reduce the amount of electricity they used and 84% stating it helped them to shift usage. As discussed above, the electricity monitor was associated with the highest level of reduction with this reduction tailing off over time. The majority of participants claimed to still use the electricity monitor (49% regularly use it, 22% occasionally use it) at the end of the Trial with 45% not agreeing that the monitor had less effect over time.

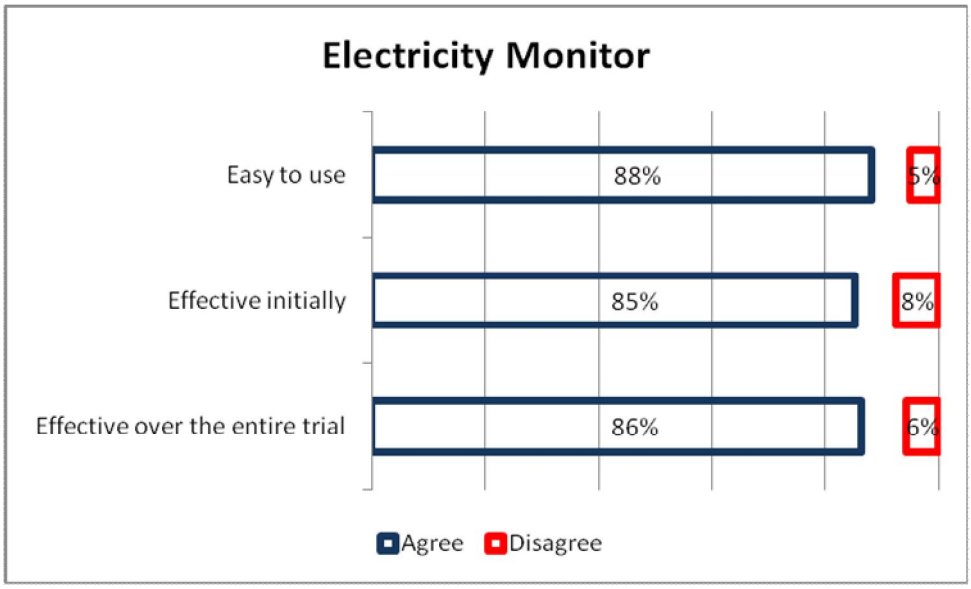

Figure 33: Assessment of the Electricity Monitor

As expected, most participants did not change the daily budget settings on the electricity monitor (19% stated that they did) with 28% not aware even of the ability to toggle the display between cost and units consumed (24% used the feature).

Participants who had received the electricity monitor were also asked to recall features without prompting, then asked if they recalled other features when listed and finally asked to assess the usefulness of the features that they recalled unprompted. The results are shown in the table below and reflect the high usefulness rating for most features recalled.

Recall of features	Awareness		Useful (among unprompted aware)
	Unprompted	Prompted	
None	20%	N/A.	N/A.
The cost of the electricity you are currently using	58%	27%	95%
The amount of electricity you are using	45%	34%	91%
Your daily budget	41%	39%	84%
The cost of the electricity you have used so far this month	39%	36%	85%
The price of the electricity at different times	39%	36%	94%
The other screen showing more detailed information on the number of units or the cost of the electricity that you used during the different times of day on the previous day and the day before that	26%	33%	82%
Your current meter reading	16%	35%	78%

Table 35: Recall of electricity monitor features by participants using the electricity monitor

Different test groups received the energy usage statement and bill bi-monthly or monthly. The energy usage statements were rated as very effective in helping to reduce usage by 51% of the participants and as effective by 28% (a combined effectiveness score of 79%) with correspondingly high scores for comprehensibility and effectiveness. These scores were very similar for both the groups receiving a monthly bill (a combined effectiveness score of 81%) and those receiving a bi-monthly bill (a combined effectiveness score of 79%). The effectiveness over the period of the Trial was recognised as decreasing with 48% agreeing that this was the case.

The participants in the OLR incentive group reported a relatively low level of recall of the existence of a target (58% recalled receiving the target) and 25% of participants with an OLR target stated that they met the target (41% of those who recalled receiving a target). While the scores for communications, reasonableness of the target and effectiveness of the OLR incentive in motivating change were very good among those who recalled the stimulus, the lack of overall awareness suggests that the effectiveness of the stimulus could have been much greater if this issue had been addressed.

7.10 Conclusions

The main findings may be summarised as follows:

Response to tariffs and DSM stimuli

- the deployment of ToU tariffs and DSM stimuli are found to reduce overall electricity usage by 2.5% and peak usage by 8.8%;

- the combination of bi-monthly bill, energy usage statement and electricity monitor is found to be more effective than the other DSM stimuli in reducing peak usage with a peak shift of 11.3%
- overall energy reduction is linked with the level of usage: Households with higher consumption tended to deliver greater reductions in usage;
- analysis of the load distribution suggests shifting of load from peak to the post-peak period and in general to night usage from peak;.
- there is no single tariff group that stands out as being more effective than the others, although Tariff C yields the lowest reduction in overall usage;
- of the four DSM stimuli none is statistically better than any of the others in reducing overall electricity usage; moreover, the bi-monthly bill was not shown to be statistically significant in delivering overall energy reduction;
- the data from the Trial provides no evidence of a tipping point;
- Analysis of the impact of the Time of Use tariffs on participants' bills showed that behaviour changes made were sufficient to generate savings and neutralise any potentially negative impact of the deployment of the Time of Use tariffs.

Demographic, behavioural and experiential conclusions

- Participants adapted usage to realise the potentially positive impact of the tariffs on their bills. 82% of participants made some change to the way they use electricity due to the Trial with 74% stating major changes were made by their households;
- Simple information can also be effective: The fridge magnet and stickers achieved 80% recall with 75% finding the magnet useful and 63% finding the sticker useful;
- The electricity monitor was deemed to be effective as a support to those achieving peak reduction (91% rated it as an important support) and shifting to night rates (87% deemed it an important support);
- Participants were not able to accurately estimate actual reduction with 40% of those who believed they reduced their usage stating the bill reduction was not to the degree expected;
- Barriers to peak reduction relate to the difficulty of linking behaviour change to bill reduction. These perceptions may have contributed to the current recorded reduction. This may be hard to address due to exaggerated expectations of savings and similar exaggerated expectations of consequences if reduction is not achieved;
- Barriers to shifting to night usage relate to safety and convenience.
- The OLR incentive was impacted by a low recall rate (58%). However, the scores for communications, reasonableness of the target and effectiveness of the OLR incentive in motivating change were all very good.

- The detected benefits of the Trial are focused on behaviour changes in response to the price signals and DSM stimuli applied. No secondary benefits were identified in increased awareness of general energy efficiency or investment in energy efficiency enhancements for the home;
- The Trial succeeded in making participants more aware of energy usage (54% agreed) which is in keeping with the reduction in usage recorded. Only 18% stated that there had been no impact on the way their household uses electricity;
- Households headed by individuals with greater educational achievement or social grade achieved higher levels of reduction than those with lower levels. This was in part related to the typically higher level of usage associated with these households. Therefore, the impact of education or social grade on the ability to gain benefit from the tariffs is limited
- The impact of the time of use tariffs on recipients of FEA shows that these individuals exhibited the same level of change as other households and therefore do not appear to be disadvantaged over other groups;
- Fuel poor households (which lack financial means to adequately heat their homes) also benefit from the deployment of time of use tariffs.

8 Design of the SME and Multi-site Trial

8.1 Introduction

The SME Customer Behaviour Trial aims to measure consumer response (behaviour change) to a range of time of use tariffs and demand side management (DSM) stimuli over the period of the Trial. The trial was divided into two components: A Small to Medium Enterprise (SME) trial and a Multi-site trial which included organisations with multiple locations (a number of which had smart meters installed).

The stimuli included:

- Specific price points (*Time of Use (TOU) tariffs*), combined with
- specific DSM stimuli (electricity monitor; bi-monthly and monthly bill with energy statement; web access to electricity usage information)

In designing the SME Trial it was recognised that there is a high degree of variability in the usage patterns amongst these types of organisations reflecting diverse sectors and businesses. A very significant sample size would, therefore, have been required in order to achieve the same power as the Residential Trial. Instead, the approach adopted for the SME Trial was to maintain a rigourous approach to experimental design and measurement with the expectation that the findings were unlikely to be statistically significant given the scale of the Trial. This would mean the focus was on empirical, rather than experimental findings.

The challenges of diversity and usage patterns are more pronounced among commercial organisations with multiple locations. Therefore the multi-site trial was designed to capture empirical findings which combined qualitative and quantitative components. The qualitative components reflected the different stakeholders within each organisation and consisted of in-depth interviews with both:

- The central finance and/or function (which receives bills, control payment and makes general investment and policy decisions associated with electricity consumption)
- The site manager (responsible for the day to day operations of the site including electricity consumption)

Further details are included in **Appendix 2**.

8.2 SME Trial Matrix

The overall sample size was specified at 728 participants and represented a broad cross-section of the population of electricity users eligible to participate in the Trial. This allowed for a 23% attrition rate. Representivity was limited to part of the SME population (i.e., non-profile meter business customers), as reflected in the customer bases of the two participating suppliers, Electric Ireland and Bord Gáis Energy. At the start of the benchmark the total

number of SMEs still participating with meters installed was 723 with 650 remaining when allocation took place in November 2009. The attrition was mainly due to change of tenancy, change of supplier and changes in premises occupancy, with some also due to businesses ceasing trading and network signal issues.

SME participants were distributed across the four stimulus groups as outlined below.

		Bi-monthly bill, energy use statement + Electricity Monitor	Bi-monthly bill energy use Statement + Web access	Monthly bill energy use statement	Bi-monthly bill energy use statement	Bi-monthly bill energy use statement	Total
	Sector	**Electric Ireland**	**Electric Ireland**	**Electric Ireland**	**Electric Ireland**	**Bord Gáis Energy**	
	Retail	31	31	29	16	33	140
	Small Industrial	13	17	19	8	19	76
	Entertainment	19	19	17	8	18	81
	Office/Professional	20	17	20	11	17	85
	Total	**83**	**84**	**85**	**43**	**87**	**372**
Control Group	Retail	67 40 34 39 **180**				33	103
	Small Industrial					19	59
	Entertainment					18	54
	Office/Professional					18	62
	Total					**88**	**268**
		475				**175**	**650**

Table 36: SME Matrix allocation as of 15 November 2009

8.3 Tariff Design and Development

Similar to the Residential Trial, the following principles were used in the design of the ToU tariffs to ensure that the key objectives of cost neutrality and cost reflectivity were achieved:

- The time of use tariff would be neutral in comparison with the standard Electric Ireland tariff to ensure that the "average" participant who did not alter their electricity consumption pattern was not penalised financially.
- The base ToU tariff would reflect the underlying cost of energy transmission, distribution, generation and supply as per standard tariffs.
- The time-of-use structure (time bands) would be based on system demand peaks.
- Tariffs would be based on the cost inputs used in the 2009/10 regulated tariffs.

	Day Rate	Peak Rate	Day Rate	Night Rate
Timeband	8am – 5pm	5pm – 7pm	7pm – 11pm	11pm – 8am
Unit Rate (excl. VAT)				

Figure 34: Time of Use Bands

The methodology and principles used in calculating the ToU tariff prices for 2010 were developed by Electric Ireland in conjunction with the CER and the electricity industry at the smart metering tariff forums. The final agreed set of ToU tariffs were approved by the CER on 2nd October 2009[27].

Two time of use tariffs were developed for the Trial, one for Nightsaver customers and one for 24 hour customers. Their purpose was to test how time of use tariffs in combination with DSM stimuli might help in reducing overall and peak electricity demand. Electric Ireland tested two different tariffs with two groups, Tariff A and Tariff B. Tariff B (Nightsaver) had a slightly higher unit charge during Day and Peak, but was almost half Tariff A for night use. Bord Gáis Energy continued to price participants on an individual basis and introduced a customised time of use tariff for each participant. The relativities developed for the Electric Ireland tariffs were maintained by Bord Gáis Energy in the development of their tariff. The final tariffs may be summarised as follows:

Domestic Time of Use Tariff				
		Night 23.00 – 8.00	**Day** 8.00 – 17.00 19.00 – 23.00	**Peak** 17.00 – 19.00 (Monday to Friday), excluding bank holidays
Electric Ireland				
- Tariff A	Cents per kWh	14.00	15.00	22.00
- Tariff B	Cents per kWh	7.50	16.00	22.50
Bord Gáis Energy	Cents per kWh	Tariff applied varied by individual participant		

Table 37: SME Time-of-Use tariffs as at 1st January 2010

[27] Smart Metering Customer Behaviour Trials: Electricity Time of Use Tariffs 2nd October 2009 www.cer.ie/en/electricity-retail-market-decision-documents.aspx?article=bae6c058-11d5-49a6-ade0-2aa1aa3ba17c

Balancing Credit

All Trial participants were guaranteed that they would not pay more for their electricity than if they had remained on their normal tariff. Based on analysis of average historic profile usage a balancing credit was calculated such that 95% of customers would not be 'out of pocket' at the end of the Trial. The small number of customers who incurred costs above the balancing credit were compensated on a case by case basis after the Trial completed.

Participants in the tariff groups received the balancing credit in two instalments, the first in December 2009 and the second in January 2011.

SME	Total Amount	Paid December 2009	Paid January 2011
Tariff A	€ 100	€50	€50
Tariff B	€ 100	€50	€50
Bord Gáis Energy	€ 100	€50	€50

Table 38: SME Balancing Credits as at 1st January 2010

8.4 Stimuli Design and Development

All of the stimuli in the Trial (the time of use tariffs and the DSM stimuli - the energy usage statement, the electricity monitor and web access to energy usage information) were designed specifically for the Trial using learnings from other international trials and consumer focus groups.

8.4.1 Energy Usage Statement Bi-monthly and Monthly

During the Trial all participants in the stimulus test groups received a more detailed bill. This was a two-page bill; the first page was similar to the existing supplier's bill (with additional lines for time of use tariffs). The second page, the Energy Usage Statement, provided additional detail on usage and tips on energy reduction. The Energy Usage Statement contained:

- Information on time of use bands
- Information on average weekly costs
- Information on their detailed weekly usage
- Tips (which rotated throughout the Trial) on reducing electricity use and on moving use out of the peak or day periods. (These tips included actions which were only possible as a result of smart meters)
- Information on how participants were doing compared to their last bill and compared to others in their group

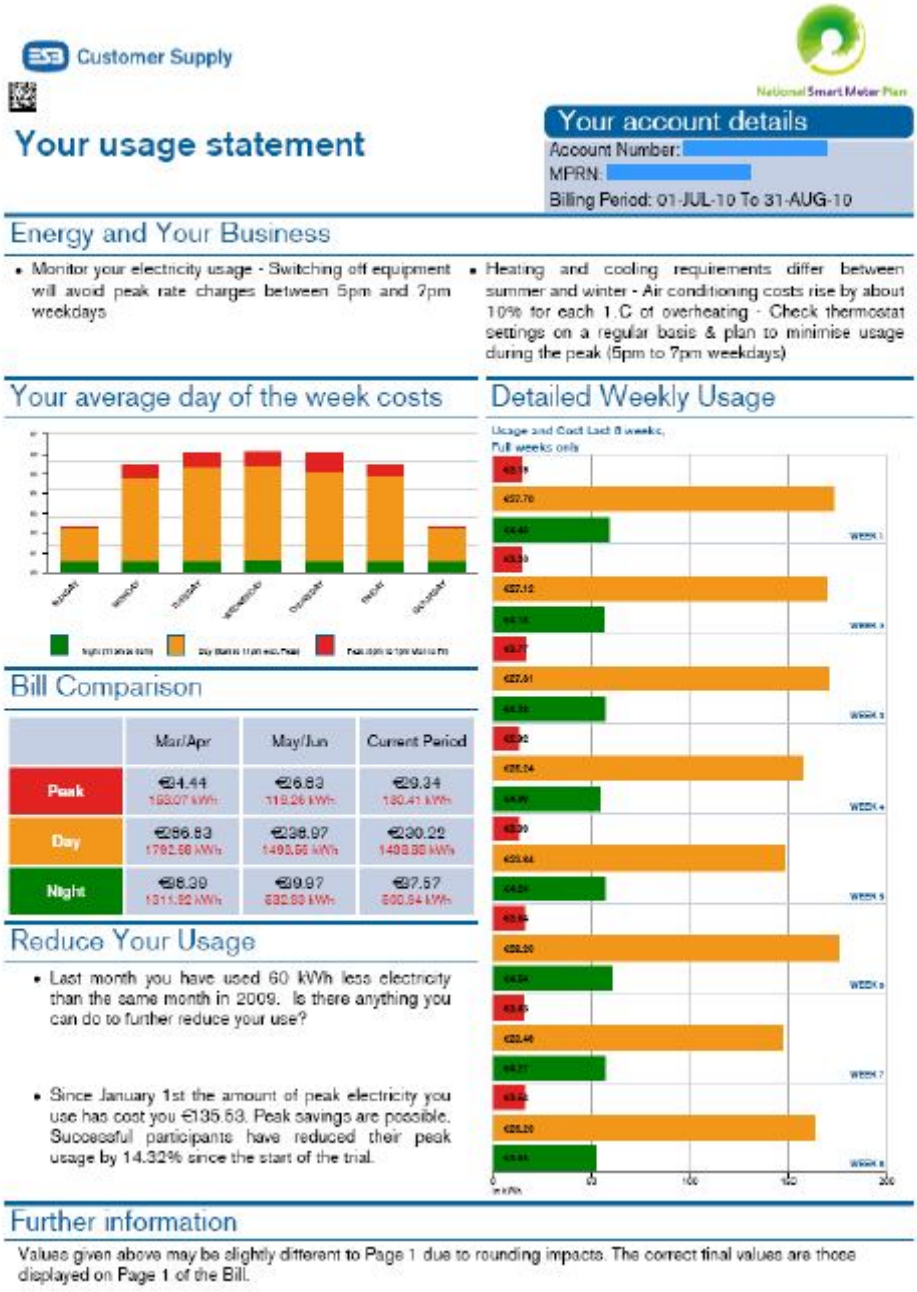

Figure 35: SME Energy Usage Statement

Two groups of participants received the bill and accompanying energy usage statement on a bi-monthly basis. Frequency was, therefore, consistent with their normal bill frequency.

All test group participants received a calendarised bill (i.e., their bills covered discrete months). As a result the payment due date changed for some. Further details are outlined in 8.5 below.

8.4.2 Energy Usage Statement Monthly

The bill and accompanying energy usage statement was provided to one of the stimulus groups on a monthly basis. This meant they received 12 smaller bills over the course of the Trial with consequent more frequent payments and a changed payment date.

8.4.3 Electricity Monitor

The electricity monitor was designed by members of the Customer Behaviour Work Stream Group, with inputs from the consumer focus groups and developed specifically by ESB Networks for the Customer Behaviour Trial. Its aim was to help consumers be more energy efficient by providing information on how much electricity they were using and how much it was costing them. The electricity monitor also included a budget setting mechanism, where consumers could decide the maximum they wanted to spend on electricity per day. A usage gauge on the home screen, showed participants their usage against their daily budget. On installation of the electricity monitor participants were provided with a suggested budget from Electric Ireland.

Figure 36: Electricity Monitor

8.4.4 Web Access to Energy Usage Information

One of the stimulus groups was provided with web access to their Energy Usage Information. This interface was based on an on-line interface already available to larger customers of Electric Ireland, but adapted to SME needs. It enabled participants to:

- View their usage and costs across different time bands
- Interrogate their historical usage and costs

Figure 37: Screenshots, Web Access

ESBIE provided similar on-line access to the multi-site participants. However, some of these participants, for logistical reasons, opted to receive their information in hardcopy format.

8.5 Calendarisation of Billing

In order to assist in comparability a decision was made to place all participants in the Trial (excluding the Control Group) on a calendar month bill cycle. Prior to the Trial participants were on a two-monthly billing cycle, with bills issuing to consumers on a phased basis over a two-monthly period. From 1st January 2010 all participants were "calendarised" i.e., their bills covered discrete months and issued approximately 10 days after the month end. One of the stimulus groups received their bill monthly. This change to calendarisation meant payment due dates also changed for some participants. A letter advising participants of this change issued to them in December 2009.

8.6 Multi-site Participant recruitment

The Multi-site Trial was focused on providing empirical insight into the experience of multi-site organisations in using smart meters. Therefore, the objective of recruitment was to ensure that the range of organisations was sufficient to provide widely applicable insights.

The participants were selected to provide representation of different sectors and different locations around the country. Reflecting this, the set of participants consisted of four organisations with one from each of the distribution industry, retail, manufacturing and business services. The level of consumption per meter is higher than among the SME participants ranging from 30,000 kWh to 500,000 kWh per annum. The same stimuli deployed in the SME trial including a web-access to energy usage information, printed energy usage statements and electricity monitors were used. The stimuli were provided based on the

varying capabilities available at each site. For example, if a location lacked internet access, the web-based system was not made available.

9 SME Participant Communication and Involvement

9.1 Introduction

A comprehensive communications programme to support the Customer Behaviour Trial was put in place. The aim of this programme was to successfully recruit a nationally representative sample of participants as outlined above and to provide them with details of the time of use tariffs and DSM stimuli they were to test.

9.2 Recruitment Communications

Participants were recruited through a voluntary "opt-in" approach, using an invitation letter, a Frequently Asked Questions (FAQ) brochure and a follow-up telephone call. Given the nature of SME consumers this follow-up phone call was considered essentially in gaining opt-in. Bord Gáis recruitment reversed the process, starting with a phone call, followed by the letter and the FAQ brochure. **Appendix 12**, Sample Communications, contains examples of the invitation letter and the FAQ.

9.3 Trial Communications

Similar to the Residential Trial, SME Trial participants were divided between Test and Control Groups. In order to control for the effect of the ToU tariffs and different DSM stimuli on behavioural change the design of the Trial precluded any specific energy efficiency campaigns linked to smart meters during the active phase of the Trial. This was necessary in order to manage the effects of the stimulus groups versus the control group and the control group versus the National population.

Participants did, however, receive energy reduction and peak shifting advice through their bill and energy statement.

Communications with participants occurred at agreed times during the benchmark period providing them with information on what would happen during the Trial and advising them re calendarisation of billing (see 8.5 above). The final communication in the benchmark period, just before the start of the Trial, advised participants of which group they had been allocated to (test or control) and the tariff and DSM stimulus to be tested.

The next communication received by participants (apart from the bill and energy statement) was in December 2010, when they were advised that their billing would return to the normal two-monthly cycle driven by meter reads after conclusion of the Trial on 31st December 2010. Their final communication was in February/March 2011 when they received a reconciliation of their trial bills versus what they would have paid had they remained on the normal "flat" tariff.

A schedule of the main communications in included in **Appendix 9**. Samples of the main communications are included in **Appendix 12**.

9.4 Consumer Research

Research of electricity consumers and Trial participants represented a fundamental aspect of the Customer Behaviour Trial.

At a primary level a pre-trial survey was carried out of participants in the Trial. Information gained from this survey provided insights into the participant allocation and provided a benchmark for any subsequent change in behaviour which might be measured at the end of the Trial.

A post-trial survey was carried out of the same participants in January 2011, comparing change in attitude, equipment or electricity use to the pre-trial findings.

Finally, surveys were also carried out of a select group who chose not to respond to the invitation letter and of those who left the Trial for various reasons before it had ended.

10 SME Trial Participants - Approach to SME Data Analysis

10.1 Approach to SME Data Analysis

In the case of the SME Trial, the focus was primarily based on the extent to which ToU pricing, in conjunction with the DSM stimuli deployed could impact on overall and peak-time electricity consumption. All participants in the test group were on ToU pricing, with differential costs associated with peak, daytime and night usage. In the case of the residential trial all participants were on the same unit cost at the start of the Trial and there were four specific tariffs tested during the course of the Trial. In contrast, SME trial participants were on different unit costs at the start of the Trial, depending on whether the participant was on GP24 or Nightsaver options. In addition a number of participants were on different unit rates negotiated with their supplier at the start of the Trial. In all these cases, the same ToU differentials were applied to the base unit cost of their tariff in order that ToU pricing could be tested.

The SME trial was smaller than the Residential Trial in terms of numbers recruited for participation on the Trial. Nevertheless, it was envisaged that if sufficient participants remained at the end of the Trial statistical techniques would be used to test a number of hypotheses, specifically testing for evidence that the following lead to a reduction in both overall and peak electricity usage:

- ToU pricing in conjunction with DSM stimuli;
- Bi-monthly bill and energy statement; monthly bill and energy statement; bi-monthly bill, energy statement combined with an electricity monitor; and bi-monthly bill, energy statement and web access in conjunction with ToU pricing;

The Customer Behaviour SME Trial was initially designed to detect changes in behaviour in relation to overall usage and peak time usage and to detect a minimum effect of a 3% change in usage over the whole sample of participants. A change of 4% would be detected at the level of the DSM stimuli and a reduction of 5% would be detected at a cellular level. A 90% confidence level would be applied to all tests conducted.

10.2 Treatment of Data

Data was collected for every meter participating in the Trial during the period July 2009 to December 2010. This comprised half-hourly reads of electricity consumption and the time of day during which the read was taken.

A strategy was put in place to deal with missing data (were it to occur) and, where possible, make use of multiple imputation to obtain reliable estimates. Further details are provided on this within **Appendix 2**, Methodology for Analysis of Customer Behaviour Trial Data.

The cleaned data set consists of 485 meters, each with 48 half-hourly meter reads per day over 536 days. The test groups, consisting of 288 meters, were provided with DSM stimuli from 1st January 2010 up to 31st December 2010. The tariff and billing information for the control group of 179 meters remained unchanged throughout the duration of the Trial.

	Number of Participant Meters	Total Usage (kWh)
Test	288	10,243,121
Control	197	7,192,650
Total	**485**	**17,435,771**

Table 39: Summary statistics for the cleaned data set

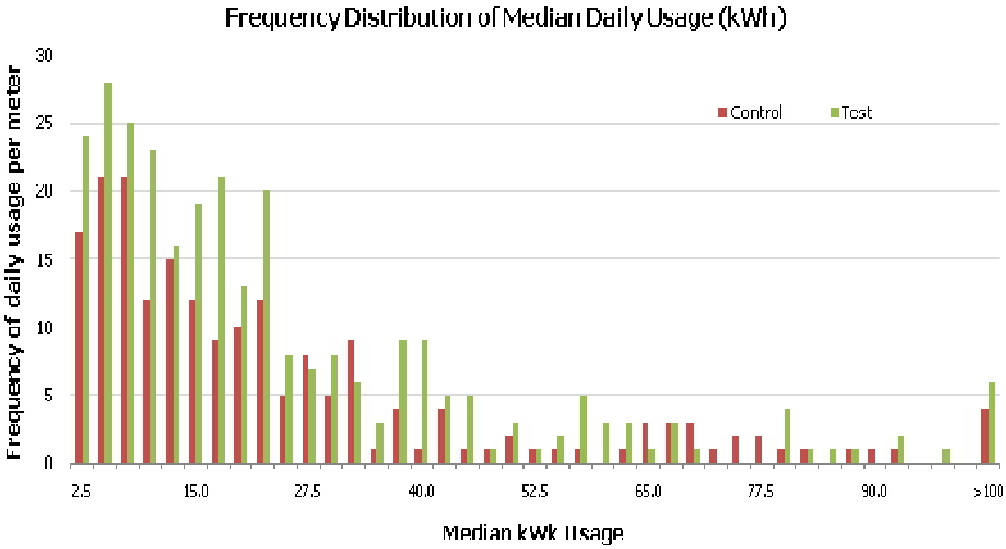

Figure 38: Frequency distribution of daily usage (kWh)

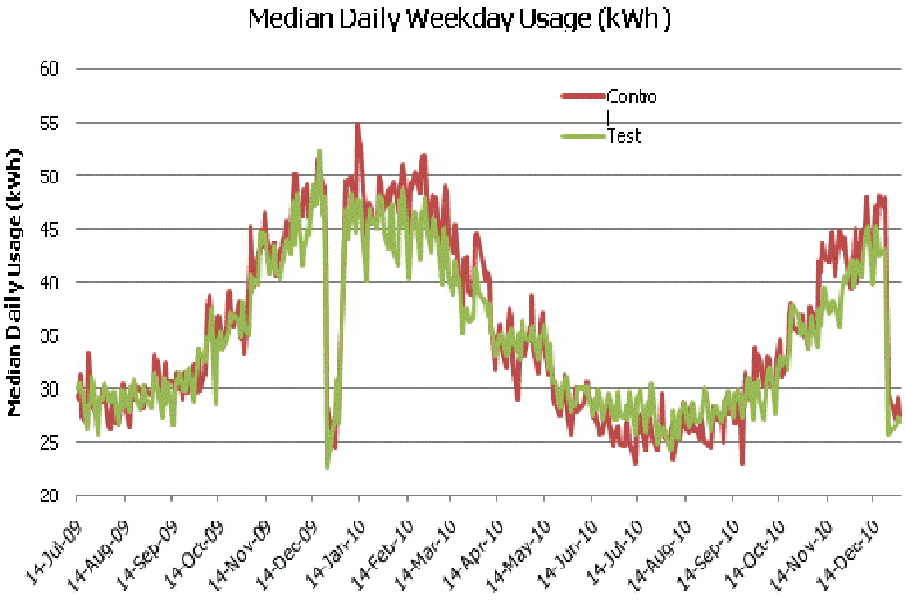

Figure 39: Median daily usage (kWh) during the Trial

10.3 Methodological Approach

An identical methodology to the Residential Customer Behaviour Trial was used to test the SME trial data - the usage behaviour of participants in the test groups was compared to the control group during the trial period. At an overall level, the ratio of total volume of electricity usage for the test groups during the trial period relative to the benchmark period is calculated (R_T). This is then compared to the corresponding ratio for the control group (R_C). The formula used to calculate the ratio is as follows:

$$R_j = \frac{\sum \alpha_{i,j}}{\sum \beta_{i,j}}$$

where $\alpha_{i,j}$ is the volume of usage for meter i in group j during the trial period and $\beta_{i,j}$ is the volume of usage for meter i in group j during the benchmark period. This ratio is also calculated for each of the DSM stimuli groups and compared to the ratio for the control group. This m is repeated for the time periods night, day and peak, where the following definitions apply

Night is defined as usage during the period 23.00 to 07.59 Monday to Sunday and,

Peak is 17.00 to 18.59 Monday to Friday excluding public holidays.

Day is 08.00 to 16.59 and 19.00 to 22.59 Monday to Sunday and 17.00 to 18.59 Saturday, Sunday and public holidays (i.e. there was no peak tariff applied on Saturdays, Sundays and public holidays).

The percentage difference in the ratios between the test and control groups quantifies the extent to which the DSM stimuli in conjunction with the ToU tariffs impact on electricity usage for those meters participating in the Trial.

Statistical procedures and tests are required to make inferences about the likely impact on the wider residential SME population. This requires estimating a measure of variance around the total volume usage figures, which was calculated using a statistical procedure known as bootstrapping.

10.4 Recruitment Approach and Outcome

The Trial focused on commercial organisations with low to medium electricity consumption. This corresponds to the definition of a Small to Medium Enterprise (SME). SME is defined to be an enterprise with up to 249 employees with either an annual turnover not exceeding €50m or an annual balance sheet total not exceeding €43m[28].

The Trial focused on commercial organisations with a single site and reasonable payment history over the previous 12 months. The organisations with multiple sites were included within the separate multi-site study. Finally, participants were drawn from the customer bases of Electric Ireland and Bord Gáis Energy Supply. Recruitment was completed in a similar manner to the residential trial with an invitation letter which was then followed up by a phone call.

10.5 Participant Distribution and Profile

All participants, (including participants who were later allocated to both control and test groups), were required to participate in a Computer Assisted Telephone Interviewing (CATI) based survey. The survey included a wide range of questions about the size of the business, the sector, the premises (including hours of operation), equipment used, level of use of each piece of equipment, the frequency of servicing (which impacts on energy efficiency), investment in energy efficiency enhancements as well as expectation of the impact and outcomes from the Customer Behaviour Trial itself. Further details on this pre-trial survey and the subsequent post-trial survey are provided in **Appendix 8**.

[28] "Official Journal of the European Commission (L 124/36) 20th May 2003 – Commission Recommendation of 6th May 2003 concerning the definition of micro, small and medium-sized enterprises"

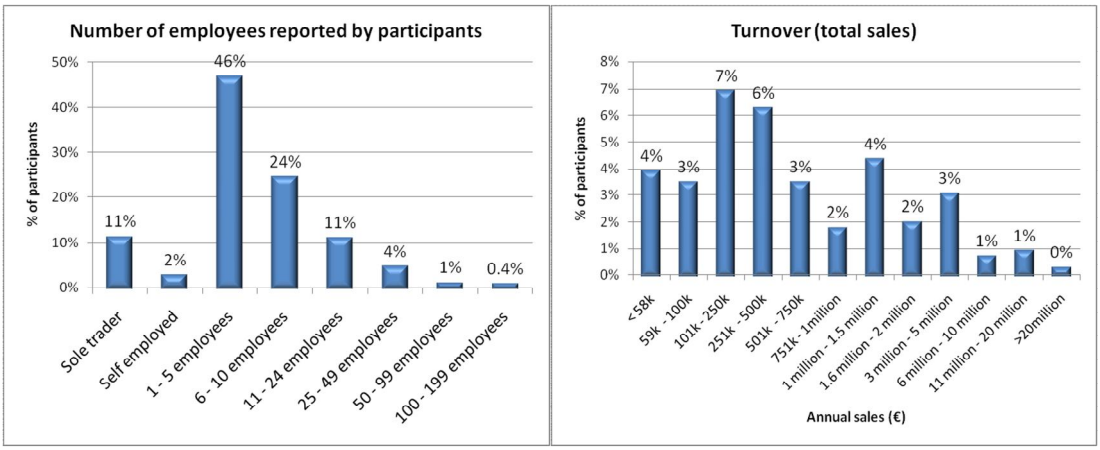

Figure 40: Number of employees and turn-over size of participants

The survey also allowed the profile to be validated against the definition of SME**. Figure 40** shows that all participants did fit within the SME definition. There is a clear focus on smaller organisations in the small or micro business definitions in line with the profile of business size in the SME sector in Ireland.

Unlike the residential trial, the SME Trial did not attempt to be representative of the entire SME sector. Instead it focused on providing insight into reduction in significant sub-sectors: Entertainment (including hotels, restaurants, sporting facilities and public houses), manufacturing, office and services, retail premises. The distribution of the organisations which completed the Trial is shown in **Figure 41**.

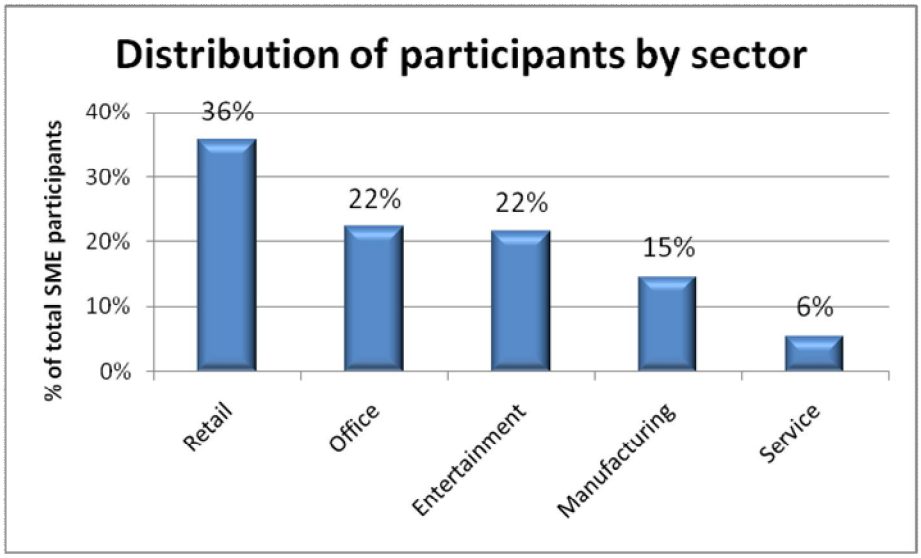

Figure 41: Distribution of SME participants by sector

Compared to the residential trial, the participants in the SME Trial were necessarily more diverse across

- Opening hours (65% opened “standard office hours”) and days (58% operated for some time during the week-end)

- Operation during peak hours (58% did operate during peak hours)
- Use of equipment (The participants included businesses using a wide range of equipment)

10.6 Non-respondent profile

The recruitment was on the basis of a voluntary response to an invitation letter which was followed up by a phone call to encourage involvement. To ensure that the recruitment process did not introduce bias it was necessary to research the profiles of invited businesses who did not respond to the invitation. The non-response survey was conducted using Computer Assisted Telephone Interviewing (CATI) and completed after recruitment in July 2009.

The analysis found that:

- The two populations (i.e., those who did and those who did not respond) were similar across number of employees (most non-respondents would not provide information on turn-over), types of equipment used in the business
- A majority (55%) of the non-respondents were from services industries with 39% from professional business services. In contrast, only 26% of respondents were from all services industries (including business services)
- Attitudes towards energy reduction in general and energy reduction in the business in particular are similar across both populations.

Over the entire set of non-respondents, 9% stated that they chose not to participate. The most commonly reported reason for not participating was lack of recall of receiving the letter (52% of non-respondents). Among those who recalled receiving the letter, 80% of non-respondents did not recall opening it. Among those who did open the letter, 27% did not read it. Among the 9% who chose not to participate, concern about the inconvenience associated with participation was listed as a reason for the decision not to participate by 60% with 40% concerned about the effort required and 40% deeming the Trial as of no benefit to the business.

Therefore, it is clear that non-participation was based on a decision for only 9% of all non-respondents. The greater degree of non-participation among services (and professional business services in particular) does impact on the size of the sample for this sector (and is reflected in the decision to combine this category with Office in the analysis). However, there is no evidence that in this sector or across all non-respondents that the usage characteristics or attitudes differ between the two populations and therefore no bias has been detected.

10.7 Attritor profile

The experimental design of the SME Trial defined a 23% attrition threshold. (The final attrition rate was 23%). Attrition criteria were similar to the residential criteria:

1. The business moved premises

2. The business switched to another electricity supplier
3. Supply was disconnected from the business premises
4. The participating business contacted their supplier and requested to withdraw from the Trial

The first and second reasons were deemed to be sufficient to cause a change in usage pattern and therefore make comparison of usage across trial and benchmark periods inappropriate. The profile of the attritors was analysed from the results of a phased CATI survey.

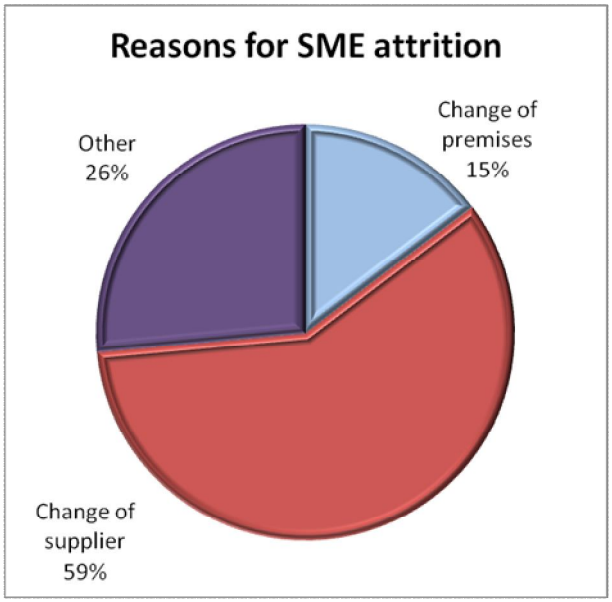

Figure 42: Reasons for SME attrition

The analysis found that change of supplier and change of business premises was the most common reason for attrition with 74% of attritors falling into these categories. The other reasons are diverse and do not show any clear pattern.

Among those participants which had switched supplier or gave other reasons, price and tariffs were considered an important factor by 50% and the potential cost of participating in the Trial was rated as an important factor for 53%. The impact of the prices and tariffs was to seek alternative suppliers for 85% of those who rated prices and tariffs as an important factor. Therefore, attrition may have been related to increased sensitivity to electricity cost. However, there is no way to determine the level of impact on the Trial as sensitivity does not necessarily correlate within increased ability or commitment to change behaviour.

10.8 Allocation of Participants to Stimulus and Tariff Groups

The allocation was completed in December 2009 in order to allow communication and implementation of the allocated tariff and stimulus. Allocation required businesses which were customers of Bord Gáis Energy to be allocated to either a single test group or the control

group and customers of Electric Ireland to be allocated to one of three tests groups (corresponding to distinct stimuli) or the control group

The allocation to particular tariffs and stimulus was on the basis of profiling of the businesses across all available survey and usage data. It was essential that the set of participants allocated to each cell was similar to the allocation in every other cell.

The quantity of data available on each participant from the usage data required a methodology which could identify factors or a combination of factors which could be used as the basis of allocation. The impact of the time of use tariffs and DSM stimuli was expected to vary across many dimensions - reflecting different business sectors, turnover bands, tariff (24 hour general purpose tariff or Nightsaver tariff), reported level of usage, different profile of usage (across types of equipment used and time used for), engagement with and investment in energy efficiency as well as attitudes towards and engagement with energy consumption reduction. The objective of the allocation was to ensure that each cell in the experimental design and the control including comparable groups of participating businesses. In the case of Bord Gáis Energy customers, this meant that the set in the control group have a similar profile to those in the test group. In the case of Electric Ireland customers, this meant that the set of businesses in each stimulus group and the control have similar profiles.

Participants were randomly allocated to each experimental cell from groups of participants with profiles deemed similar across the available factors. After the initial allocation, corrections were made to ensure representivity across all data measures through a process of rebalancing the allocation by moving participants from one cell to another. Further details are included in **Appendix 4**, Allocation of participants.

11 Outcome of SME Trial

11.1 Summary

The following sections detail the main findings of the SME data analysis.

11.2 Impact of ToU Tariffs in conjunction with DSM Stimuli on Overall and Peak Usage

The data gathered from the Trial shows a reduction of **0.3%** in overall electricity usage and **2.2%** in peak electricity usage for SME participants on DSM stimuli and TOU tariffs relative to the control group. Day usage shows a minor reduction of 0.9%, while an increase of 1.5% is measured in the case of night usage. None of these results is statistically significant at the 90% confidence level.

Usage	Overall %	Day %	Peak %	Night %
All Participants	-0.3	-0.9	-2.2	1.5
* denotes results statistically significantly different from control group using a 90% confidence level				

Table 40: Percentage change in overall, day, peak and electricity usage relative to the control group

The SME sample was recruited to represent a cross section of the range of SME industry and service sectors as defined by the NACE codes. The primary categories used were Retail, Office/Service, Entertainment and Manufacturing. These sectors were selected for recruitment in order to cover different types of business operation in terms of hours and days of opening as well as different usage levels and demands both within day, within weak and across the different seasons. Consequently it is more valid to consider the within sector changes as there is more homogeneity within sector. In **Table 41** below, reductions are measured in all sectors except the Entertainment sector, where increases for all times of day were measured. It should be noted that these results have been tested and none is determined to be statistically significant at the 90% level. The Manufacturing sector shows the largest relative decrease in usage and this is measured across all times of day. A similar pattern of decline is apparent in the case of the Service and Office sector but this is less pronounced compared with the Manufacturing sector.

Usage	Overall %	Day %	Peak %	Night %
Retail (n=104)	-1.3	-1.7	-2.2	0.5
Entertainment (n=62)	2.2	0.7	-0.1	6.7

Manufacturing (n=40)	-2.5	-2.8	-8.1	-3.0
Service and Office (n=82)	-1.3	-1.7	-2.3	-0.2
* denotes results statistically significantly different from control group using a 90% confidence level				

Table 41: Percentage change in overall, day, peak and electricity usage by test group sector relative to the equivalent sectors in control group

The implementation of differential pricing is found to have mixed success in terms of achieving a reduction in usage across the trial participants and seems to depend on their current Tariff (GP24 or Nightsaver). **Table 42** shows that those trial participants on the GP24 Tariff are not showing themselves to be responsive to ToU tariffs - on the contrary they are measured to show an increase in usage across all periods within the day. In the case of those participants on the Nightsaver tariff, the application of further ToU differentials is showing evidence of a reduction among those participants when compared to control group Nightsaver customers. Achieving an overall reduction of 1.6%, this group also reduced their daytime and peak usage and appears to have shifted a certain proportion of their energy into the night-time period, with its favourable rate.

Usage	Overall	Day	Peak	Night
GP24	1.4	1.8	0.2	1.0
Nightsaver	-1.6	-3.6	-1.8	1.8
* denotes results statistically significantly different from control group using a 90% confidence level				

Table 42: Percentage change in overall, day, peak and electricity usage by current tariff category relative to equivalent Tariff categories in the control group

Considering the DSM stimuli in combination with the tariffs, (**Table 43**) the results show a mix of reductions and increases across the stimuli, but these results are not statistically significant. The analysis and testing determines whether the combination of bi-monthly bill, energy use statement and either the electricity monitor or web access is effective. As with the residential trial analysis, it is not possible to determine the benefit of the electricity monitor or the web access stimuli independent of the energy use statement (as distinct from the incremental benefit when combined) as the combination may have additional interaction effect which impacts on the reduction achieved.

In the context of the stimuli, the electricity monitor and the Web access test groups are most effective at reducing energy usage. While the Web access group appears to have been the most effective, it is known through the survey and tracking of web activity that this group did not frequently avail of the web access option. Nevertheless they received their usage data via the energy usage statement, consistent with Stimulus 1, but were contacted during the Trial to see if they needed assistance in terms of accessing the web.

Usage	All DSM Stimuli groups on ToU Tariff % change	DSM Stimulus on Time of Use Tariff			
		Bi-monthly bill and energy usage statement (*Stimulus 1*) % change	Monthly bill and energy usage statement (*Stimulus 2*) % change	Bi-monthly bill, energy usage statement and electricity monitor (*Stimulus 3*) % change	Bi-monthly bill, energy usage statement web access (*Stimulus 4*) % change
Overall	-0.3	1.2	-0.1	-1.1	-2.9
Peak	-2.2	0.0	-4.7	-0.6	-5.2
Day	-0.9	0.2	-1.6	0.0	-3.3
Night	1.5	3.9	5.3	-4.4	-1.9
* denotes results statistically significantly different from control group using a 90% confidence level.					

Table 43: Percentage change in overall, peak, day and night electricity usage relative to the control group by stimulus

The relationship of tariff group within stimulus is explored in **Table 44.** The pattern of greater reduction levels among the Nightsaver tariff groups is less systematic when tariff group by stimulus is considered. The comparison for each Tariff with stimulus group is the similar Tariff within the Control Group. This differs from **Table 43** where the full tariff group is used.

Usage	Overall %	Day %	Peak %	Night %
Bi-monthly bill and energy usage statement				
GP-24	2.7	2.7	3.6	2.5
GP-NS	0.1	-2.2	-0.1	4.7
Monthly bill and energy usage statement				
GP-24	0.3	0.0	-3.9	4.3
GP-NS	3.2	0.4	1.3	6.6
Bi-monthly, energy usage statement and electricity monitor				
GP-24	-0.2	1.4	0.5	-4.8
GP-NS	3.1	3.8	6.4	0.1
Bi-monthly bill, energy usage statement and web-access				
GP-24	2.4	3.0	0.4	2.0
GP-NS	-12.6	-15.7	-14.2	-8.6

* denotes results statistically significantly different from control group using a 90% confidence level

Table 44: Percentage change in overall, day, peak and electricity usage by tariff group within stimulus group sector relative to the equivalent Tariff groups in the control group

The relationship of sector within stimulus is explored in **Table 45**. As with **Table 43** the comparison for each Sector with stimulus group is the similar Sector within the Control group. It is interesting to note the responsiveness of the Manufacturing sector to peak reduction, for the bi-monthly bill and energy usage statement and the monthly bill and energy usage statement combined with time of use tariffs. It is also noteworthy that the Services and Office sector was responsive across almost all the stimuli

Usage	Overall %	Day %	Peak %	Night %
Bi-monthly bill and energy usage statement				
Entertainment	3.3	1.2	0.1	10.4
Manufacturing	9.1	1.6	-14.7	19.9
Retail	-1.6	-1.9	-1.9	-0.7
Services and Office	0.5	-0.2	1.7	1.8
Monthly bill and energy usage statement				
Entertainment	5.6%	2.5	-0.3	17.1
Manufacturing	-9.1%	-9.5	-15.5	-9.7
Retail	4.8%	3.9	5.2	7.4
Services and Office	-5.7%	-7.1	-14.2	2.8
Bi-monthly bill, energy usage statement and electricity monitor				
Entertainment	-1.1%	-0.8	0.3	-2.0
Manufacturing	2.7%	3.3	0.4	0.5
Retail	-3.1%	-1.8	-0.4	-8.5
Services and Office	0.4%	3.1	-2.2	-5.4
Bi-monthly bill, energy usage statement andweb-access				
Entertainment	-0.5%	-1.0	-0.7	0.3
Manufacturing	-1.7%	-0.3	-0.2	-5.9
Retail	-3.8%	-5.3	-8.7	2.3
Services and Office	-3.8%	-2.9	-4.2	-5.9

* denotes results statistically significantly different from control group using a 90% confidence level

Table 45: Percentage change in overall, day, peak and electricity usage by Sector within stimulus group relative to the equivalent Sector in the control group

11.3 Impact of Time of Use Tariffs (in conjunction with DSM stimuli) over time

The extent to which the response to DSM stimuli and ToU tariffs changes over the period of the Trial provides insight into the potential long term impact of smart meters. If the impact declines after an initial period, this may be of concern as it is a potential longer term response to smart meter enabled initiatives. Equally, an increasingly positive response over time may point to incremental benefits accruing over the period when smart meters are available.

A comparison of the change in usage during the first six months and the second six months is shown in **Table 46.**

		Overall % change	All DSM stimuli with ToU Tariffs			
			Bi-monthly Bill and energy usage statement (*Stimulus 1*) % change	Monthly Bill and energy usage statement (*Stimulus 2*) % change	Bi-monthly Bill, energy usage statement and electricity monitor (*Stimulus 3*) % change	Bi-monthly Bill, energy usage statement web access (*Stimulus 4*) % change
Overall	1st six months	-0.9	-0.5	0.5	-2.5	-1.8
	2nd six months	0.3	3.1	-0.9	0.3	-4.1
Peak	1st six months	-2.9	-2.1	-4.9	-2.3	-2.9
	2nd six months	-1.5	2.1	-4.5	1.2	-7.7

Table 46: The percentage change in overall and peak usage in the first and second six month periods of the Trial across tested stimuli

The month to month trends in usage reduction (**Figure 43** and **Figure 44**) show great variation in the level of reduction across time and stimulus. The empirical nature of the Trial should be stressed as the number of businesses and the diversity of usage is great and increases the variability. Nevertheless the impact of the electricity monitor can be seen to follow a similar pattern to the residential trial with greatest impact at the start and end periods which may suggest similar drivers to electricity monitor use during the high usage periods during the winter.

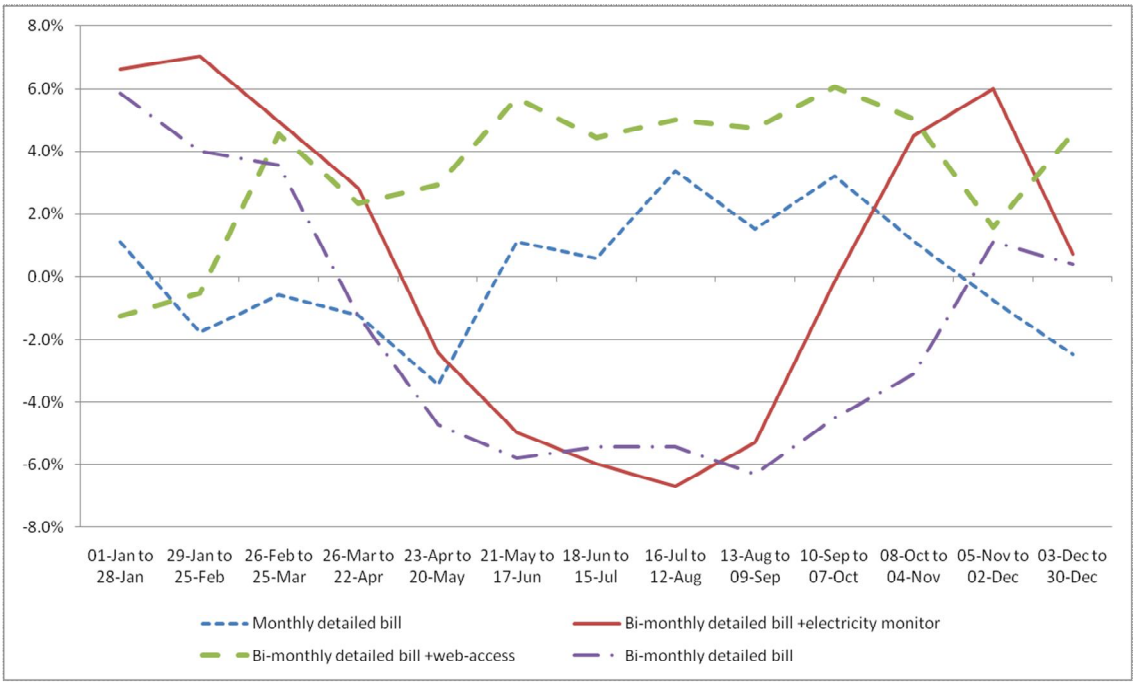

Figure 43: Trends in overall usage reduction for each tariff group (for 4 week periods)

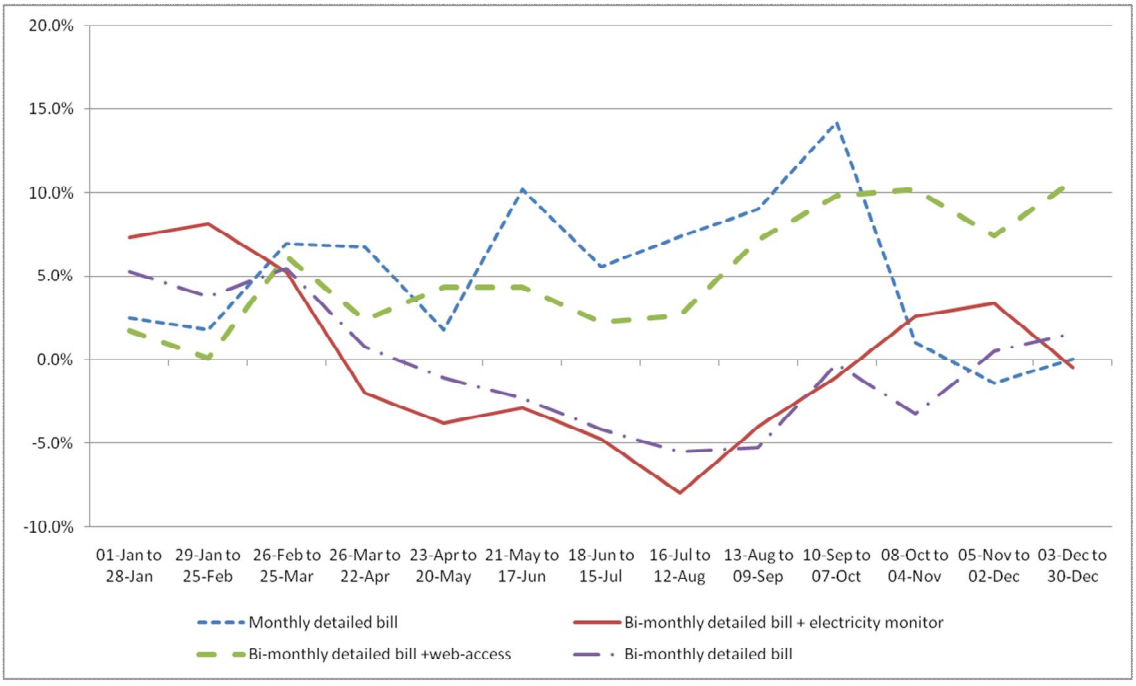

Figure 44: Trends in peak usage reduction for each tariff group (for 4 week periods)

11.4 Participant attitudinal and behavioural impact

At the completion of the trial, all participants who had not attrited (including both control and test groups) were requested to participate in a Computer Assisted Telephone Interviewing (CATI) based survey. Further details are provided in **Appendix 8**, The SME pre-trial and post-trial surveys.

41% of participants in the Trial believed that they reduced overall usage (meter data show 59% reduced usage) with 22% stating that they reduced peak usage (meter data show that 63% reduced peak usage). Therefore, it is clear that the participants are under-estimating the degree of reduction. Most (91%) stated that their night-time usage did not change.

Among those who believed that they did reduce peak usage, the tariffs were regarded as effective in making the business focus on reducing peak usage (79%) with 71% stating that the increased peak cost forced the business to attempt peak usage reduction. However, this did not have a negative impact on the business for 79% of respondents. (14% stated that it did have a negative impact).

Participation in the Trial did not impact on the overall attitudes towards electricity consumption within the business. (with only one of the five tracked metrics showing a marked difference in attitudes between control and test groups (*"By changing the way the people I work with and I use electricity, I can reduce my electricity bill"*).

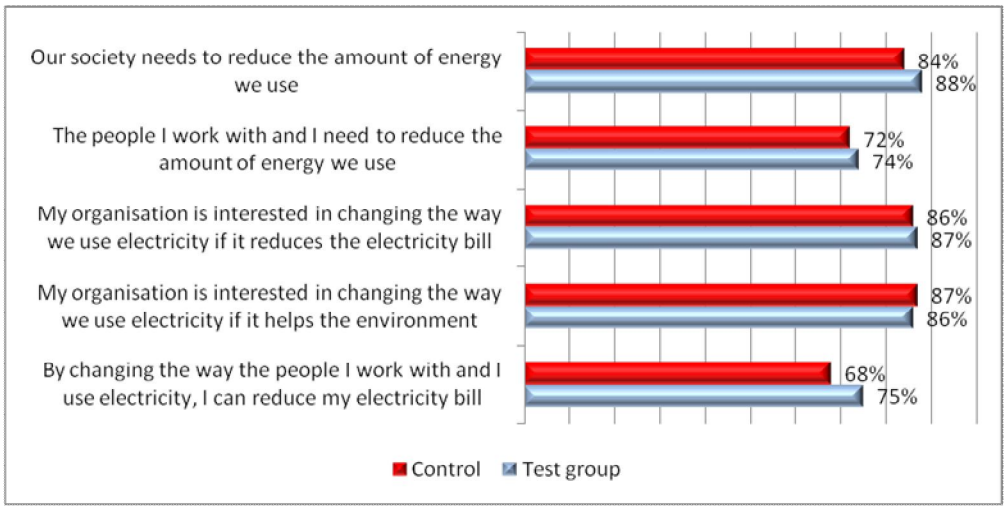

Figure 45: Comparison in attitudes towards energy reduction between control and test groups

Nevertheless participants perceived that their business had become generally more aware of energy related matters. In particular 66% of businesses claimed to be more aware of the electricity used and 79% stated that they were more aware of the cost of electricity used. This is supported by the higher proportion of businesses in the Trial which state they have regular monitoring and reporting of electricity usage at 13% (**Figure 46**) compared to 8% among those in the control group and 6% across all participants in the pre-trial survey.

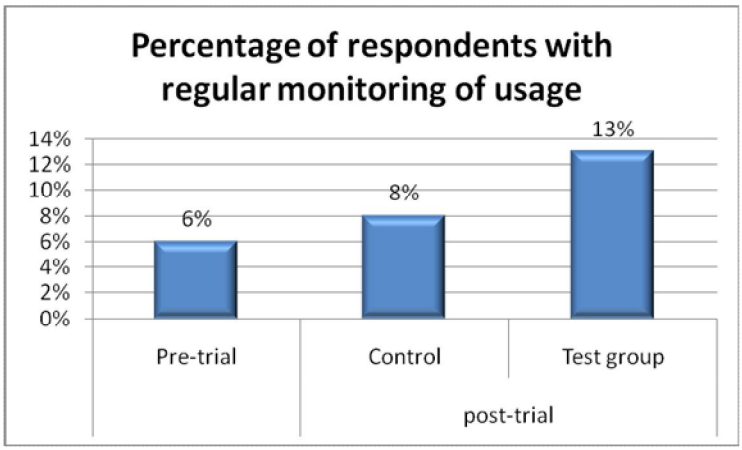

Figure 46: Percentage of SME respondents with regular monitoring of electricity usage

Furthermore, a proportion of test group participants state that they identified easy to implement changes which reduced usage (39%) or invested in more energy efficient equipment to reduce usage (64%) as shown in **Figure 47**. The investment was most common in retail with 27% of respondents stating that they had invested and least common in Entertainment with only 13% stating that they had made an investment.

However, some findings suggest that the impact was limited to a minority of participants. The level of understanding of the tested tariffs was low with 40% of participants previously on a single rate tariff and 33% of participants previously on a night saver tariff unaware that the tariff varied by time of day.

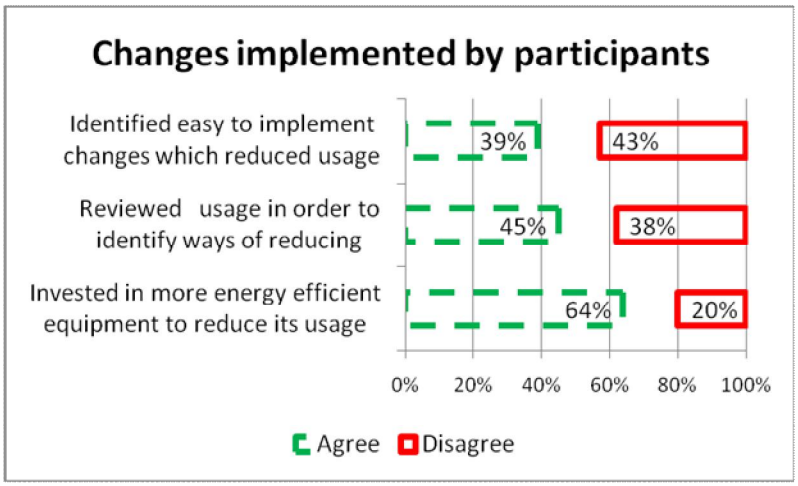

Figure 47: Proportion of SME test group participants who state they have made changes to reduce energy usage

11.5 Reasons for lack of reduction

Participants who reported not shifting usage to the cheaper night-time period were asked to identify potential reasons. The most common reason identified was inconvenience (**Figure 48**) with 61% stating this as a very important reason. In contrast, issues of safety or cost savings were much less often identified.

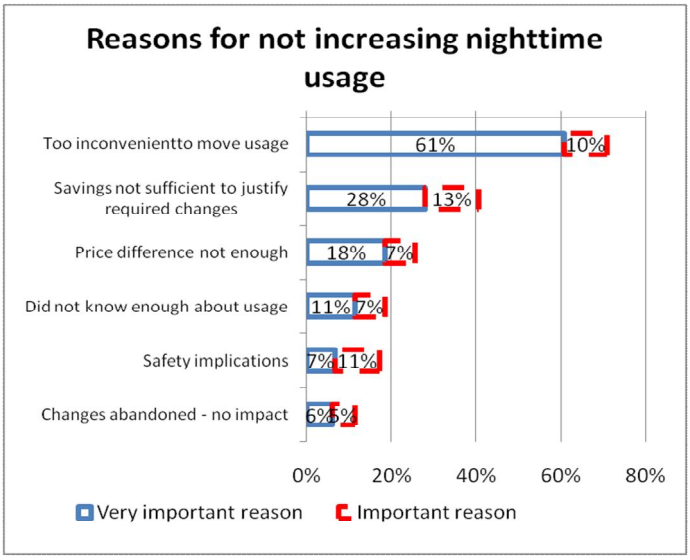

Figure 48: Reasons for not increasing night-time usage

Similarly, 71% of respondents who stated that they had not reduced their peak usage also identified most often identified lack of opportunity to move usage as a very important reason for not reducing peak usage (**Figure 49**).

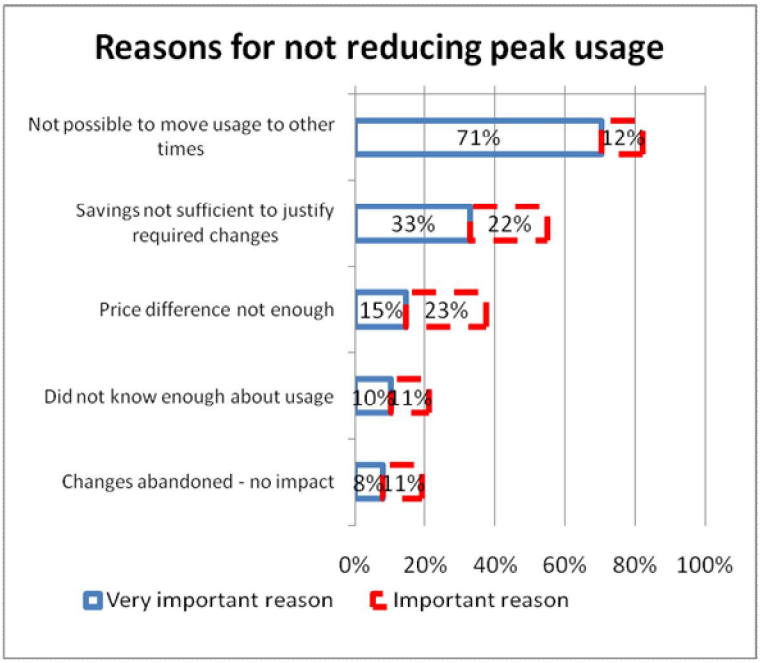

Figure 49: Reasons for not reducing peak usage

This suggests that the primary barrier for SMEs was lack of empowerment or capability to shift usage even when incentivised by a time of use tariff.

11.6 Impact of supporting stimuli

	Energy usage statement	Electricity Monitor	Web-site information
Importance to overall reducers	72%	93%	24%
Importance to peak reducers	74%	85%	57%

Table 47: Importance of DSM stimuli in supporting reported reduction

	Time of use pricing	Overall cost	Business' need to reduce usage
Importance to overall reducers	65%	73%	79%
Importance to peak reducers	79%	82%	74%

Table 48: Importance of other factors in supporting reported reduction

Respondents who stated that they had reduced overall usage or peak usage were asked to rate the DSM stimuli in terms of their importance in achieving the reduction (**Table 47**). Respondents also stated how important other factors were in supporting the achieved reduction (**Table 48**). As with the residential trial, it is clear that the electricity monitor is considered as important by almost all participants who reduced usage and had the monitor. In contrast, the web-site information achieved a low score among overall reducers and a better but still low score among peak reducers.

Among participants who were given access to the electricity monitor, 97% stated that the monitor was used at first with 79% stating that it is still used (39% use it regularly). Reasons for not using it varied. Most found the electricity monitor easy to use (66%) with 9% finding it difficult. While the monitor was mostly used by the respondent (individuals responsible for energy management decisions), 21% were used by other management and 33% by other staff within the business. However, the electricity monitor was primarily used without changing the settings (97% stated that the settings had not been changed).

Table 49 shows that among the SME participants who received the electricity monitor, a majority found the device effective in helping the business reduce electricity usage (55% agree) and changing when it used electricity (55% agree). Over three quarters (76%) found that the monitor made the business more aware of electricity usage.

Electricity Monitor	Agree	Disagree
Helped your business reduce its electricity usage	55%	24%
Helped my business become more aware of the electricity we were using	76%	9%
Helped my business to reduce the amount of electricity overall	61%	18%
Helped my business to change when it uses electricity	55%	24%

Table 49: Perceptions of the electricity monitor

However, a significant proportion did not recall any feature suggesting limited use in these cases. The degree to which features were used can be assessed through the degree to which the participants could recall those features unprompted. In the table below, it can be seen that the basic features visible on the initial screen are the items most often recalled unprompted (in the column titled "Unprompted recall") with 48% recalling the cost of electricity display, 33% recalling the time of use pricing information and 27% recalling the cost so far this month. Overall 36% were not able to recall any features which suggests that these individuals did not engage and effectively use the device. Even when prompted for features (the column titled "Total recall" combines the unprompted with prompted recall), 33% were not able to identify any feature.

Electricity Monitor	Unprompted recall	Total recall
Cost of electricity at that time	48%	73%
Amount of electricity being used	15%	67%
Daily budget	12%	58%
Cost of electricity so far this month	27%	55%
Price of the electricity at different times	33%	55%
Other screen showing more detailed information	9%	48%
Your current meter reading	3%	39%
None of these	36%	33%

Table 50: Recall of electricity monitor features

Among those recalling features, the rating of usefulness was high with all features being rated as useful by 75% or more of those who recalled the feature **Figure 50**

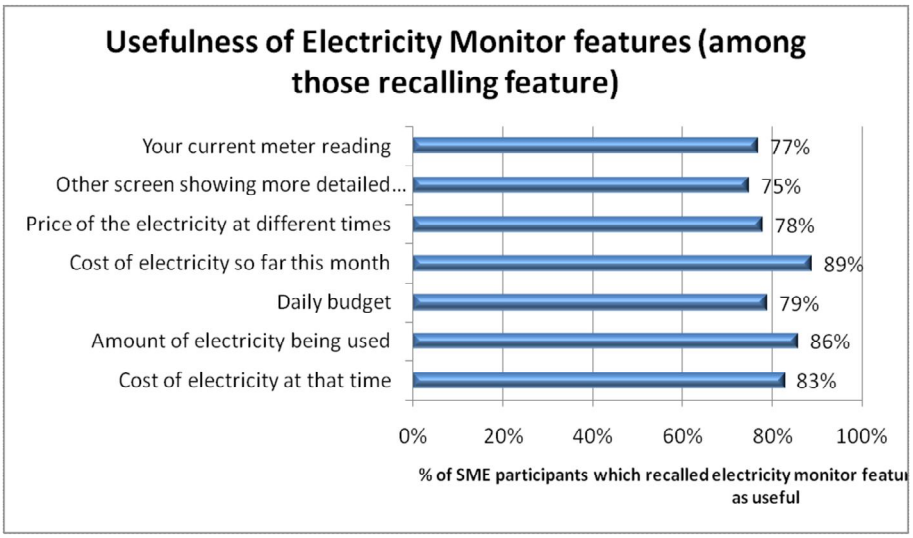

Figure 50: Usefulness of electricity monitor features

Among the participants given access to the web-site, only 15% state that they logged into the system with 47% stating that they were aware of the system. Among the group that did use the system, 71% used the system a single time with the remainder using it two or three times. Given this low level of take-up, it is unsurprising that the assessment of value also suffers.

Of the group that used web access, 86% stated that they found it easy to understand however the rating of the impact of the web-site on the groups scores less well (**Table 51**):

Web-site	Agree	Disagree
Helped your business reduce its electricity usage	43%	43%
Helped my business become more aware of the electricity we were using	57%	29%
Helped my business to reduce the amount of electricity overall	43%	43%
Helped my business to change when it uses electricity	43%	43%

Table 51: Perceptions of web access

11.7 SME Energy Reducers

The population of SME participants included a proportion of businesses which reduced[29] as well as a proportion that did not (as was the case with the residential participants). **Figure 51** shows the level of reduction among this group with an average overall reduction of 8.51% and average peak reduction of 8.33% among those who reduced overall with overall reductions of 5.74% and 10.25% among those who reduced peak.

[29] Reducers are defined to be organisations which have reduced their usage compared to the average change in the control group (either overall or peak). This approach is used to remove differences between usage in the benchmark and trial related to external factors such as weather which are unrelated to the trial itself. This is consistent with the methodology used to calculate overall and peak reduction in the test group as a whole.

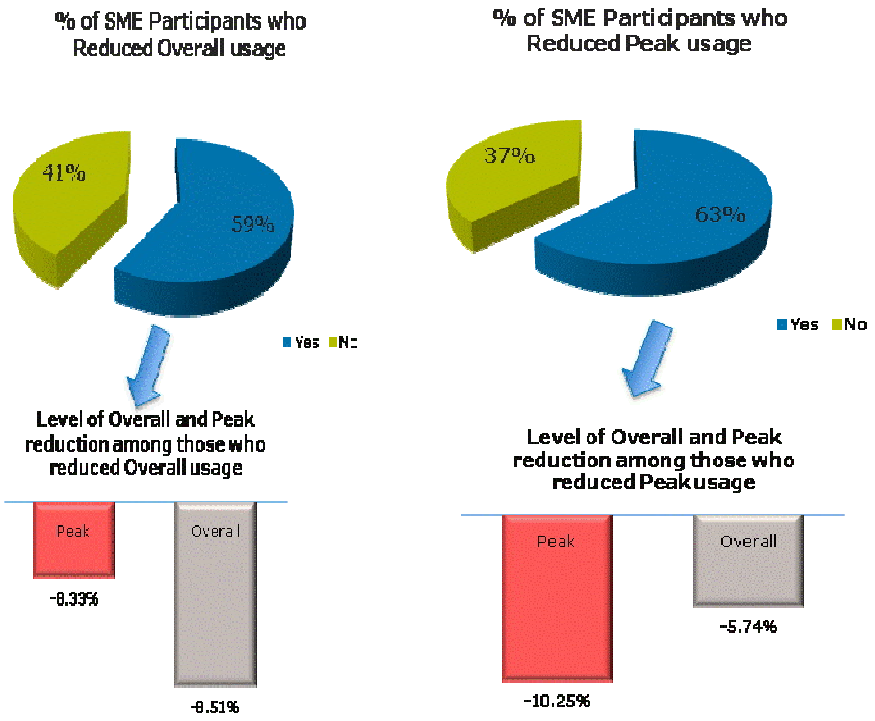

Figure 51: Overall and peak reduction among SME participants who reduced usage

This clearly shows the size of the reduction achieved by many in the Trial (as 59% reduced overall and 63% reduced peak). However, it should be recalled that among the control group (and any set of SME businesses selected at random) there will be companies that reduce usage. The above figures are for reduction achieved compared to the average change in the control group (i.e. only those with a change greater than that among the control group). Therefore, the figures for the control group are 50% for overall reduction and 63% reduction in peak.

Profiling the set of SMEs in the Test group that reduced usage compared to the benchmark shows that sector and scale in terms of employees or turnover does not influence the achievement of overall or peak reduction. Similarly, the level of engagement with energy reduction does not differ greatly from the overall set of participants (**Table 52**).

	Overall		Peak	
Agree that …	Reducers %	Non-reducers %	Reducers %	Non-reducers %
Our society needs to reduce the amount of energy we use	91	85	89	87
My organisation is interested in changing the way we use electricity if it reduces the electricity bill	82	90	82	90
My organisation has already done a lot to reduce the amount of electricity it uses	49	54	50	53
My organisation has already made changes to the way we work in order to reduce the amount of electricity we use.	53	52	58	49
My organisation would like to do more to reduce electricity usage	76	87	77	86

Table 52: Engagement with energy reduction among SME's achieving overall and peak reduction

However, differences do emerge between organisations that reduced overall and/or peak usage and those which did not when their approach to energy usage and reduction was taken into account:

The reducers were more likely to have undertaken regular monitoring of energy use and reporting of trends. Among those who reduced overall energy, 19% undertook monitoring compared to 10% of those who did not reduce their overall energy usage. Similarly, 18% of businesses which reduced peak consumption monitored energy consumption compared to 11% of those who did not. Therefore, it seems clear that energy reduction is more likely to occur when tracking occurs.

Similarly, energy reduction is more likely to occur when there is a person responsible for energy monitoring. 38% of organisations reduced overall usage stating a person is assigned to energy monitoring, compared to 19% of those who did not reduce overall usage. Similar patterns occurred among those who reduced peak usage with 34% of these stating a person was assigned, compared to 23% of those who did not reduce peak usage.

Perhaps reflecting a greater engagement with the topic of energy reduction, the reducing organisations are also more likely to be *considering* generating their own electricity from sources such as solar panels or wind turbines (with 21% of overall reducers and 21% of peak reducers considering this compared to 7% in the non-reducing populations). However, the decision to invest has yet to be made with identical proportions (12%) of overall reducers, peak reducers and the non-reducing populations planning such investments.

Furthermore this is not significantly related to the role of electricity usage in the organisation. As can be seen from **Figure 52** on average, businesses which are overall reducers use relatively less electricity, whereas businesses which are peak reducers use relatively more electricity. The degree of difference in each case is very small and not significant. The difference is also not related to the potential impact on the business of making changes. Very similar proportions of the reducing and non-reducing populations state that participation in the Trial had no impact on their business.

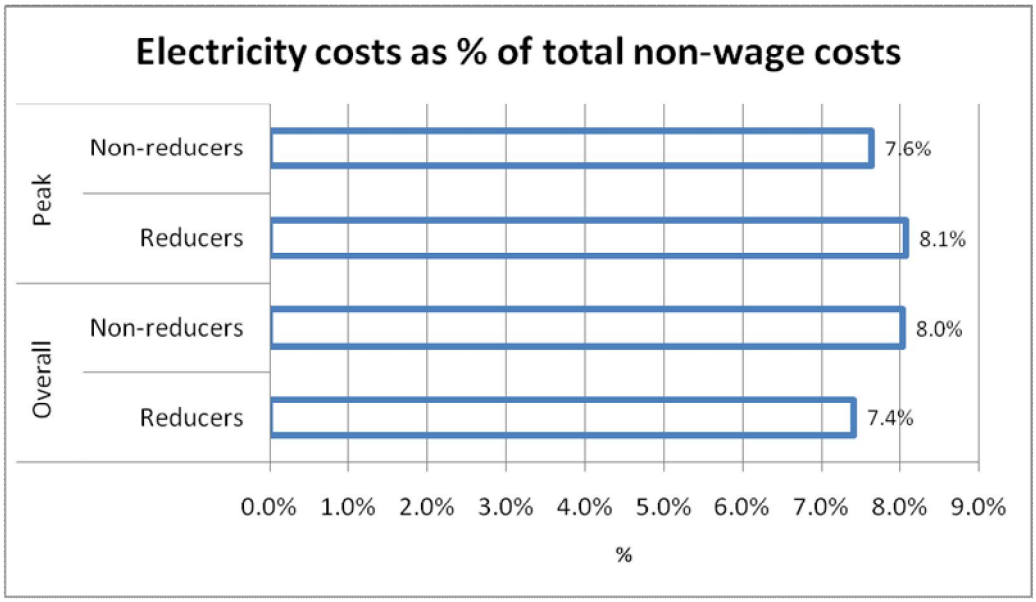

Figure 52: Significance of electricity costs among SMEs that reduced or did not reduce

11.8 Conclusions

The main findings of the SME Trial may be summarised as follows:

Response to tariffs and DSM stimuli

- the deployment of ToU tariffs and DSM stimuli are found to reduce overall electricity usage by 0.3% and peak usage by 2.2%, although neither result is found to be statistically significant;
- there is no tariff, DSM stimulus or tariff/DSM stimulus group which reduced overall electricity usage or peak usage by a statistically significant amount;

Empirical, behavioural and experiential conclusions

- 41% of participants believed that they reduced overall usage with 59% stating they reduced peak usage. The tariffs were regarded as effective in supporting this reduction with 71% stating the peak cost forced their business to attempt to reduce usage at this time.

- Participants have an increased level of regular monitoring of their electricity usage with 13% reporting this to be the case compared to 8% among the control group with 45% stating that they reviewed usage to identify ways of reducing it;
- The main barrier to reduction was the perception that it was not possible to move the usage to other times. This was stated as a very important reason by 72% of businesses who stated they did not reduce peak usage and 61% of those who did not reduce overall usage;
- Among participants who reduced either peak or overall usage, the electricity monitor was deemed to be effective with 93% of those reducing overall usage stating it was important and 85% of those reducing peak usage stating it was important;
- In contrast, the web-site information was rated as important to overall usage by 24% of reducing businesses with access to the stimulus. This reflects the low level of usage of the system (at 15% stating they logged in).

12 Outcome of Multi-site Trial

12.1 Introduction

Organisations with multiple sites having at least two and, on occasion, three types of stakeholders were included within the research (in many cases the Type 1 and 2 stakeholders were the same individual):

1. A manager with central authority for financial aspects of energy consumption (typically receipt of bills and authorisation of payment)
2. A manager with central authority for setting policy and budgets for future energy spending
3. The manager on the site responsible for the day to day operations including energy consumption

The research included up to three in-depth interviews of each stakeholder (one prior to the start of the Test period, potentially an additional one during the Test period and a final interview at the completion of the Trial).

The interview prior to the start of the Test period included items such as:

- The respondent's involvement in the setting and achievement of energy usage or cost goals
- The respondent's current access to information (including both the type, regularity and review of information) and current use of that information in controlling usage
- The respondent's level of knowledge and personal attitudes towards reduction of energy usage in the business
- The level of motivation and incentive the participants have to reduce energy usage

The interviews during and after the Trial focused on the experience of and attitudes towards the stimuli deployed and the potential impact on the organisation's attitudes and behaviours in the area of reduction of electricity consumption.

12.2 Context of Multi-site electricity consumption

Multi-site organisations are inherently more complex and typically larger than the organisations included in the SME Trial. The energy bills were significant in the context of the overall cost base of a site as well as in absolute amounts. In this research they were much higher than that of organisations included in the SME Trial.

In most multi-site organisations, energy consumption is considered exclusively from a cost perspective and in that context is controlled from budgetary and procurement perspectives.

The first consequence of the budgetary focus is that energy consumption reviews are primarily to ensure that budgetary targets are met. More detailed reviews typically occur "by exception" when costs are outside of the budget. In that case comparisons are made to previous years' consumption. A second consequence of the budgetary focus is that the bills and other information are sent directly to the accounts department or are forwarded to the department without substantive review or analysis by the site manager. Both of these consequences reduce the overall engagement by the site manager in electricity usage issues and opportunities for usage reduction.

For organisations which carry out formalised procurement procedures around electricity supply, the reviews cover both consumption and cost imperatives. However, consumption is more typically reviewed to ensure compliance with agreed unit costs rather than to track potential reductions in usage. The review is also typically driven by the central administration and not by the site manager. The focus on usage management, primarily from a budget control perspective, tends to reduce the engagement and motivation of the site manager in initiating incremental activity aimed at electricity usage reduction.

In a minority of cases where a reduced environmental impact is an objective for the business (for instance for organisations committed to carbon neutrality), this tends to occur as part of a parallel process of consumption reduction. It usually forms part of a carbon reduction programme. This process will encourage and educate site managers and motivate reduction as part of an organisation wide initiative. This forms an additional tier of objectives on those managers decoupled from the primary financial controls.

In every case considered during the multi-site trial, the site managers perceive their role in energy consumption decisions as somewhat limited. Once they are in compliance with the budget line item for energy costs, this aspect of their role tends to move down the list of daily priorities. There was no case where site managers were involved in or initiated decisions to invest in upgrades to reduce electricity consumption.

As a line item in the budget, the objective with regard to electricity consumption is similar to his or her role to other line items (such as maintenance or security) - to track spend and to ensure that budgets are adhered to or participate in analysis where this does not occur. Site managers involved in the Trial did not have specific targets or incentives to reduce energy usage.

This limited scope for action and engagement tends to lead site managers to consider their role with regard to energy reduction as maintenance of the status quo. Notwithstanding this observation, it should be noted that site managers were personally very interested in managing energy consumption efficiently and, as good managers, were vigilant in ensuring that there

was no apparent wasted usage. Participant site managers focus on promoting good behaviour among staff members with emphasis on simple actions such as switching off lighting or equipment. This is motivated by the belief that it is *the right thing to do* and not as a systematic approach to reduction of consumption. Similarly, there is little engagement in investigation of current consumption or potential for investing in more efficient equipment. In the second case, these decisions were again centralised and unlikely to be considered outside of the periodic refurbishment of premises (at which point more energy efficient equipment might be installed).

Therefore, to achieve behaviour change in the multi-site organisations, either the site managers must be empowered and motivated to make changes or the organisation as a whole must change the current approach to managing electricity consumption within a line item without incentives for reduction as well as control (the processes).

12.3 Impact of the stimuli on attitudes and behaviours

The Multi-site Trial was designed as a qualitative assessment. While smart meter data was available, the reporting of potential reductions in overall or peak usage is not appropriate due to the relatively small number of organisations included. This variability is clear in **Figure 53** which shows the overall usage ratios (the 4 weekly usage divided by the benchmark usage) for the participating multi-site organisations: In some cases, usage is level across the year; other exhibit seasonal trends with high usage during winter periods. Therefore, the analysis focuses primarily on the outputs from the qualitative research undertaken with the multiple stakeholders within the participating organisations.

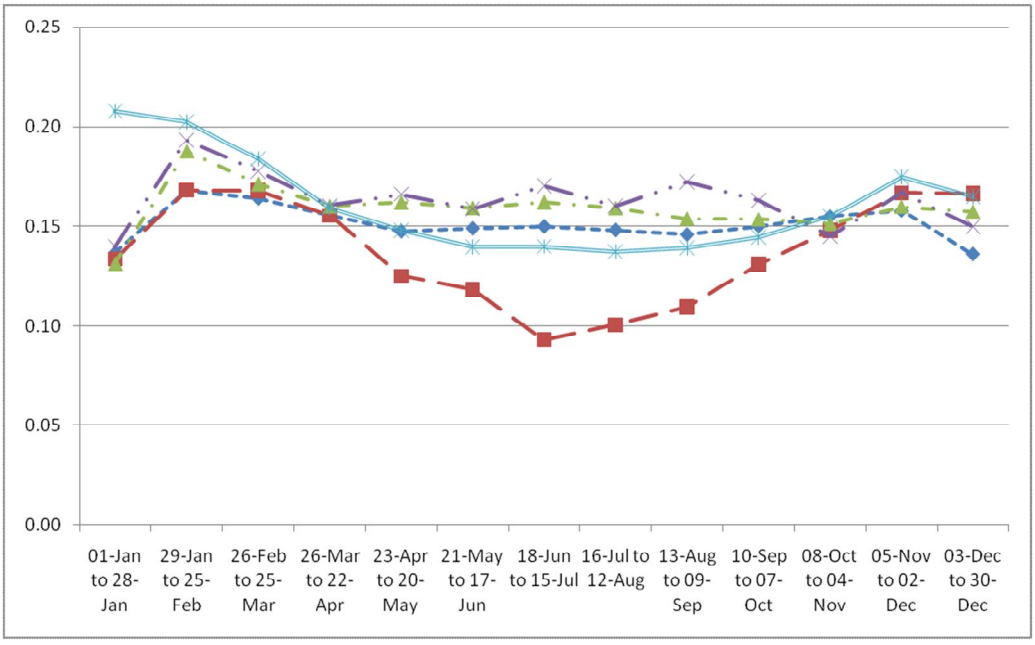

Figure 53: Trends in overall usage ratios for the organisations in the multi-site trial showing variability and seasonal trends

The participants were provided with energy usage statements which provided additional information on time of use data. Participants with office internet connectivity also had access to an on-line system providing further usage information. In the research conducted during or after the completion of the Trial, the emphasis was on determining the degree to which processes and behaviours related to electricity usage were impacted by the stimuli.

The research found that the process within which electricity usage is reviewed and considered was not impacted as a result of participation in the Multi-site Trial. As a process change, this would have required a central decision to change the approach to the management of electricity usage. Participants in the research clearly stated that such a change would be possible but would require clear financial justification. Such justification would require internal commitment or external expertise with significant consultancy. It was clear from the research that the stimuli did not motivate internal commitment where it did not already exist. The provision of the external consultancy was outside of the scope of the Trial. This lack of change in process had a significant knock-on impact on the effectiveness of the stimuli deployed in motivating behaviour change.

The energy usage statement was not examined in any greater detail than the regular bill provided prior to the Trial by the site manager. This reflects:

- A lack of process change as site managers perceive themselves to have little or no defined role in the analysis of energy usage. The energy usage statement was not able to influence this perception. Furthermore, the energy usage statement did not change the perception among some site managers that there is limited opportunity to reduce usage (beyond generic behaviours such as switching off lights).
- An association of the energy usage statement with the bill due to its delivery as part of the bill. In some organisations, as part of the bill it was sent directly to the central function for payment processing and was not seen at all by the site manager. In other organisations, the site manager forwarded it as part of the bill package, with no change in the level of scrutiny when compared to the previous bill. The central function's primary role was payment processing or checking against supply contracts. The energy usage statement was not relevant within that context.
- Therefore, it was deemed useful and effective by a minority of site managers already actively engaged in usage review and not effective by those not already engaged. One suggestion from the research was to separate the energy usage statement from the bill and send it directly to the site manager as part of a separate communication.

12.4 Observed change in energy usage by enterprises involved in the multi-site Trial

The Trial was effective in increasing awareness of energy usage within the enterprises. Notwithstanding the different experiences at site level, the central contacts in all cases were reasonably engaged in the Trial. Their attention to the energy usage statements was reported as reaching a good level. They reported that they monitored changes both over time and seasonal changes and compared these changes with similar periods for the previous year. The meter data shows that three of the four enterprises involved showed reductions in absolute usage, compared with the same period the previous year:

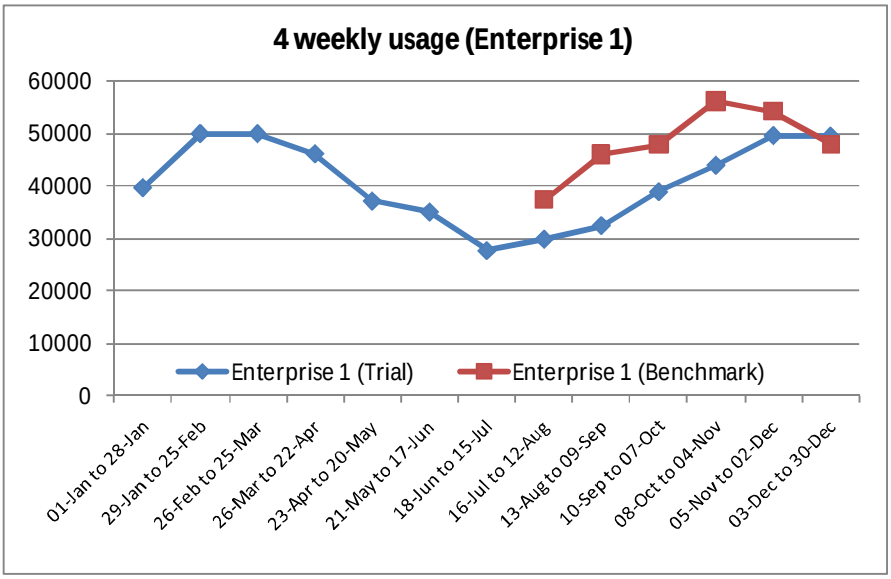

Figure 54: Four Weekly Usage – Enterprise 1

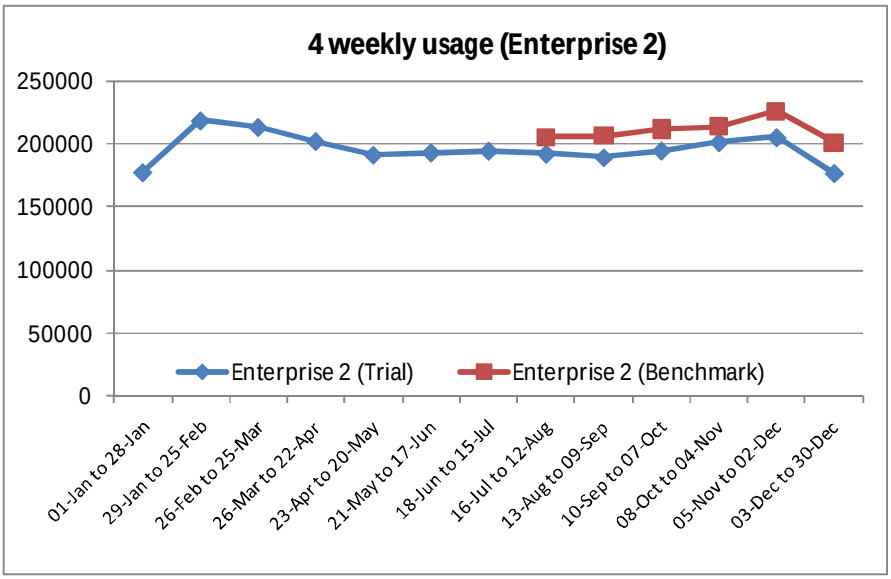

Figure 55: Four Weekly Usage – Enterprise 2

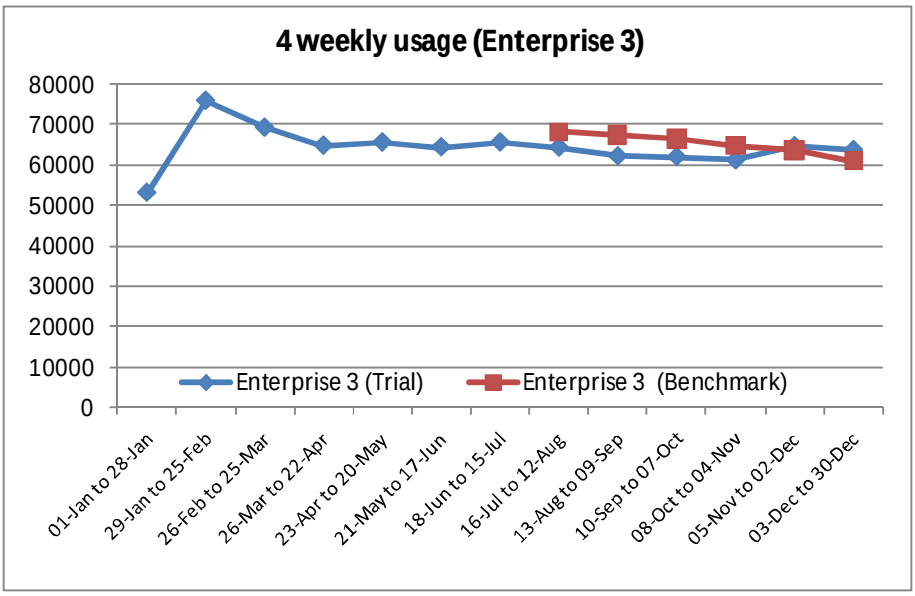

Figure 56: Four Weekly Usage – Enterprise 3

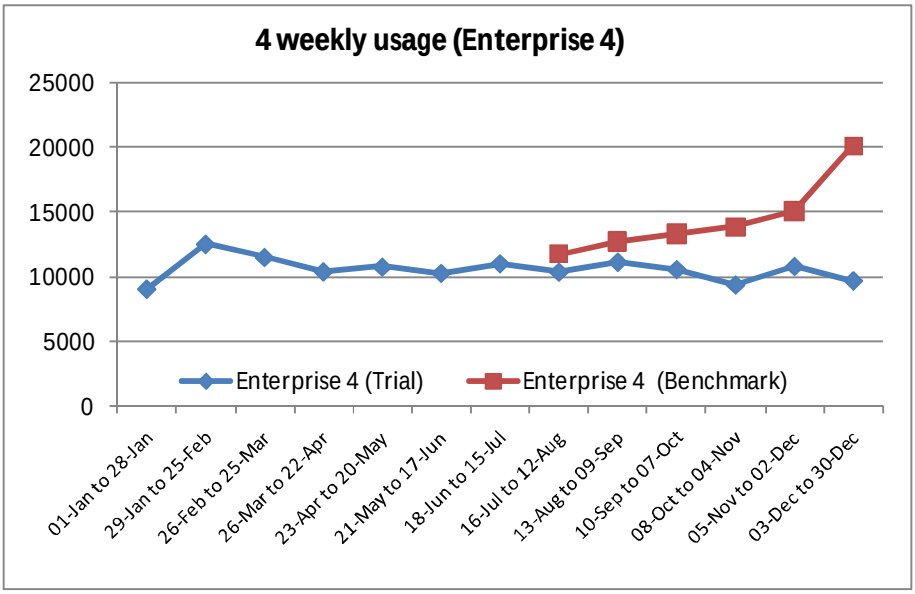

Figure 57: Four Weekly Usage – Enterprise 4

In the case of Enterprise 4, one of their meters showed very significant changes between the Benchmark and Test period, for reasons unrelated to the Trial. It has, therefore, been removed from the calculations.

The central managers highlighted the effectiveness of the information in informing them of changes in usage and the statement was regarded as an efficient way of communicating changes in usage. The on-line option was not as extensively used as the paper option among the trial participants, for reasons related to access and time availability. The on-line option required the central manager to prioritise the task of energy monitoring and set aside time to review the energy usage on-line, whereas the paper copy allowed a more immediate

inspection. In fact the physical existence of the energy statement acted as a reminder to review usage. As with the site managers, this outcome was more pronounced among the more engaged central managers.

In conclusion, the energy usage statement was useful in supporting managers already engaged in energy reduction. It did not of itself promote the required process or behaviour changes required to engage previously unengaged site or central managers.

12.5 Conclusions from the Multi-site Trial

- The established processes operating around energy usage within these organisations focus on budgetary compliance and not cost reduction on an on-going basis. This militates against the effective deployment of smart meters outside of a broader framework of engagement.

- The energy usage statement was an effective stimulus but was constrained by the broader barriers to engagement outlined above: It was most effective for site and central managers already engaged or more open to engagement in electricity usage and review.

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13 Design of the Prepayment Trial

13.1 Introduction

One of the potential benefits of smart metering is the ability to define the smart meter as a debit or a credit meter through the back-end software in the supplier systems. This would make a prepayment option more readily available as a specific prepayment meter would not need to be installed. It would also mean energy supply companies could facilitate similar services to the "Pay-As-You-Go" (PAYG) type pre-payment service currently available in the mobile telecommunications industry. A small scale proof of concept trial of this "thin prepayment" solution was carried out between February 2010 and February 2011. An outline of the trial follows.

The first phase of the trial comprised 35 staff members of Electric Ireland and one CER staff member. This phase, which began in February 2010, trialled the thin prepayment solution before it was offered to Electric Ireland customers in October 2010 (Phase 2). 24 Electric Ireland customers were involved in Phase 2, which was completed in February 2011 for all participants.

An overview of the Trial is as follows:

- Account Balance was calculated daily, inclusive of up to date consumption, received payments, and any debt repayment commitments.
- For the purposes of the trial participating customers were able to query their daily balance by SMS (free text service) or by phone (lo-call number)
- If outstanding credit runs low, reminder messages were issued to the customer to "top-up" their account.
- The "top-up" process consisted of making a payment via any of Electric Ireland's existing payment channels.
- Payments were processed overnight and were reflected in the following day's balance (other than laser payments over the phone/web which are immediate and cheque postal which could take longer).
- As with PAYG mobile phones, failure to maintain credit above agreed level resulted in disconnection, following warnings. This was carried out remotely at a pre-notified time.
- If a customer was disconnected, supply was reconnected remotely once a top-up payment was made and confirmed to Electric Ireland.

See **Appendix 11** for an Overview of the Prepayment Concept.

13.2 Bill Top-Up Design

Participants on the Prepayment Trial were expected to keep their outstanding account balance in credit (inclusive of standing charges, electricity consumption charges and any arrangements for the payment of outstanding debt on their account).

Account balance information

Participants could check their account balance at any time. This was the live balance, including consumption up to midnight the night before and all payments. They were also advised how much they would need to pay to cover arrears and ongoing usage.

Retrieval of the account balance was through the following channels:

1. By texting "ESB Balance" to 50123. A reply text with the account balance was generated. This was a free text facility and participants were not charged.
2. By telephoning a low call number and following the prompts to hear their balance. Both automated account balance information and **c**ustomer service agent assistance were available

Statements

All participants were provided with a final statement outlining usage and payments for the duration of the Trial.

13.3 Data Sources and Flows

Once the consumer opted in to the Trial, ESB Networks installed the new smart meter. This meter returned daily readings similar to the Residential Customer Behaviour Trial. The daily reads and daily payments were uploaded manually to the system and the account balance was calculated daily.

The daily balance was made available to participants by phone (Interactive Voice Response (IVR)) and by text message (SMS). The balance also incorporated any arrangement due for outstanding payment of arrears.

Participants could make payments to Electric Ireland through all the existing payment channels i.e., on-line and billpay.ie, at AIB or Bank of Ireland, by Laser card or an Ulster Bank visa debit card, through the National Contact Centre and at all Paypoint, Payzone, Postpoint and An Post outlets.

An off-line debt management process monitored account balances and compliance with any account arrangements. Accounts found to be in breach of agreed thresholds received a reminder by SMS.

13.4 Prepayment Trial Principles

The Prepayment Trial adhered to the main principles of the De-energisation Code of Practice (see **Appendix 10**).

14 Prepayment Trial Participants

14.1 Participant Distribution and Profile

A total of 60 participants were recruited for the Prepayment Trial. This was made up of 35 staff members of Electric Ireland, one CER staff member and 24 Electric Ireland customers. Customers were selected from a number of groups:

- Group A: those who would ordinarily be offered a token meter as their account was due for de-energisation.
- Group B: those in the early stages of debt recovery
- Group C: those who, for lifestyle reasons, may prefer to use a prepayment option.

For the first three months only staff members used the system. The selected participants commenced using the prepayment option three months later.

14.2 Recruitment Approach and Outcome

A range of recruitment methods was used in the Prepayment Trial i.e.:

14.2.1 Staff Recruitment

Staff members were recruited by means of a general email invitation.

14.2.2 Participant Recruitment

The recruitment approach varied according to their subgroup:

- Group A – those who would otherwise have received a Token Meter were advised that they would receive a prepayment meter and were provided with information on how the process would work.
- Groups B and C – those in early stages of debt, or who might use prepayment for lifestyle reasons were invited to participate by means of an invitation letter.

15 Participant Communication and Involvement

15.1 Introduction

Given the relatively manageable sample in the Prepayment Trial, communications were easily tailored and customised to particular groups. The aim of the communication was to recruit individuals from the different groups and to provide them with details on the prepayment system and how it would work.

15.2 Recruitment Communications

As outlined in 11.2 above, participants in the early stages of debt, or who may use prepayment for lifestyle purposes were recruited through a voluntary "opt-in" approach, using an invitation letter and a follow-up telephone call. ESB staff were recruited by email.

Once they agreed to opt-in, all groups received a letter acknowledging their participation and providing further details on the Trial.

Samples of the invitation and acknowledgement letters are included in **Appendix 12**.

15.3 Account Management Communications

Participants were required to maintain a minimum credit balance on their account of €5 at all times. This value is the same as the emergency credit value currently available to token meter customers

First Reminder

Failure to maintain this minimum balance triggered the first reminder to participants as follows:

> Balance between €5 and €0:
>
> *Msg ESB.Customer Supply[30]. The balance on your acc on <today> is <amount> in credit. As part of the Prepayment User Trial your acc must have a min 5 euro credit. Please Top Up your Acc.*
>
> Balance between €0 and **minus €5**
>
> *Msg from ESB Customer Supply. The balance on your account shows you owe «amount» on «today». As part of the Prepayment User Trial your acc must have a min 5 euro credit. Please Top Up your Acc.*

Second Reminder

[30] As per the decision on the Roadmap for Deregulation (CER/10/058), a criterion for deregulation is the provision of a satisfactory commitment to re-brand. ESB Customer Supply and ESB Independent Energy have now commenced their re-branding process with the launch of their new name, Electric Ireland. As is fitting, the CER will hence with adopt this name in all its publications.

A second reminder issued to participants when their balance was between minus € 5 and minus €25:

> *Msg from (ESB Customer Supply. The balance on your account shows you owe «amount». This amount is due today plus at least €5 to keep your account in credit and avoid disconnection of your supply.*

Final Reminder

The final reminder issued when the account balance reached minus €25 and allowed participants five days to bring their account up to date:

Msg from ESB Customer Supply. The balance on your account shows you owe «amount» <today>. Pay this amount plus at least €5 immediately to return your account to credit and advise us at 1850372372 to avoid disconnection of your supply on <<D/E Date>>.

In the event of no payment, a service order issued to ESB Networks to de-energise the participant.

Communications post de-energisation

Where the customer's supply was de-energised, they received the following text:

> *Msg from ESB Customer Supply. Your electricity supply has been disconnected today. To have your supply restored you must pay «amount>>plus at least 5 euro to return your account to credit and advise us at 1850372372. Reconnection may take 48 Hours*

Once the customer contacted Electric Ireland and payment was confirmed, ESB Networks was requested to re-energise the customer.

16 Outcome of Prepayment Trial

16.1 Focus Group Findings

Feedback on the Prepayment Trial was collected by means of focus groups. Two focus groups were conducted in total and their attendance comprised over 63% of the participants in the Trial. Staff of Electric Ireland or the CER did not participate.

In general participants had a very positive assessment of the Trial. Over 85% declared themselves happy with the concept of prepaying their electricity bill as a result of their experience of participating in the Trial. In addition over 85% indicated that the Trial itself was either helpful or very helpful in helping them pay for their electricity.

16.1.1 Benefits of the Trial

Participants were very clear in articulating the benefits of participation, which revolved around

i) **Bill management** – participants had one less bill to worry about.

ii) **Cumulative bill size** – participants were satisfied that they would not receive a large bill because they were part paying in advance.

iii) **Increased awareness of energy usage** – participants felt more empowered in controlling their usage.

iv) **No estimated bills** – participants felt more in control.

v) **Effective small reminders** – participants felt the benefit of the frequent texts in terms of a payment reminder 'alarm'.

16.1.2 Drawbacks of the Trial

While participants were very clear on the benefits of participating in the Trial, they were equally clear on the drawbacks. The drawbacks related to five areas:

i) **Speed of payment registration**
Post office and online payments typically typically took three days to register with the supplier. This lag created issues as accounts were not real time and as such they were always behind in their payments, notwithstanding the trial objectives being driven by a prepayment imperative.

ii) **Texts arriving post payment registration**
The lag between payment and registration of payment resulted in reminder texts being sent in relation to energy that had already been consumed and paid for but not registered. This caused irritation and in some cases further texts relating to unpaid amounts were

disregarded. This confusion persisted during the Trial. Where participants contacted their supplier this issue was addressed as they were recommended specific payment amounts that would cover current usage and a recommended amount that would compensate for usage arising from the payment lag days.

iii) Consumption monitor/support

Participants highlighted the absence of immediate information on how much energy was being used at a specific point in time. For some a monitor or device to advise on consumption would have been useful. This would have allowed them to budget for their energy bill. While the trial design allowed for participants to text an account balance service, less than 40% used this service.

iv) Relationship between balance and usage

Some participants identified the relationship between account balance and usage as an inhibitor to their successful use of prepayment. Their preference would have been to text in the meter number to receive a real time consumption update as opposed to a balance statement.

v) Dependency on a specific mobile number

Where mobile phones were lost or otherwise unusable text messages were not read and could not be actioned. (Note: This is despite the fact that participants were advised that they could register any number of phones to which messages could be sent.)

16.2 Behaviour changes occurring during the Trial

It is interesting to note that the participants fell into a pattern of fixed payments after the first two weeks. A total of 86% decided to make weekly payments in the range of €15-€30.

Apart from the issue raised regarding texts and the payment lag, the reminder texts were an effective mechanism for motivating payment action. All participants who received texts read them and sought to specifically understand what they were being advised. Over 50% paid on the same day of receiving the text and the remaining participants waited a short period until money became available.

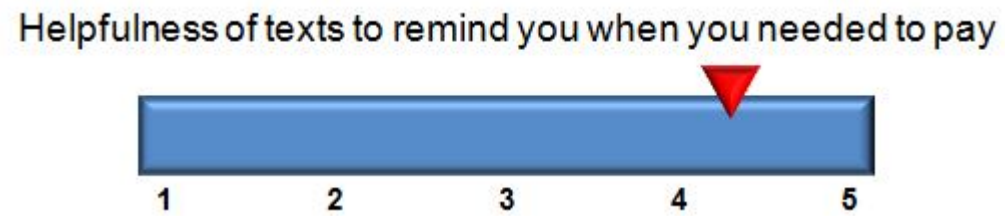

Figure 58: Helpfulness of texts to remind you to pay

No participant indicated that they ignored the text. Two participants reported that they got notification of de-energisation and they actioned the outstanding amount immediately.

50% of participants used the Account Balance texting option regularly. 33% did not use it at all. Over 80% indicated that the prepayment approach was effective in that they were less likely to fall behind in their bill payments.

16.3 Improvements to the Prepayment Trial

Participants asked to suggest improvements to the Prepayment Trial. Apart from the issues associated with reminder texts arriving after payment had been made, the primary improvements suggested related to the on-going effectiveness of prepayment.

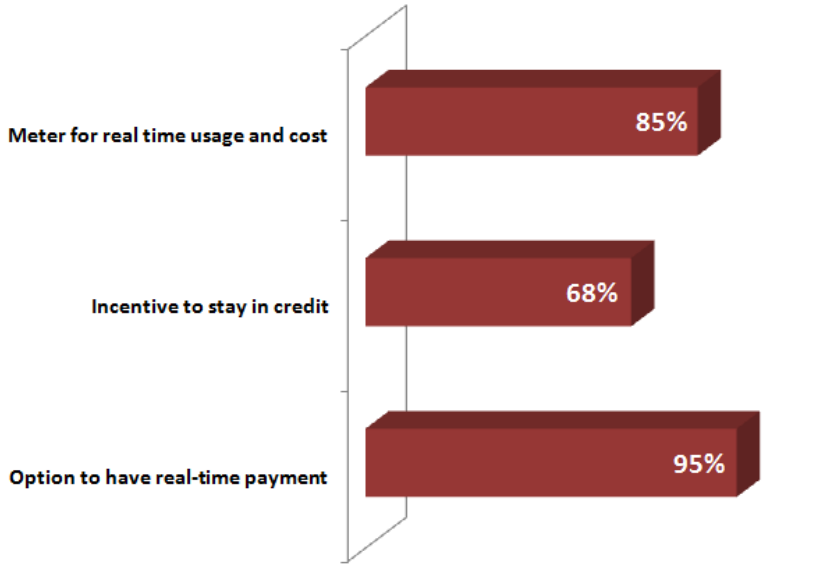

Figure 59: Participant suggestions for improvements to prepayment

Specifically, participants would value real-time payment options, where payments would be immediately credited and texts would relate to late payment or change in credit status. They would also value a meter providing real-time data on their usage and credit status, thus reducing the need for texts and mitigating mobile phone access issues.

Participants felt there were a number of benefits for suppliers from prepayment, including reduction in debt risk and reduced meter reading and contact costs. On this basis, they felt prepayment should be incentivised through a reduced cost per unit, or loyalty scheme.

16.4 Future interest in a prepayment option

Participants were asked if they were offered an option to continue on prepayment, would they avail of that offer. 89% of focus group participants indicated that they would chose the option of remaining in prepayment.

APPENDICES

(Published separately)