Smart Metering Information Paper
Gas Customer Behaviour Trial Findings Report

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Abstract:
The gas smart metering customer behaviour trial (CBT) is among 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 residential gas consumers in Ireland. The gas CBT looked at the measureable reduction in customer demand achievable through the use of smart meters in combination with a number of information stimuli (i.e. detailed billing on a bi-monthly and monthly frequency, in-home displays) and a variable tariff. The gas CBT design, methodology and results are outlined in this report.

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 5 – CER/11/180 – 11 Oct 2011
  - Dual Fuel Smart Metering Technology Trial Findings Report – CER/11/180b – 11th October 2011
  - Gas Smart Metering Cost-Benefit Analysis (CBA) Report – CER/11/180c – 11th October 2011
- Smart Metering Information Paper 4 – CER/11/080 – 16 May 2011
  - Electricity Smart Metering Customer Behaviour Trials (CBT) Findings Report – CER/11/080a – 16th May 2011
  - Electricity Smart Metering Technology Trial Findings Report – CER/11/080b – 16th May 2011
  - Electricity Smart Metering Cost-Benefit Analysis (CBA) Report – CER/11/080c – 16th May 2011
- Smart Metering 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

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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
IHDD	In-home Display Device
SEAI	Sustainable Energy Authority of Ireland
SME	Small and medium enterprise

Executive Summary

Introduction

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

A number of key EU legislative instruments and initiatives promote smart metering, including the Third Package[1] which states: *Member States shall ensure implementation of intelligent metering systems, where roll-out of smart meters is assessed positively, the purpose being to ensure the active participation of customers in the electricity and gas supply market*"

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[2].

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 is managed by the CER and consists of representatives from the Department of Communications, Energy and Natural Resources (DCENR), Sustainable Energy Authority of Ireland (SEAI) and Irish Gas and Electricity Industry Participants There were three distinct strands to Phase 1, the 'exploratory phase', of the Project; technology trials, customer behaviour trials and cost-benefit analyses for the national rollout of electricity and gas smart metering. The reports containing findings from the electricity smart metering customer behaviour and technology trials and cost-benefit analysis were published by the CER in May 2011 (CER/11/080[3]).

The CER is now publishing the findings from the gas smart metering trials and cost-benefit analysis. This Gas CBT Findings document is one of three gas smart metering findings reports and sets out the detail and results of the customer behaviour trials for gas residential and non-daily metered business consumers (SMEs). It is accompanied by the findings reports on the Dual Fuel Technology Trial (CER/11/180b) and the Gas Cost-Benefit Analysis (CER/11/180c). The publication of these reports is a major milestone in the CER's Smart

[1] http://ec.europa.eu/energy/gas_electricity/legislation/third_legislative_package_en.htm
[2] http://www.taoiseach.gov.ie/eng/Publications/Publications_2011/ Programme_for_Government_2011.pdf
[3] CER/11/080 Electricity Smart Metering Cost-Benefit Analysis and Trials Findings Reports
www.cer.ie/en/information-centre-reports-and-publications.aspx?article=5dd4bce4-ebd8-475e-b78d-da24e4ff7339

Metering project and a key deliverable in the completion of Phase 1. The findings from the CBA will 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 more detailed and frequent billing, in-home displays, innovative tariffs and prepayment metering.

The Irish Gas and Electricity CBTs are one of the largest and most statistically robust smart metering behavioural trials conducted internationally to date and thus provide a wealth of insightful information on the impact of smart metering enabled initiatives on gas and electricity consumers. The statistical evidence from the Residential Gas Customer Behaviour Trial is that the deployment of smart metering enabled Demand Side Management stimuli results in a reduction in overall gas consumption. A summary of the Gas CBT and its key findings follows.

The Customer Behaviour Trial

Pilot Objectives

The overall objective of the Customer Behaviour Trial was to ascertain the potential for smart metering technology, when combined with different demand side management stimuli, to effect measurable change in consumer behaviour in terms of reductions in overall gas use.

Duration of the Residential and SME and Customer Behaviour Trials

The Residential Customer Behaviour Trial had two distinct periods:

a) **The Benchmark period** - 1st December 2009 to 31st May 2010. 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 allocated to a test or control group at the end of the benchmark measurement (see **Table 1** below).

b) **The Test period** - 1st June 2010 to 31st May 2011. During the test period participants trialled different demand side management stimuli (see *Demand Side Management Stimuli* below).

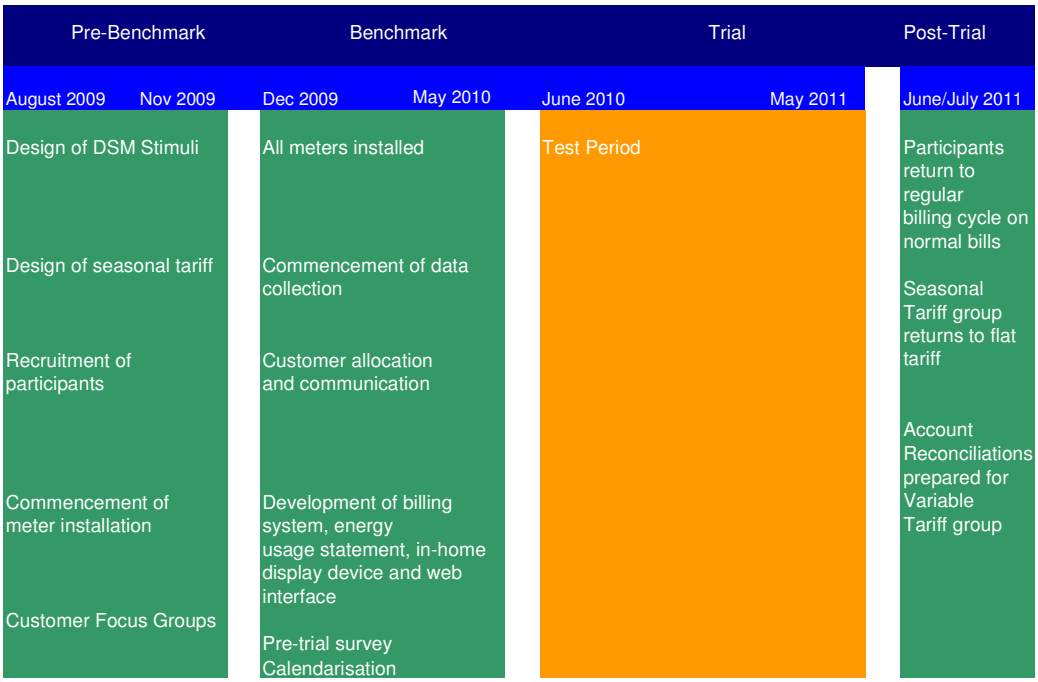


Figure 1: Gas Customer Behaviour Trial Timeline

The SME trial commenced on 1st August 2010 and continued to 31st May 2011. It followed a continuous monitoring approach where participants were provided with information through the Smart Meter User Trial Gas Web interface with a view to assessing whether smart meters helped them reduce their usage. Consistent with the more qualitative self assessment of

reduction, the SME trial structure focused on start and end of trial interviews as well as usage monitoring. There was no specific benchmark or test period and there was no control group established.

Residential Trial Test and Control Groups

At the end of the benchmark period participants in the Residential Trial were divided into test and control groups. The test groups were asked to trial different DSM stimuli. The control group was billed on their normal gas supplier tariff and saw no changes to their bill. They received none of the DSM stimuli and were requested to continue using their gas as normal.

Customer Research

Research into gas 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:

- Focus groups with non-Trial participants in order to assist in design of communications and the energy usage statement.
- 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 June/July 2011, comparing change in attitude, equipment or gas use to the pre-trial findings.
- Non-response survey of those who chose not to respond to the invitation letter and of those who left the Trial for various reasons.
- Attrition survey of those who left the trial after allocation.

Participants in the Residential pre- and post-trial survey received a thank you payment of €25 for each survey (credited to their bill in May 2010 and August 2011).

The Residential Customer Behaviour Trial

The optimal sample size for the Trial was determined to be 1,927 participants. Allowing for attrition during the Trial, 1,892 were still in the Trial when allocation was completed in April 2010.

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 were 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. In addition, the profile of those who had accepted the invitation to participate was compared with the sample of Bord Gáis Energy customers of 50,000, from which the invitation list was drawn.

Participant selection and recruitment followed a voluntary "opt-in" model using a tear off slip and achieved an average response rate of 25%.

Demand Side Management (DSM) Stimuli

The demand side management stimuli were specifically developed for use in the Customer Behaviour Trial. Different combinations were trialled across four groups. These may be summarised as follows:

1. A bi-monthly bill, combined with a detailed energy statement
2. A monthly bill, combined with a detailed energy statement
3. A bi-monthly bill, combined with a detailed energy statement and an in-home display device
4. A bi-monthly bill, combined with a detailed energy statement, an in-home display device and a variable tariff

Design of the Variable Tariff

One of the DSM stimuli groups was asked to test a variable tariff during the Customer Behaviour Trial. The following principles were used in the design of the tariff to ensure that the key objectives of cost neutrality and cost reflectivity were achieved:

- The variable tariff would be neutral in comparison with the standard Bord Gáis Energy tariff (3.932c per unit excluding VAT) to ensure that the "average" participant who did not alter their gas consumption pattern was not penalised financially.
- The tariff transmission and distribution elements would be left unaltered, including the standard element of the charge.
- All other components of the tariff would be shaped seasonally to match the seasonal wholesale cost of procuring gas.
- Tariffs would be based on the cost inputs used in the 2009/10 regulated tariffs.

The structure of the variable tariff was as follows:

Residential Variable Tariff

	June/July Cents per kWh	Aug/Sept Cents per kWh	Oct/Nov Cents per kWh	Dec/Jan Cents per kWh	Feb/Mar Cents per kWh	Apr/May Cents per kWh
Unit Rate excl. VAT	3.3c	3.3c	3.8c	4.6c	3.9c	3.4c

Table 1: Residential variable tariff 1st June 2010 to 31st May 2011[4]

Note: The standard Bord Gáis Energy tariff at the time was 3.932c per unit excluding VAT

Balancing Credit

Throughout the Trial all participants testing the variable tariff were guaranteed that they would not pay more for their gas than if they had been on the normal Bord Gáis Energy tariff (3.932c per unit ex VAT). Accordingly, all participants received a *balancing credit* of €15 at the end of the benchmark period. Any individuals who incurred costs above this average were recompensed on a case by case basis.

Allocation to Groups in the Residential Trial

At the end of the benchmark period Residential trial 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 in-home display	Bi-monthly bill, energy usage statement, in-home display and variable tariff	Total
Existing Tariff	303	303	303	-	909
New Tariff	-	-	-	302	302
Control Group					681
	303	**303**	**303**	**302**	**1,892**

Table 2: Residential Matrix allocation as of 30th April 2010

[4] Reference CER approved BGES tariff submission: http://www.cer.ie/en/gas-retail-market-current-consultations_.aspx?article=070739a1-d5cc-49ad-a1a8-a190f81b5d07

Residential Customer Behaviour Trial Findings

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

Response stimuli

- The deployment of stimuli was found to reduce overall gas consumption by a statistically significant 2.9%.
- Each of the four stimuli combinations tested was found to reduce usage by a statistically significant amount, although no individual stimulus was significant over the others.

		Bi-monthly bill and energy usage statement (Stimulus 1) %	Monthly bill and energy usage statement (Stimulus 2) %	Bi-monthly bill , energy usage statement and IHDD (Stimulus 3) %	Bi-monthly bill, energy usage statement, IHDD and Variable tariff (Stimulus 4) %
Overall	**-2.9***	**-2.2%***	**-2.8%***	**-2.9%***	**-3.6%***
* denotes results statistically significantly different from control group using a 90% confidence level.					

Table 3: Overall Gas Usage reduction by Stimulus group compared with Control group

- The combination of bi-monthly bill, energy usage statement, IHDD and variable tariff led to the greatest reduction of 3.6% although this was not statistically different from the reduction achieved by the groups exposed to other stimuli combinations.
- The greatest volume reduction occurred during the High Usage period (from October to March inclusive) and this accounted for 70% of the overall reduction reported. The reduction during the Low Usage period (from April to September inclusive) is not insignificant as it accounts for 30% of the overall volume reduction.
- Participants allocated to Stimulus 4 (the variable tariff) responded to the price signal by concentrating their reduction during the period of highest prices (from December to March) as well as achieving the greatest overall reduction in usage.

Demographic, behavioural and experiential conclusions

- The Trial had a positive impact on increased awareness of gas usage with 74% reporting that they became more aware of gas usage and the cost of gas they used (77%).
- Changes adopted were supportive of the objective of reducing overall energy consumption.
- The levels of reported substitution of other heating sources were measured at 36%; 64% reported no increased use of the other heating sources.

- The usage statements were reasonably effective with 57% stating it helped them to reduce the amount of gas they used. The frequency of the statement (monthly or bi-monthly) was acceptable to most participants.
- The In-home display device was reasonably effective with 62% stating it helped them reduce their gas usage and 75% stating that they still used the IHDD at the end of the Trial. Text messages sent to the IHDD were effective for those who recalled receiving the message. However only 15% recalled the messages.
- Most participants (87%) engaged in behaviour change reporting that they made some change to the way they used gas due to the Trial.
- The variable tariff (while achieving the greatest volume reduction) was not understood by most participants (57% were aware that the tariff varied and over 90% of participants were not able to provide any estimate of the unit costs).

The SME Customer Behaviour Trial

The overall sample size for the SME Customer Behaviour Trial was specified at 50 participants and covered six combined sectors to include Restaurants/pubs/take-aways, Government buildings, Leisure/Hotels/Spa's, Healthcare, Education and Industrial with an emphasis on process load and space heating. The objective of the recruitment was to spread the available meter number (50) across the diverse gas usage industry sectors and to cover different SME usage levels. A total of 58 SME's had smart meters installed, with 53 still participating at the end of the Trial on 31st May 2011.

The structure of the Gas CBT focused on gaining an understanding of the use of the identified stimulus (ie. Web interface) by the SME participants. In contrast to the Residential CBT, which followed an experimental design approach, the SME Trial adopted a more qualitative approach. This was because early analysis indicated that in order to apply an experimental design approach to the measurement of the impact of the stimulus on energy reduction by the SME's a very large sample number would be required, particularly if a precision level of 3% reduction was to be identified. This is due to the variability in gas usage at sector level and by size of enterprise. As a result the alternative option of adopting a more qualitative approach, which would require a smaller number of companies whilst providing coverage of the larger sectors, was chosen.

Recruitment of Participants

The SME trial comprised a study of over 50 single and multi-site gas consumers with more than 73,000 kWh annual consumption. It was based on the selection of certain sectors and the classification of companies into three usage criteria.

Participants were drawn from the customer base of Bord Gáis Energy Supply. Recruitment was by means of telephone calls, followed by an acknowledgement letter.

Web Interface

A web interface was developed specifically for use in the Customer Behaviour Trial.

Test Group

All participants were allocated to the stimulus group in line with the approach adopted. There was no control group, as the focus was on achieving a qualitative understanding impact of exposure to the stimulus as opposed to testing the impact of exposure to the stimulus:

	Bi-monthly Bill and Web Access	
Test Group	50	50
Control Group	N/A	N/A
	Total	**50**

Table 4: SME Matrix allocation as of August 1st 2010

SME Customer Behaviour Trial Findings

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

Empirical, behavioural and experiential conclusions

- 48% of participating SMEs reported reduced gas usage during the Trial with a typical estimated reduction of between 5% and 10%.
- A majority of respondents to the SME post-trial survey stated that participation in the Trial increased their organisation's awareness of the cost of natural gas used (74% as shown in **Figure 42**) and increased their organisation's awareness of where gas is used (70%).
- Participation in the Trial led to reviews of natural gas usage (61%), identification of easy to implement changes (61%) and investment in more energy efficient equipment (52%). It also led to increases in the level of energy audits, introduction of monitoring and tracking and assignment of responsibility for energy usage monitoring.
- Most impacts of the Trial were not specific to any sector and not related to level of consumption.

Response Web interface stimulus

- The Web interface was used by 45% of participants who assessed it as simple to use (82% of users) and provided the right amount of information (73%).
- The Web interface was considered effective in helping actual reduction in natural gas usage by 36%. In contrast, a further 36% also stated it was not effective. This

suggests that the web interface is not sufficient to drive reduction without other interventions.

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 gas customer behaviour trial conducted in Ireland is one of the largest and most statistically robust gas 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 gas 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.
- Bord Gáis Networks implemented and maintained the smart metering systems (meters, communications technology and back-end systems), in-home display devices and the SME web interface.
- Bord Gáis Energy recruited customers to the Residential and SME trials, devised a variable tariff in conjunction with the CER, delivered customer communications, provided customer support and produced detailed energy usage statements.
- Airtricity, Electric Ireland, Energia and Vayu which contributed to the scope and design discussions relating to the gas customer behaviour 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 managed the individual meter level data streams, provided group level aggregate summaries of consumption data , developed the methodology for the treatment of missing 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.

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 Gas Customer Behaviour Trial (CBT, or "The Trial), which formed a key part of Phase 1 of the CER Smart Metering Project. The CBT covered gas smart metering for residential and business consumers (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 gas consumers.

The findings from the CBT provide a rich source of information which will be used to inform energy policy decisions in Ireland relating to gas smart metering enabled initiatives such as more detailed and frequent billing, gas in-home display devices, variable tariffs and prepayment metering. The CBT drew upon a representative sample of Irish gas residential 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 residential 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 met 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."[5]

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.

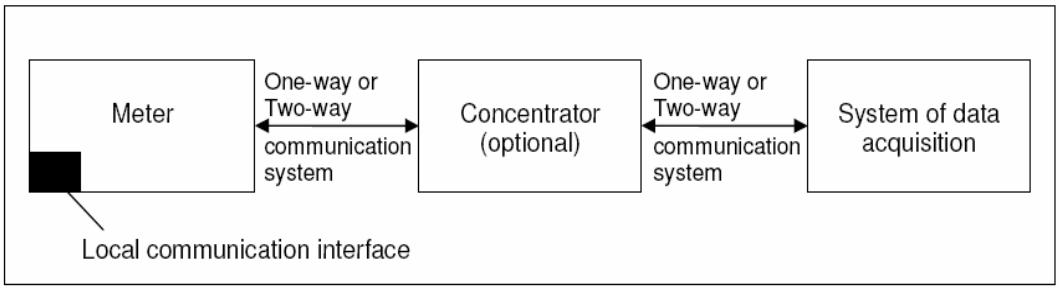


Figure 2: General structure of a smart metering system (Source: Figure 6, ERGEG Status Review of Regulatory Aspects of Smart Metering[6])

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.

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

[5] 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

[6] 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

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 consumers' 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 consumers. Access to this information provides opportunities to reduce network operation costs, including reduced costs of visiting customer premises to manually read the meter and potentially, subject to safety requirements, carrying out any necessary connections and disconnections. There are also savings due to reductions in system losses.

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 consumers to manage their consumption of electricity in line with price movements and demand patterns. Innovative variable tariff arrangements may also be facilitated for gas consumers.

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 [7]

The Third Package contains provisions regarding intelligent metering systems, with the aim of providing consumers with better information on their consumption and helping to increase awareness of energy consumption. The implementation of these metering systems may be subject to an economic assessment of all the long-term costs and benefits to the market and the individual consumer. It may also assess which form of intelligent metering is economically reasonable and cost-effective and which timeframe is feasible for their installation.

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

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) [8]

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 for the implementation of intelligent metering systems.

ii) Proposed Energy Efficiency Directive[9]

On 22 June 2011 the European Commission adopted a proposal for an Energy Efficiency Directive to establish a common framework for the promotion of energy efficiency across the EU; ensure the achievement of the Union's target of 20% primary energy savings by 2020; and pave the way towards the realisation of further energy efficiency beyond that date.

[8] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0072:EN:NOT
[9] EC Proposal for new Energy Efficiency Directive
http://ec.europa.eu/energy/efficiency/eed/eed_en.htm

The Directive on Energy Efficiency will amend and subsequently repeal the Cogeneration Directive (2004/8/EC, CHP Directive) and the Energy Services Directive (2006/32/EC, ESD)[10]. Given the assessment that the Union is unlikely to achieve its energy efficiency target of 20% primary energy savings by 2020 based on the current policy mix, the Commission is proposing to take a much firmer line with Member States. While there are no binding targets in the draft there are a number of binding measures

The European Commission's proposal for a Directive on Energy Efficiency (COM(2011)370) has direct implications for the activities of regulators, who have to ensure that customer interests are always taken into account and that competition is not distorted. The Energy Efficiency Directive covers a range of areas including; Energy Efficiency Obligation Schemes (Article 6), Metering and informative billing (Article 8), Promotion of efficiency in heating and cooling (Article 10) and Energy Transmission and Distribution (Article 12).

iii) Directive 2005/89/EC – Security of Supply[11]

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.

iv) Directive 2004/22/EC - Measuring Instruments[12]

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

[10] 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

[11] 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

[12] 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

Metering for Electricity and Gas (E10-RMF-23-03)[13]. 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**[14] 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 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)[15] 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 concluded in June 2011 and the deliverables are published on www.openmeter.com.
- In January 2010 a **Task Force on Smart Grids**[16] 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.

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[17] 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

[13] 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

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

[15] 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

[16] Smart Grids Task Force http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm

[17] 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

survey, as of 1st January 2011 eleven had completed an electricity CBA and six had completed a gas CBA.

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 5: Status of Smart Metering CBA Development in EU Member States
(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[18] 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 of the national situations.

- 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, Norway, Finland and, most recently, France. 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.

[18] 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

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.

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**[19]. 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)**[20] 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".*

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

[19] www.attorneygeneral.ie/esi/2009/B27331.pdf
[20] Chapter 07 – Residential Sector, Page 79
www.dcenr.gov.ie/Energy/Energy+Efficiency+and+Affordability+Division/National+Energy+Efficiency+Action+Plan.htm

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)*[21] 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)*[22], 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.

Figure 3: Smart Metering Project Phase 1 – Overview of Participants

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

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

To achieve its objectives the Smart Metering Working Group was divided into four Workstreams each focusing on separate aspects of the Smart Metering Project Phase 1 (Figures 4 and 5 below):

- **Networks**: Technical design and rollout of smart metering infrastructure required for the technology trials and customer behavior trials.
  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 for the customer behavior trials (time of use tariffs for electricity and a variable seasonal tariff for gas) and development of a Prepayment Trial.
  Lead: Electric Ireland.

- **Billing / Data:** Mainly focusing on data flows from the smart metering systems to Suppliers, for customer behaviour trial billing options, and statisticians, for analysis of results from the customer behavior trials.
  Lead: Bord Gáis Energy.

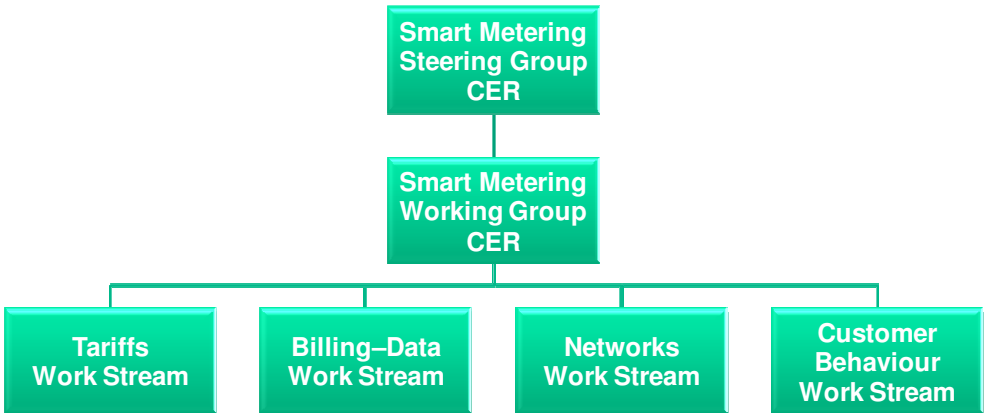


Figure 4: Smart Metering Project Phase 1 – Governance Structure

The CER was responsible for undertaking Smart Metering Cost-Benefit Analyses (CBAs) for national electricity and gas smart metering rollouts and worked with Frontier Economics and 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

(Electricity CBA) and Frontier Economics (Gas CBA) for their modelling. The CER also arranged for an independent review of the supplier and network operator cost and benefits included in the CBAs, which was conducted by Frontier Economics for both the electricity and gas CBAs. A peer review of the gas CBA was conducted by the ESRI.

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

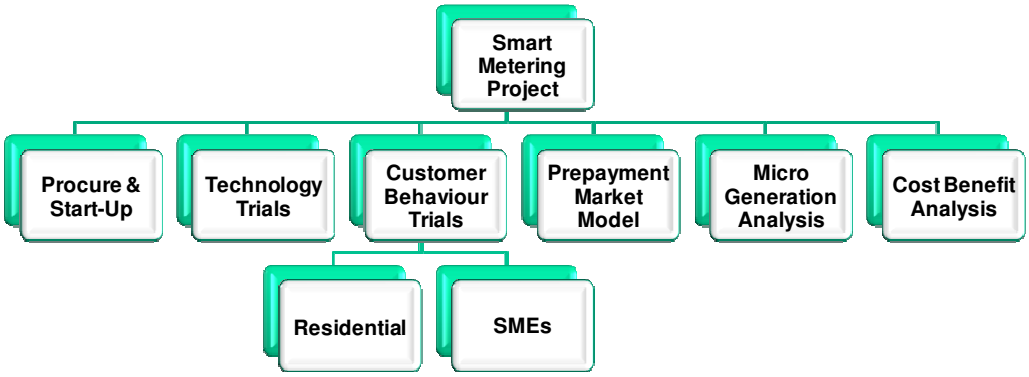


Figure 5: Key deliverables of the Smart Metering Project Phase 1

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 customer behaviour trials (CBT) for residential and SME customers in December 2010 and completion of associated analysis and reporting in April 2011, the detailed report of which was published in May 2011 (CER/11/080a).
- Completion of the electricity technology trials in September 2010, the detailed report of which was published in May 2011 (CER/11/080b).
- Completion of the 'smart prepayment' trial in February 2011, the findings of which are included in the electricity CBT report (CER/11/080a).
- Completion of the electricity cost-benefit analysis in April 2011, the detailed report of which was published in May 2011 (CER/11/080c).
- Completion of the gas customer behaviour trials (CBT) for residential and SME customers in May 2011 and completion of associated analysis and reporting in September 2011, the detailed report of which is published alongside this CBA (CER/11/180a).
- Completion of the dual fuel technology trials in May 2011, the detailed report of which is published alongside this CBA (CER/11/180b).
- Completion of the gas cost-benefit analysis in September 2011, the subject of this report (CER/11/180c).

Further detailed information on the CER Smart Metering Project and its progress to date is available via the consultation papers and information papers that have been published on www.cer.ie/en/information-centre-reports-and-publications.aspx.

- Smart Metering Information Paper 5 – CER/11/180 – 11 October 2011
  - Gas Smart Metering Customer Behaviour Trial (CBT) Findings Report – CER/11/180a – 11th October 2011
  - Dual Fuel Smart Metering Technology Trial Findings Report – CER/11/180b – 11th October 2011
  - Gas Smart Metering Cost-Benefit Analysis (CBA) Report – CER/11/180c – 11th October 2011
- Smart Metering Information Paper 4 – CER/11/080 – 16 May 2011
  - Electricity Smart Metering Customer Behaviour Trials (CBT) Findings Report – CER/11/080a – 16th May 2011
  - Electricity Smart Metering Technology Trial Findings Report – CER/11/080b – 16th May 2011
  - Electricity Smart Metering Cost-Benefit Analysis (CBA) Report – CER/11/080c – 16th May 2011
- Smart Metering 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
- Other Smart Metering Information Papers:
  - Information Paper 3 - CER/09/186 - 7th December 2009
  - Information Paper 2 - CER/09/118 - 31st July 2009
  - Information Paper 1 - CER/09/024 - 6th February 2009

Other CER publications at this same Website location relating to smart metering which may be of interest are:

- Approved Smart Metering CBTs Gas Tariff – published 1st April 2010
- Approved Smart Metering CBTs Electricity Time of Use (TOU) Tariffs – original published 2nd October 2009 and renewed 7th September 2010
- Arrangements for Micro Generation Decision and Response to Comments Received (CER/07/208) – 20th Nov 2007
- Smart Metering - The Next Step in Implementation (CER/07/198) – 5th Nov 2007
- Demand Side Management and Smart Metering Consultation Paper (CER/07/038) - March 2007

1.4 Structure of this paper

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

- **Sections 2.0 to 7.0** outline the detail of the Residential Gas CBT, its design and outcomes
- **Sections 8.0 to 11.0** outline the details of the SME Gas CBT, its design and outcomes
- **Appendices 1 to 8** provide more detail on the design, implementation and outcomes of the Customer Behaviour Trial.
- **Appendices 9 and 10** contain details of communications which issued during the Trial.

1.5 Commenting on this paper

This report is for provided as an information source on the Gas 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 Gas Customer Behaviour Trial – Residential

2.1 Introduction

The Gas Customer Behaviour Trial (CBT) was split into a large experimental trial for residential consumers and a small experiential trial for small-to-medium enterprises (SMEs). Sections 2 to 7 focus on describing the Residential Trial while the SME Trial is described later in Sections 8 to 11.

The Residential Trial was designed on an experimental basis in order to allow for the collection of statistically robust findings that could be extrapolated to national smart metering rollout scenarios and thus provide inputs to the gas smart metering cost-benefit analysis. The Trial was structured to compare ratios of gas consumption for test and control group participants before and after the introduction of smart metering related stimuli. The Trial thus had two distinct periods:

a) **The Benchmark period** - 1st December 2009 to 31st May 2010. 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 June 2010 to 31st May 2011. During the test period participants were in either a test group (i.e., each group tested a different demand side management (DSM) stimulus) 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 in-home display device.

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 different DSM stimuli, to effect measurable change in consumer behaviour in terms of reduction in overall gas use.

3 Design of the Residential Trial

3.1 Introduction

The Residential Gas Customer Behaviour Trial aimed to measure consumer response (behaviour change) to a range of demand side management (DSM) stimuli over the period of the Trial.

The DSM stimuli were:

1. A bi-monthly bill, combined with a detailed energy usage statement
2. A monthly bill, combined with a detailed energy usage statement
3. A bi-monthly bill, combined with a detailed energy usage statement and an in-home display device
4. A bi-monthly bill, combined with a detailed energy usage statement, an in-home display device and a variable tariff

Further details are included in Chapters 3 to 7.

3.2 Trial Matrix

The optimal sample size for the Trial was determined to be 1,927 participants, allowing for a 35% attrition (fallout) rate. An opt-in approach was used by Bord Gáis Energy to recruit participants. As Bord Gáis Energy represented approximately 98% of the residential gas market (by number of customers) at that time (mid 2009), this was representative of the population of gas users eligible to participate in the Trial (see para 4.3. below). At the start of the benchmark period, the total number still participating with meters installed was 1,892. The main reasons for participant attrition during the Trial were changes of tenancy and change of supplier, which comprised (84% of the fallout cases).

Tariff	Bi-monthly bill and energy usage statement	Monthly bill, and energy usage statement	Bi-monthly bill, energy usage statement and IHDD	Bi-monthly bill, energy usage statement, IHDD and variable tariff	Total
Existing Tariff	303	303	303	-	909
New Tariff	-	-	-	302	302
	303	**303**	**303**	**302**	**1,211**
Control Group					681
					1,892

Table 6: Residential Matrix allocation as of 17 June 2010

3.3 Stimulus Design and Development

All of the DSM stimuli in the Customer Behaviour Trial (the variable tariff, the energy usage statement and the in-home display device) were designed specifically for the Trial using learnings from other international trials, the electricity smart meter trial and consumer feedback. The DSM stimuli were initially developed by the Customer Behaviour Workstream Group based on their combined experience in the gas and electricity industry and using learnings from international trials. Consideration was also given to the requirements of the EU Directive EC 2006/32[23] 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 consumers and more frequent billing.

3.3.1 Consumer Involvement in the Design of DSM Stimuli

Based on these inputs and considerations, draft layouts for the energy statement 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:

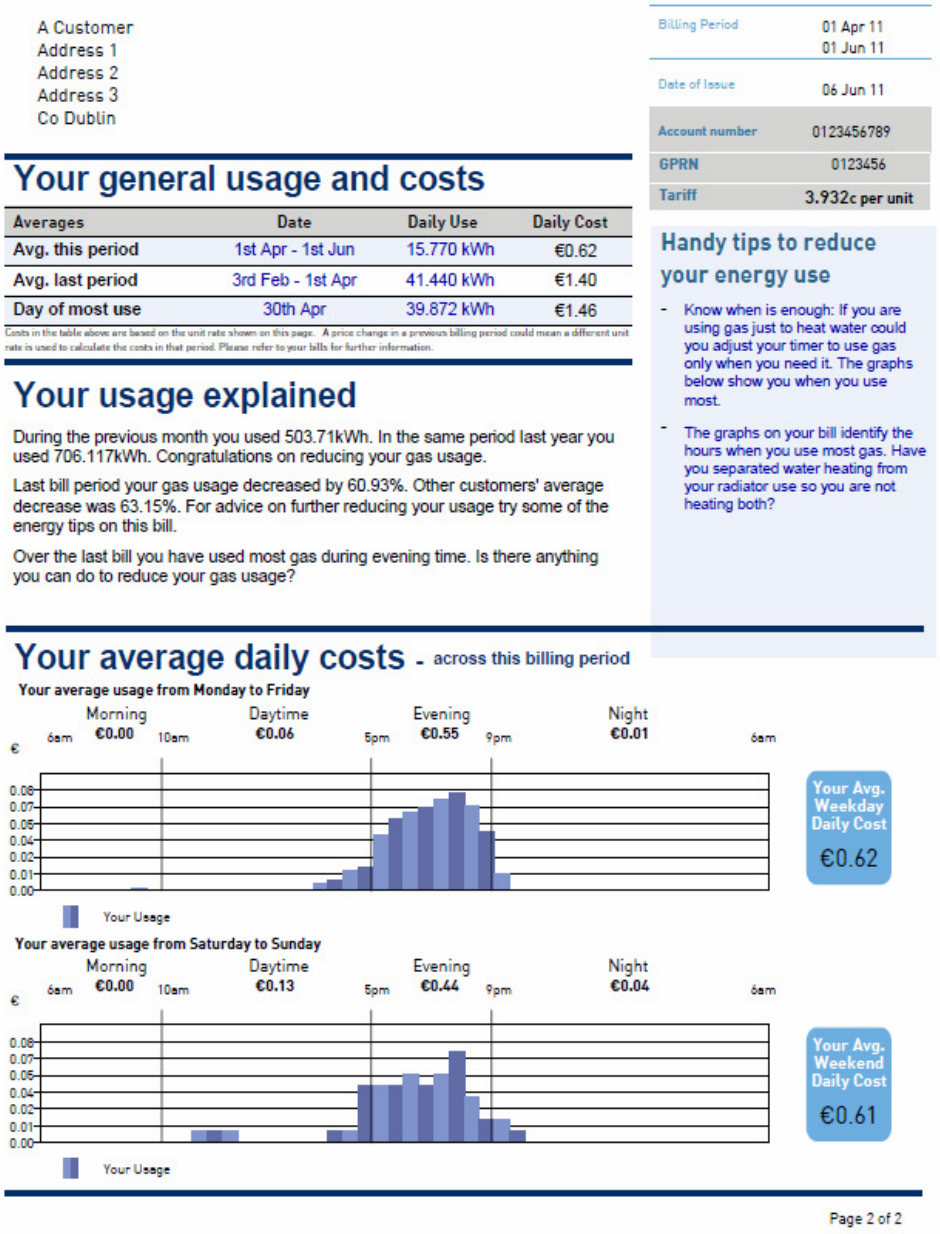
- Introduction of variable pricing
- Calculations across different billing periods
- Tracking historical use against current performance
- Tracking of savings against previous performance

[23] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0064:0064:en:pdf

Following these focus groups the design of the energy usage statement was finalised. Further details on this research are contained in **Appendix 5**, Outcome of Focus Groups conducted during the Customer Behaviour Trial.

3.3.2 Energy Usage Statement Bi-Monthly

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



A Customer
Address 1
Address 2
Address 3
Co Dublin

Billing Period	01 Apr 11 01 Jun 11
Date of Issue	06 Jun 11
Account number	0123456789
GPRN	0123456
Tariff	3.932c per unit

Your general usage and costs

Averages	Date	Daily Use	Daily Cost
Avg. this period	1st Apr - 1st Jun	15.770 kWh	€0.62
Avg. last period	3rd Feb - 1st Apr	41.440 kWh	€1.40
Day of most use	30th Apr	39.872 kWh	€1.46

Costs in the table above are based on the unit rate shown on this page. A price change in a previous billing period could mean a different unit rate is used to calculate the costs in that period. Please refer to your bills for further information.

Your usage explained

During the previous month you used 503.71kWh. In the same period last year you used 706.117kWh. Congratulations on reducing your gas usage.

Last bill period your gas usage decreased by 60.93%. Other customers' average decrease was 63.15%. For advice on further reducing your usage try some of the energy tips on this bill.

Over the last bill you have used most gas during evening time. Is there anything you can do to reduce your gas usage?

Handy tips to reduce your energy use

- Know when is enough: If you are using gas just to heat water could you adjust your timer to use gas only when you need it. The graphs below show you when you use most.
- The graphs on your bill identify the hours when you use most gas. Have you separated water heating from your radiator use so you are not heating both?

Your average daily costs - across this billing period

Your average usage from Monday to Friday

Morning €0.00 | Daytime €0.06 | Evening €0.55 | Night €0.01

Your Avg. Weekday Daily Cost €0.62

Your Usage

Your average usage from Saturday to Sunday

Morning €0.00 | Daytime €0.13 | Evening €0.44 | Night €0.04

Your Avg. Weekend Daily Cost €0.61

Your Usage

Page 2 of 2

Figure 6: 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 (see 3.4 below) in the course of the Trial, the payment date changed for some of this group.

3.3.3 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.

3.3.4 In-home Display Device

The in-home display device was adapted for the User Trial by Bord Gáis Networks and members of the Customer Behaviour Workstream Group.

Its aim was to help consumers become more energy efficient by providing additional information on how much gas they were using and how much it was costing. At any stage consumers could quickly see how much gas they were using at a point in time, over the previous month, as well as how much it cost.

Figure 7: In-Home Display Device

3.3.5 Tariff Design and Development

The installation of smart meters allows gas suppliers to create innovative pricing, such as variable tariffs, which can be offered to consumers to support the efficient use of gas. This allows consumers to manage their use of gas in line with price movements and demand patterns.

A new variable tariff was developed for the Customer Behaviour Trial. This tariff changed with each bill with the highest tariff in the winter and the lowest in the summer. Its purpose was to test how a variable tariff, based on seasonality in combination with other stimuli might help in reducing gas demand.

The following principles were used in the design of the variable tariff to ensure that the key objectives of cost neutrality and cost reflectivity were achieved:

- The variable tariff would be neutral in comparison with the standard Bord Gáis Energy tariff (3.932c per unit excluding VAT) to ensure that the "average" participant who did not alter their gas consumption pattern was not penalised financially.

- The tariff transmission and distribution elements would be left unaltered, including the standard element of the charge.
- All other components of the tariff would be shaped seasonally to match the seasonal wholesale cost of procuring gas.
- Tariffs would be based on the cost inputs used in the 2009/10 regulated tariffs.

The methodology and principles used in calculating the tariff prices for the User Trial were developed by Bord Gáis Energy in conjunction with the CER and the gas industry at the smart metering tariff forums. The final agreed variable tariff was approved by the CER on 1st April 2010[24].

The final variable tariff, which applied from 1st June 2010 to 31st May 2011 was:

3.3.5.1 Residential Variable Tariff

	June/July Cents per kWh	Aug/Sept Cents per kWh	Oct/Nov Cents per kWh	Dec/Jan Cents per kWh	Feb/Mar Cents per kWh	Apr/May Cents per kWh
Unit Rate excl. VAT	3.3c	3.3c	3.8c	4.6c	3.9c	3.4c

Table 7: Residential Variable tariff 1st June 2010 to 31st May 2011

3.3.5.2 Balancing Credit

Throughout the Trial all participants testing the variable tariff were guaranteed that they would not pay more for their gas than if they had been on the normal Bord Gáis Energy tariff (3.932c per unit ex VAT). Based on analysis of participants' past usage the potential cost of gas over the Trial was estimated. This provided the basis for an average *balancing* credit of €15 to all participants in this stimulus regardless of whether they used less or more than the average. The small number of individuals who incurred costs above the average were recompensed on a case by case basis.

It should be noted that the estimate of the average balancing credit was calculated in advance independent of smart meter data. It did not seek to predict the bill impact of smart meters, nor could it predict how behaviour might change with the introduction of the variable tariff and other DSM stimuli.

[24] CER approved BGES tariff submission: http://www.cer.ie/en/gas-retail-market-current-consultations_.aspx?article=070739a1-d5cc-49ad-a1a8-a190f81b5d07

To control for any impact the receipt of this credit may have had on behaviour, it was made outside of the test period i.e., in May 2010.

3.4 Calendarisation of Billing

In order to assist in comparability, a decision was made to place all participants in the Trial 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 December 2009 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 during the User Trial related only to Trial usage. The change to calendarisation also meant payment due dates changed for some participants. Further details on the calendarisation decision are provided in **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 gas consumer population, the recruitment process was phased. After each phase the respondents who opted in were profiled to confirm that they were representative of the national gas consumer profile. When deviations were observed during the process, for instance higher proportions of respondents in particular geographical areas, the subsequent waves were adjusted to correct for this effect.

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 (e.g. related to the trial stimuli) or co-incidental (e.g. opted out or changed supplier). If the former was true, this would require detailed consideration as part of the attrition survey and would have had to been addressed with specific and detailed questions in the post trial survey. The reasons for attrition included change of supplier and change 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 (see **Appendix 10**). 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 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.

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 each 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 recruitment framework developed for the Trial attempted to maximise the representivity of the participants 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 four waves of invitations issued.

4.2.1 Exclusions from the Residential Trial

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

- Participation was limited to customers of Bord Gáis Energy: As Bord Gáis Energy represented approximately 98% of the residential gas market (by number of customers) at the time of recruitment, this limitation did not impact on the representivity of the Trial. During the Trial some attrition occurred. 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 were on a prepay basis, who were flagged as vulnerable (see 7.7.5 below), or who had unresolved complaints.
- Consumers where the billing address did not match the residential address, or who had more than one account were excluded.
- Staff of Bord Gáis Energy were not included.
- Consumers classified by Bord Gáis Energy to be in arrears or liable to disconnection were also excluded – this impacted on <1 % of the total eligible population
- Finally those having usage totalling more than 73,000 kWh annual consumption and those consuming less than 1,000 kWh were excluded. Premises with gas usage greater than 73,000 kWh overlap with the categorisation of SME users of gas. Those premises with less than 1,000 kWh annual consumption are likely to be unoccupied or partially occupied throughout the year (for example summer houses) or are premises that use gas for light cooking only and as such comprise a very small percentage of the total gas consuming population.

4.3 Participant Distribution and Profile

All participants were requested to participate in a Computer Assisted Telephone Interviewing (CATI) based pre-trial survey. Each participant received a credit of €25 to their bill. The survey included a wide range of questions about household demographics, the home, presence, use of different gas appliances (e.g. gas cookers, gas dryers) and heating,

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 gas consumer population. The exclusion of short term tenancies reduced 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 gas appliances as well as the attitudinal information. The information gathered was used in the allocation of participants to control and test groups to ensure that participants within the control group and within the stimulus groups were representative of the national gas consumer 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. In addition, in order to ensure that the recruitment process did not introduce bias as a result of the group which opted in, the profile of those who did not respond to the invitation was also researched.

The non-response survey was conducted using Computer Assisted Telephone Interviewing (CATI) in June 2010. It comprised a total of 250 interviews of those invited to participate in the Trial, but who chose not to.

The analysis found that:

- The two populations (i.e., those who did and those who did not respond) were similar across home profile (home type, age and bedroom count) as well as household composition (number of adults and children). Some differences emerged with regard to social grade, employment status, age and gender with younger more affluent consumers making up a greater proportion of the trial participants than of the non-respondents. This is a well-established challenge of any study involving voluntary recruitment[25]. However, an analysis of the impact of these differences determined that they had no effect on the conclusions of the trial. More details of this analysis are included in **Appendix 3**. The non-respondent group profiled themselves as less engaged in energy reduction generally and less motivated to reduce than the

[25] In the case of the electricity smart meter trial, the additional information available on consumers (in the form of segmentation) prior to recruitment controlled for these demographic differences in the recruitment process. As such information was not available prior to the gas trial, it was not possible to use these controls for this trial.

acceptance group. They were also less likely to have energy controls and to use those controls.

- A majority of the non-respondent group (57%) did not recall the letter or did not read the letter (63%) with only 14% of the non-response group making an active decision not to participate. This means that the substance of the Trial had limited impact on the non-response rate. Analysis of the reasons for the decision not to participate revealed that 8% of all non-respondents surveyed stated that they did not participate because they did not agree with the Trial being held and 6% selected each of the lack of perceived personal benefit, concerns about the effort required and concerns about the potential inconvenience associated with the meter installation.

Given the low level of active rejection of the offer (14%), 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. In order to estimate more accurately the impact of differences in age profile and social grade between those who chose to participate and respondents to the non-response survey, the change in overall consumption was calculated. This was done using bootstrap resampling (with 30,000 iterations) weighted to reflect the proportions of each age category or social grade within the acceptance group and the non-response group. The use of weightings based on the proportions within the non-response group simulates a participant population with the same age or social grade profile as the non-response group. The conclusion of this analysis was that the impact of the difference in the social grade proportions between participant and the non-response groups was to increase the reduction measured in the Trial by at most 0.08% (equal to approximately 3% of the total change in usage measured in the Trial). Therefore, the impact is not significant and does not affect the Trial's conclusions.

It is therefore concluded that the populations of respondents and non-respondents were sufficiently similar across the full spectrum of measurement and it is thus reasonable to conclude that response bias was not introduced by the recruitment process.

4.5 Attritor profile

Attrition was deemed to have occurred if:

1. The participant moved home
2. The participant switched to another gas 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 1,927 participants. This allowed for a 35% attrition rate (with an expectation of some participant attrition for multiple reasons). 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 provisions for attrition and actual attrition recorded were as follows:

	Residential allowance	Residential actual
Overall attrition	35%	18%
Change of tenancy	22%	3%
Change of supplier	10%	12%
Disconnection	0.5%	<.01%
Non specific attrition	3%	3%

Table 8: Provision for attrition

While the overall level of attrition was lower than the original provision, the level of attrition within the change of tenancy and the change of supplier categories did significantly vary from the original provision. In the case of the lower level of actual change of tenancy recorded, this reflects the exclusion of existing tenancies of less than 12 months and hence the proportion of the population who move regularly. In the case of the higher level of actual change of supplier, this reflects the increased competitor activity within the market during the period of the Trial[26]. The level of attrition did vary across test groups (levels ranged from 12.3% to 18.5%) with 20.3% of control group participants attriting. The higher level of attrition exhibited in the control group suggests a lack of impact on attrition from participation in the test groups and reflects the competitive activity in the market combined with the natural lack of incentive to remain in the Trial (apart from the final payment for the survey). It should be noted that 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. Across the test groups and control group it is within the original target of 35%:

[26] According to the results of a survey of residential gas customers undertaken by The Research Perspective on behalf of and published by CER, 18% of residential gas consumers changed supplier during 2011.

Tariff	Bi-monthly bill and energy usage statement	Monthly bill and energy usage statement	Bi-monthly bill , energy usage statement and IHDD	Bi-monthly bill, energy usage statement, IHDD plus Variable tariff	Total
Test groups	15.5%	18.5%	13.2%	12.3%	14.9%
Control					20.3%
TOTAL					16.8%

Table 9: Levels of attrition post-allocation during the Trial

The profile of the attritors was analysed from the results of a CATI survey with phasing used to ensure that attritors were surveyed within a reasonable timeframe of when the attrition occurred. The analysis found that change of supplier was the most common reason[27] for attrition with 73% of post-allocation attritors falling into this category; an additional 14% attriting due to change of tenancy; and 3% for technical reasons unrelated to the participant. The remaining 10% of attritors provided a variety of reasons unrelated to participation in the Trial.

Overall, a majority of attritors were not aware that they were no longer part of the Trial (62%) and therefore their decision to attrite could not have been influenced by participation in the Trial.

Direct attrition (where the participants requested removal from the Trial) did not occur. Attrition was a secondary result of other actions (such as change of energy supplier). Nevertheless, the responses from the attrition survey were analysed to ensure that actions such as change of supplier were not related to participation in the Trial. This analysis found that the increased information provided made these participants more aware of usage and hence contributed to their decision to switch supplier. However, at the level of the Trial this influence cannot be considered significant in terms of bias (at a cell level this corresponds to approximately to 12% of attrition and between 1% and 2% of total allocation within those cells).

It was concluded that both the level of attrition and reasons for attrition were unlikely to be associated with the Trial. (Further details on the attrition research are included in **Appendix 3**, Profile of Residential Participation).

[27] The level of attrition related to change of supplier 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.

4.6 Allocation of Participants to Stimulus and Tariff Groups

The allocation of participants to stimulus groups was completed in May 2010 in order to allow communication and implementation of the allocated tariff and stimulus. The allocation to the test groups 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 DSM stimuli was expected to vary across many dimensions - reflecting different demographic, household, socio-economic parameters as well as across different levels of usage.

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 at a weekly level), engagement in energy investment and reduction, an analysis of presence and use of heating and general behaviours associated with use of space and water heating. The identified predictors of usage were centred on a combination linked to usage profile, a combination linked to interest and engagement with energy reduction and two combinations associated with a mix of engagement and socio-demographic elements. 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 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. The average opt-in response rate was 25% significantly above average for this type of communication. Samples of the final letter and other trial communications are contained in **Appendix 10, Sample Communications.**

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 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 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 gas consumer population.

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 3.4 above) and arranging installation of the communications unit and the in-home display device.

The final communication in the benchmark period advised participants which group they had been allocated to (test or control) and the 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 usage statement) was in May 2011, when they were advised that the Trial was ending and that their billing would return to the normal two-monthly cycle driven by manual meter reads.

Those participants who had been requested to trial a variable tariff also received a further communication in June 2011 in the form of a reconciliation of their trial bills versus what they would have paid had they remained on the normal "flat" tariff. 66.5% of those on the variable tariff received a credit of €15 on their bill at this time. This was due to unusually cold weather in December (increasing bills on the smart tariff) and a mild spring (which lessened the ability to offset those costs with consumption during lower prices).

A schedule of the main communications is included in **Appendix 9**. Samples of the main communications are included in **Appendix 10**.

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 May 2010 and at the end of the Trial in June 2011.

5.5 Consumer Research

Research of gas 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 June 2011, comparing change in attitude, equipment or gas 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 energy usage statement. 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 statement. Results of these focus groups are outlined in more detail in **Appendix 5**, Outcome of Focus Groups conducted during the Customer Behaviour Trial.

5.6 Participant Queries and Feedback

Throughout the Trial, Bord Gáis Energy monitored participant contact in order to identify whether the introduction of the smart meters 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. It appears that fewer calls were received from smart meter trial participants than non-participants. However, it is possible participants were calling on a number other than that provided to them during the smart meter trial.

6 Approach to Data Analysis

6.1 Overall Approach

The general objective of the Customer Behaviour Trial was:

> *"to ascertain the potential for smart meter technology to effect measurable change in consumer behaviour, which will result in the reduction of overall gas use, when operated with appropriate Demand Side Management initiatives (DSM).*

The design of the measurement was structured to assess overall energy reduction as the result of the application of different DSM stimuli, which were enabled by the introduction of smart meters over the period of the Trial. Analysis of the data associated with the Trial would quantify the extent to which DSM stimuli had an impact on overall gas consumption. The findings from the Customer Behaviour Trial could then be used to make predictions about how the wider gas consumer base might respond to the DSM stimuli.

The approach to the measurement was to compare usage by individuals in the test groups with individuals in the control groups. Usage by any individual was first benchmarked during a benchmark period. The individual was then followed for a further period where the stimulus was applied. This was termed the test period. The ratio of the usage for these periods was the outcome measure and was calculated on a per individual basis and at a group volume level.

Assessment of the outcome as significant required the use of statistical techniques to test a number of hypotheses, specifically testing for evidence that the following led to a reduction in overall gas usage:

- All DSM stimuli in combination compared with the control group;
- Individual DSM stimuli, each compared with the control group
    - bi-monthly bill and energy usage statement;
    - monthly bill and energy usage statement;
    - bi-monthly bill, energy usage statement and In-home Display Device, and
    - bi-monthly bill, energy usage statement and In-home Display Device together with a variable tariff designed for the Trial
- Individual DSM stimuli, compared with each other

The Customer Behaviour Trial was designed to detect changes in behaviour in relation to overall usage 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 against the control group and a reduction of 5% would be detected at a cellular level. A 90% confidence level was applied to all tests conducted.

The calculation of the levels at which statistically significant changes would be detected was based on a calculation of variance from limited data available in 2009 as well as using

predicted final sample numbers (post attrition). At the end of the Trial, the sample size was larger than anticipated, as the level of attrition was lower than expected and the trial data was less variable. Thus, the combination of both of those factors (sample size and variability) increased the precision associated with the Trial and in post-trial analysis reductions of less than 3% associated with the full sample were statistically significant at 90% confidence. These results will be presented in detail in **Chapter 7**.

6.2 Treatment of Data

Half hourly data for each meter in the Trial were sought for each day of the Trial throughout the Benchmark and Test periods. Each data file was to contain the rate of energy usage (measured in kWh) and the calorific value used to calculate this rate. Data files were downloaded weekly.

Of the 1,575 meters that remained in the Trial on 31st May 2011, only 103 had complete data and the remaining 1,472 had at least one missing half-hour entry.

Two approaches were used to deal with the missing data, thus ensuring there was no negative impact on the quality of the results from the Trial. The first approach was case deletion and the second was Imputation. Further details on these approaches are included in Appendix 2.

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 gas usage for the test groups during the trial period relative to the benchmark period is calculated (RT). This is then compared to the corresponding ratio for the control group (Rc). 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 DSM stimuli groups within the overall test group and compared to the ratio for the control group. It is repeated for specific time periods during the day, over the different days of the week and across seasons.

A more detailed description of the methodological approach is contained in **Appendix 1**.

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 Changes in volume of Gas Usage

The smart meter data gives an insight to the level of consumption measured at half hourly intervals for the duration of the Trial. In consumption terms, it is clear that the levels of absolute gas consumption of both groups are very similar as outlined in **Table 10**, where there is a 0.8% difference in average consumption between the test and control groups for the 18 months of the Trial.

Consumption for Benchmark and Trial

	Number of participants	Total usage – Benchmark and Trial	Average usage - Benchmark and Trial	Total usage - Trial only	Average usage -Trial only
Test Group	967	24,747,353	25,592	13,575,506	14,039
Control Group	524	13,513,586	25,789	7,510,830	14,334

Table 10: Average consumption of Test and Control Groups for Trial and Test periods

The measurement of the trial comprised a six month benchmark period followed by a twelve month trial period. The common months within this measurement timeframe were 1st December 2009 to 31st May 2010 and 1st December 2010 to 31st of May 2011. The smart meter data shows that there was a decrease in consumption when comparing these two timeframes, with the test group using 13% less during this time and the control group using 11% less.

Consumption for Benchmark and Trial (comparable six months only)

	Number of participants	Total usage – Benchmark and Trial (1 Dec – 31 May 2010)	Total usage – Benchmark and Trial (1 Dec – 31 May 2011)	Change
Test Group	967	11,171,846	9,723,995	-13%
Control Group	524	6,002,755	5,340,595	-11%

Table 11: Consumption for Benchmark and Trial (comparable six months only)

7.3 Impact of DSM Stimuli on Overall Usage

Notwithstanding the observed volume reduction the measurement approach to assess the impact of the deployment of the stimuli enabled by smart meters considers the ratio of overall volume change. This is based on the comparison of the ratio of change between the Benchmark and Trial period for the test groups compared with the change for the control group.

The data collected from the Trial shows a volume reduction in overall gas usage of **2.9%** for residential gas users between the test group (to whom the different stimuli were deployed) and the control group. This difference was found to be statistically significant at the 90% confidence level.

Usage	All DSM Stimuli Groups
Overall	**-2.9***
* denotes results which are statistically significantly different from control group using a 90% confidence level.	

Table 12: Overall Gas Usage reduction compared with Control group

Each of the different stimuli was found to be effective in reducing gas consumption when each individual stimulus group was compared with the control group. All results for overall usage are statistically significant at the 90% confidence level.

		Bi-monthly bill and energy usage statement (Stimulus 1) %	Monthly bill and energy usage statement (Stimulus 2) %	Bi-monthly bill , energy usage statement and IHDD (Stimulus 3) %	Bi-monthly bill, energy usage statement, IHDD and Variable tariff (Stimulus 4) %
Overall	**-2.9***	**-2.2%***	**-2.8%***	**-2.9%***	**-3.6%***
* denotes results statistically significantly different from control group using a 90% confidence level.					

Table 13: Overall Gas Usage reduction by Stimulus group compared with Control group

When the stimuli are compared with each other, the statistical tests fail to find evidence of a particular DSM stimulus being superior from any other in terms of reduction in gas consumption.

Of all the stimuli deployed, the stimulus which included the bi-monthly bill, energy statement, IHD device and variable tariff is most effective at reducing overall gas usage (-3.6%) for

participants. Relatively similar reductions in overall gas usage among the participants are noted for the monthly bill and energy usage statement (-2.8%) and for the bi-monthly bill, energy usage statement and IHD device (-2.9%). All results for overall gas usage are statistically significant at the 90% confidence level when compared with the control group.

It should be noted that the results reported relate to the results of tests for the DSM stimuli as deployed. The outcome reports whether the combination of bi-monthly bill, energy usage statement and either the IHD device or the IHD device and variable tariff was effective. It is not possible to determine the benefit of the IHD device or the variable tariff 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.

7.4 Impact of DSM stimuli over time

In terms of consumption it is interesting to note the distribution of gas usage among the test and control groups separately over the eighteen month period of the Trial.

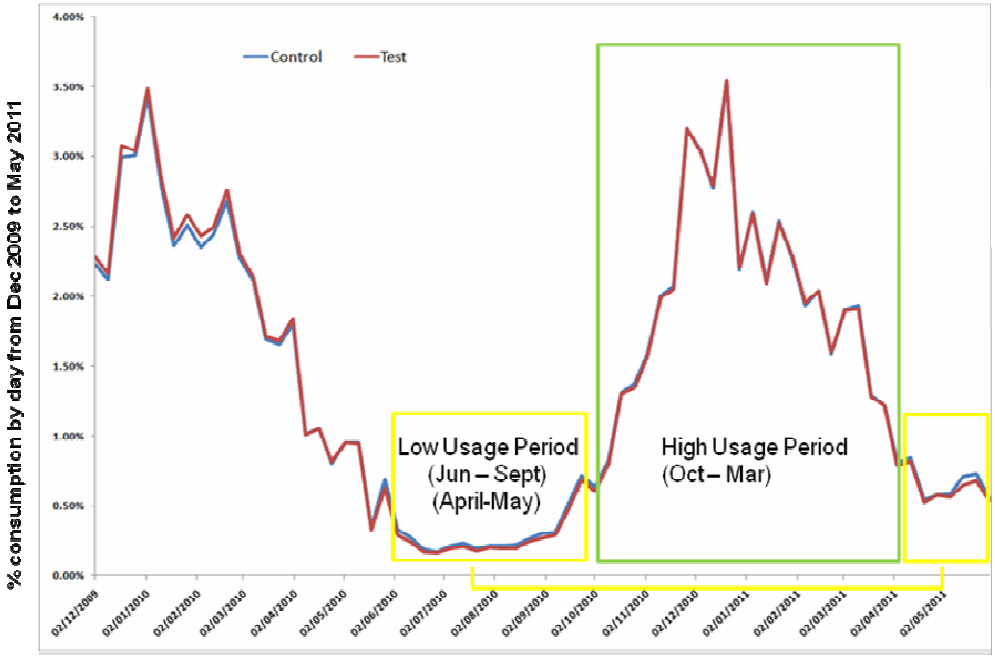


Figure 8: Distribution of usage by Test and Control groups over measurement period

Looking at the smart meter data, the pattern of consumption can be broadly divided into two periods, the Low Usage Period typically extending from April to September inclusive (split into June to September 2010 and April to May 2011 in the context of the Trial) and the High Usage Period which extends from October to March. The months of June to August are the months of consistently low consumption. During the trial period, the pattern of consumption did not differ by test or control group, with the exception of minor variations in proportion of consumption in the Low Usage Period.

Considering the proportion of consumption for each of the stimulus groups the same pattern is maintained, with an almost identical distribution of consumption across the trial period for each of the stimulus groups.

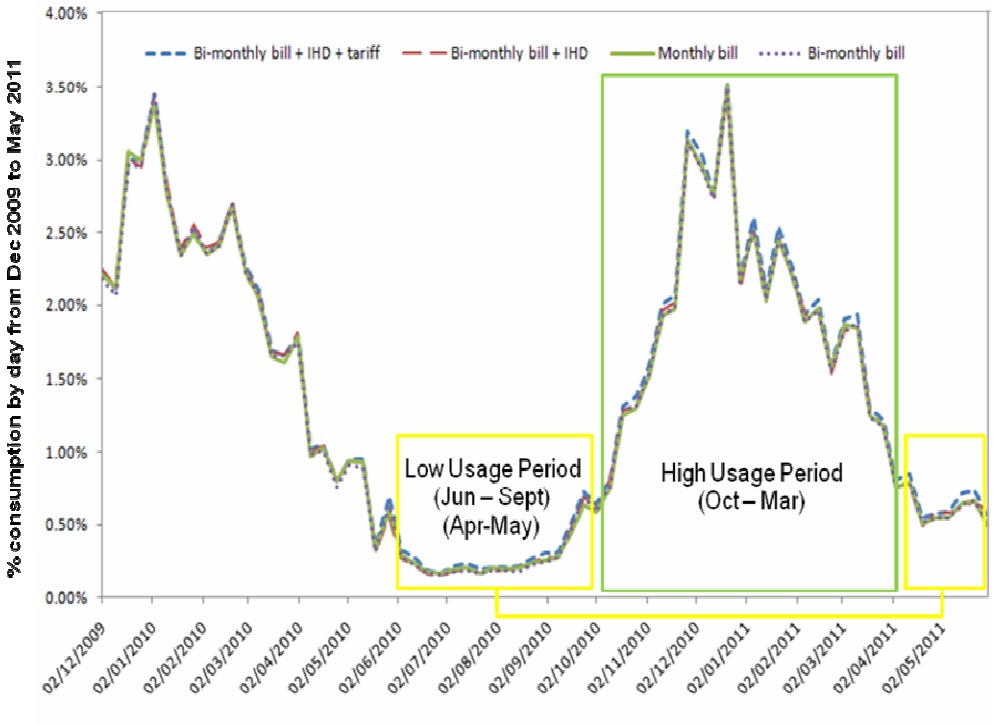


Figure 9: Distribution of usage by Stimulus groups over the measurement period

It is interesting to look at the changes over time, particularly at the start of the trial period since it is reasonable to expect that there may be an early inflated impact associated with the deployment of the stimuli. This is where recipients may alter their consumption behaviour in line with the new detailed information, energy statement and the IHD device for those participants to whom this stimulus was deployed.

However, when the impact of the stimuli is considered separately for the Low Consumption Period and the High Consumption Period the following results emerge:

	Overall	Bi-monthly bill and energy usage statement (Stimulus 1) %	Monthly bill and energy usage statement (Stimulus 2) %	Bi-monthly bill , energy usage statement and IHDD (Stimulus 3) %	Bi-monthly bill, energy usage statement, IHDD and Variable tariff (Stimulus 4) %
Overall	**-2.9***	**-2.2%***	**-2.8%***	**-2.9%***	**-3.6%***
Low Usage Period (Jun to Sept 2010 and Apr to May 2011	**-7.5%***	**-5.0%***	**-8.4%***	**-7.8%***	**-8.7%***
High Usage Period (Oct 2010 to Mar 2011)	**-2.0%***	**-1.7%**	**-1.7%**	**-1.9%***	**-2.5%***
* denotes results statistically significantly different from control group using a 90% confidence level.					

Table 14: Overall Gas Usage reduction by Stimulus group compared with Control group for the Low Usage Period and High Usage Period

A more detailed breakdown of gas consumption reduction for two monthly periods from June 2010 to May 2011 shows that the most significant changes occur in the low consumption months and in particular June, July, August and September. It is clear that such comparatively large usage reductions are calculated on an equally comparatively low base of gas consumption associated with the summer months.

Similarly, it is possible that the large relative decreases in gas usage of the stimulus groups compared with the control group during the summer months is associated with the immediate initial impact and benefit of the deployment of the stimulus. This appears to diminish considerably at the start of October and the relative percentage reduction (stimulus versus control) remains comparatively lower until April-May, at which point it begins to increase again.

	Overall	Bi-monthly bill and energy usage statement (Stimulus 1) %	Monthly bill and energy usage statement (Stimulus 2) %	Bi-monthly bill , energy usage statement and IHDD (Stimulus 3) %	Bi-monthly bill, energy usage statement, IHDD and Variable tariff (Stimulus 4) %
Overall	**-2.9***	**-2.2%***	**-2.8%***	**-2.9%***	**-3.6%***
Jun-Jul	**-11.0%***	**-6.6%**	**-13.4%***	**-8.6%**	**-15.2%***
Aug-Sep	**-9.1%***	**-7.0%**	**-10.2%***	**-10.2%***	**-9.1%**
Oct-Nov	**-2.8%**	**-2.2%**	**-2.4%**	**-3.8%**	**-2.7%**
Dec-Jan	**-1.6%**	**-2.1%**	**-1.0%**	**-1.0%**	**-2.3%**
Feb-Mar	**-1.8%**	**-0.4%**	**-2.1%**	**-1.9%**	**-2.8%**
Apr-May	**-5.5%**	**-3.4%**	**-5.8%**	**-6.4%**	**-6.3%**
* denotes results statistically significantly different from control group using a 90% confidence level.					

Table 15: Overall Gas Usage reduction by Stimulus group compared with Control group for two monthly periods from June 2010 to May 2011

The following chart showing weekly change in usage **Figure 10** indicates in a more granular way that the most dramatic initial decreases in usage are associated with the bi-monthly bill, energy usage statement, IHD device and variable tariff and the monthly bill and energy usage statement. Both stimuli show a strong level of decrease which is sustained for the four months from June to September.

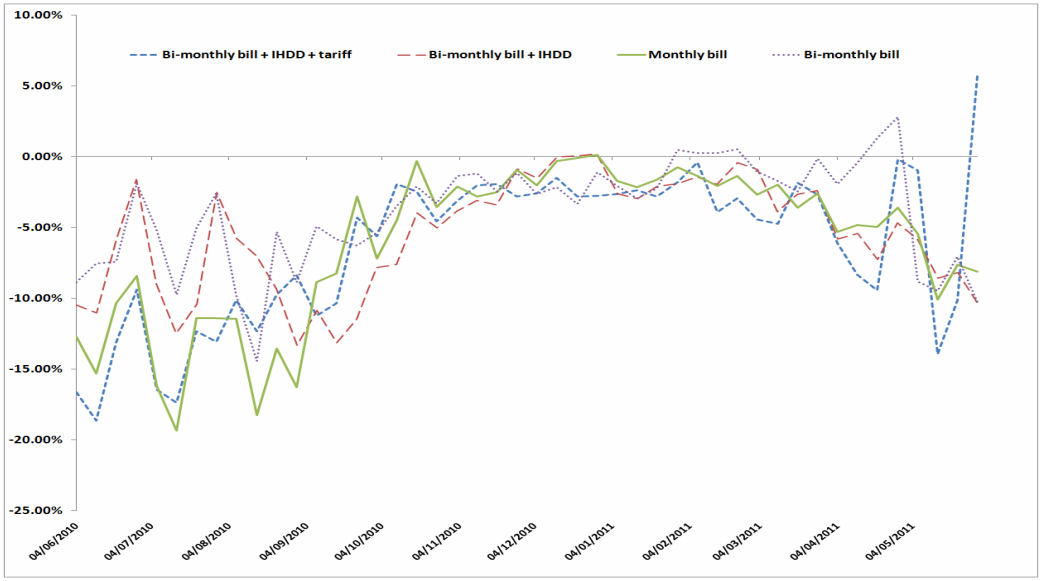


Figure 10: Weekly change in Gas Usage by Stimulus relative to control group over trial period

As the Trial progresses from the Low Usage Period to the High Usage Period, **Figure 11** below zooms in on the months from October to March. It is interesting to see that the monthly bill and energy usage statement begins to become less effective while the bi-monthly bill, energy usage statement, IHD device and variable tariff maintains its effectiveness in achieving usage reduction. The bi-monthly bill, energy usage statement and IHD device stimulus is effective at the outset but begins to lose effectiveness in the pre-December period, and regains traction in the post Christmas period. The bi-monthly bill and energy usage statement performed reasonably well initially during the High Usage Period but its effect began to fade over time. In addition, it was the least effective throughout the Low Usage Period.

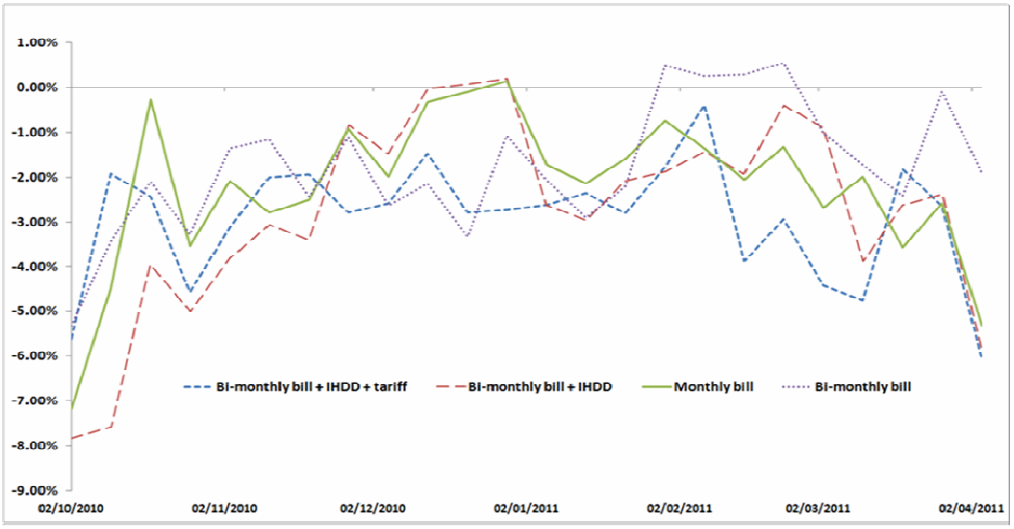


Figure 11: Weekly change in Gas Usage by Stimulus relative to control group over for the High Usage Period

In relation to stimulus 4, the bi-monthly bill, energy usage statement, IHD device and variable tariff, the relationship between the change in price and the level of reduction in gas usage is explored. It is observed in **Figure 12** that the tariff rate does not have a linear relationship with consumption reduction and the reduction is greatest in percentage terms during the periods when the price is lowest. This is further demonstrated in the analysis of the relationship of tariff rate to rate of reduction in the High Usage Period specifically in **Figure 13** where the rate of reduction is lowest when the highest tariff has been deployed (observed on three pairs of data points only).

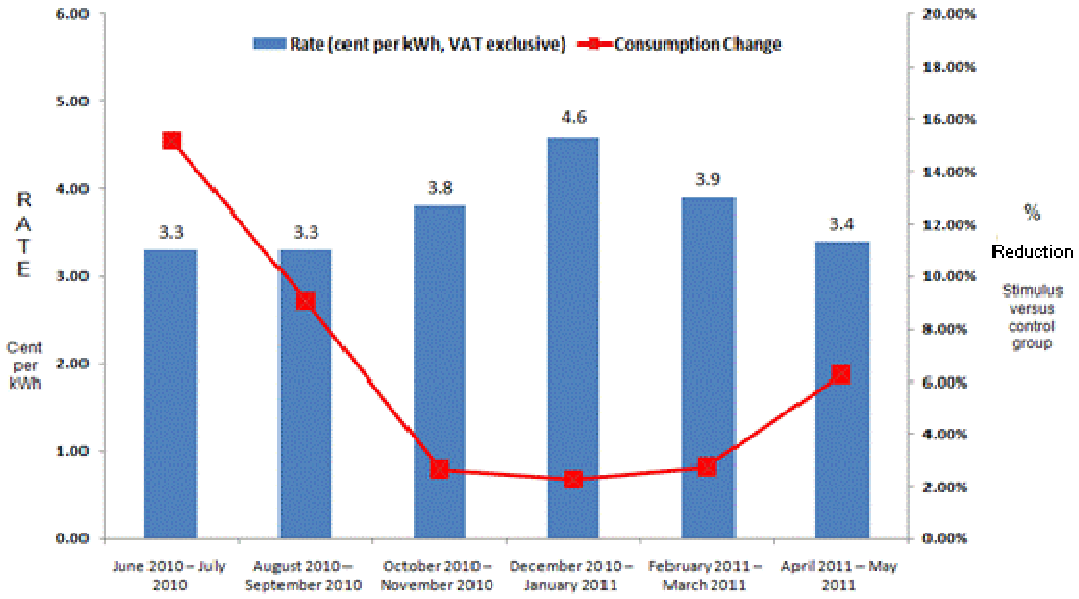


Figure 12: Relationship between % change in consumption of bi-monthly bill, energy statement, IHD device and variable tariff group with control group and rate per kWh

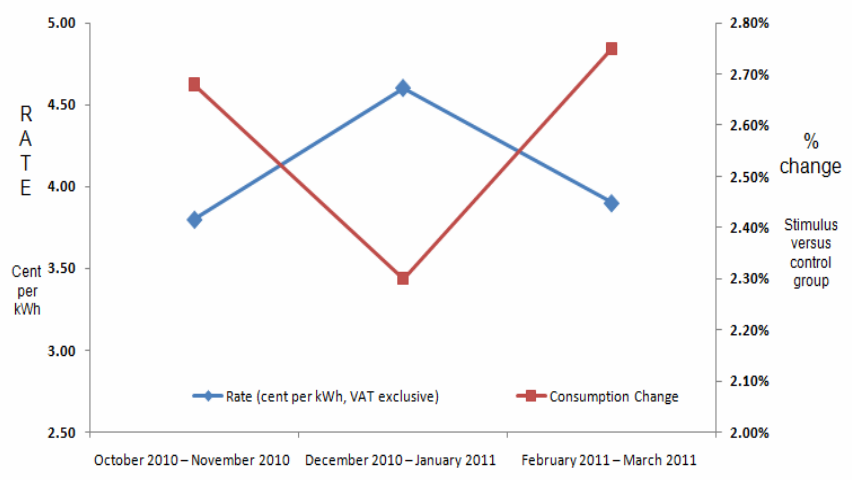


Figure 13: Relationship between % change in consumption of bi monthly bill, energy statement, IHD device and variable tariff group with control group and rate per kWh for High Usage Period

However, this does not take into account the potentially greater level of discretionary use during warmer periods. This factor was identified in focus groups on gas usage patterns which indicated that gas users did not perceive that there was discretionary use in winter when their priority was to have an environment which they considered to be comfortable from their perspective during this time. Nevertheless they acknowledged scope for reduction in discretionary use in warmer periods.

Notwithstanding the rate of change, it is of interest to further consider the volume of change over time. It is clear from Section 7.3 that October to March is the period of highest consumption and while the reduction in gas usage may be smaller, in volume terms it is quite significant.

	Overall	Bi-monthly bill and energy usage statement (Stimulus 1) %	Monthly bill and energy usage statement (Stimulus 2) %	Bi-monthly bill , energy usage statement and IHDD (Stimulus 3) %	Bi-monthly bill, energy usage statement, IHDD and Variable tariff (Stimulus 4) %
Overall	-2.9*	-2.2%*	-2.8%*	-2.9%*	-3.6%*
Low Usage Period (Jun to Sept 2010 and Apr to May 2011	-7.5%*	-5.0%*	-8.4%*	-7.8%*	-8.7%*
High Usage Period (Oct 2010 to Mar 2011)	-2.0%*	-1.7%	-1.7%	-1.9%*	-2.5%*
* denotes results statistically significantly different from control group using a 90% confidence level.					

Table 14 (for illustrative purposes repeated above) shows that the reduction for the December-January period was 89.4 kWh per participant with the % reduction registering at 1.6%. The equivalent average absolute reduction for the June-July period was 44.3 kWh per participant while the % reduction was 11.0%. On that basis, it is very important to track the High Usage Period reductions since the impact of their contribution in absolute terms is proportionately greater.

	Jun-Jul	Aug-Sept	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May
Average kWh reduction per month - All Test Groups	**44.38 kWh**	**53.33 kWh**	**83.02 kWh**	**89.41 kWh**	**59.36 kWh**	**69.56 kWh**
Average % reduction – Test over Control	**11.0%**	**9.1%**	**2.8%**	**1.6%**	**1.8%**	**5.5%**

Table 16: Average absolute gas usage reduction and % reduction of all test groups compared with control group for two monthly periods from June 2010 to May 2011

Figure 14 shows the average weekly consumption of the stimulus 4 group (variable tariff), contrasted with the average weekly consumption of the control group. What is evident from the chart and fromTable 17: Average absolute gas usage reduction and % reduction of all test groups and

stimulus Group 4 compared with control group for two monthly periods from June 2010 to May 2011 **Table 17** is that the reduction in absolute terms is more accentuated for the stimulus 4 group, who were exposed to the variable tariff as part of their stimuli.

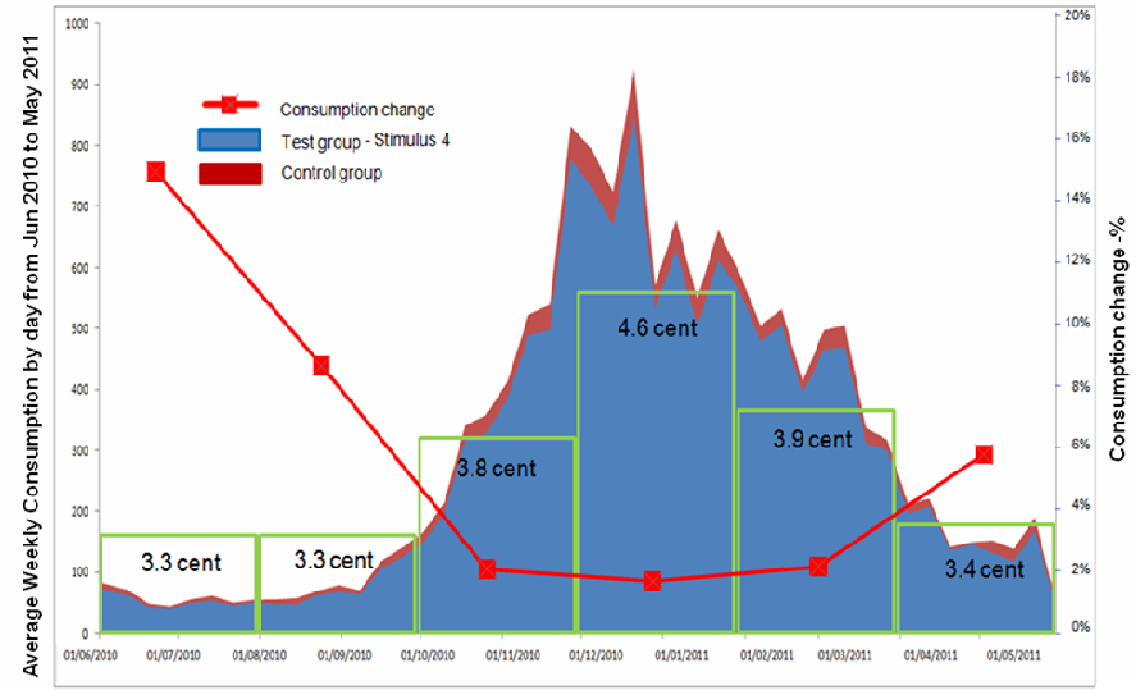


Figure 14: Average weekly gas consumption for Test and Control compared with consumption change from June 2010 to May 2011

	Jun-Jul	Aug-Sept	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May
Average kWh reduction per month **- All Test Groups**	44.38 kWh	53.33 kWh	83.02 kWh	89.41 kWh	59.36 kWh	69.56 kWh
Average kWh reduction per month – **Tariff Group**	58.61 kWh	53.13 kWh	80.39 kWh	124.36 kWh	90.82 kWh	79.16 kWh
Average % reduction – **Test over Control**	11.0%	9.1%	2.8%	1.6%	1.8%	5.5%
Average % reduction – **Tariff Group versus Control**	15.2%	9.1%	2.7%	2.3%	2.8%	6.3%

Table 17: Average absolute gas usage reduction and % reduction of all test groups and stimulus Group 4 compared with control group for two monthly periods from June 2010 to May 2011

It is particularly noticeable that for this stimulus group, in particular, the average absolute reduction is notably strong in the December to January and February to March periods, but there is also evidence for proportionately larger average absolute reductions in the April to July periods.

Figure 15 shows that the percentage of overall absolute reduction observed was the highest that was achieved over the different timeframes. It is clear that the High Usage Period

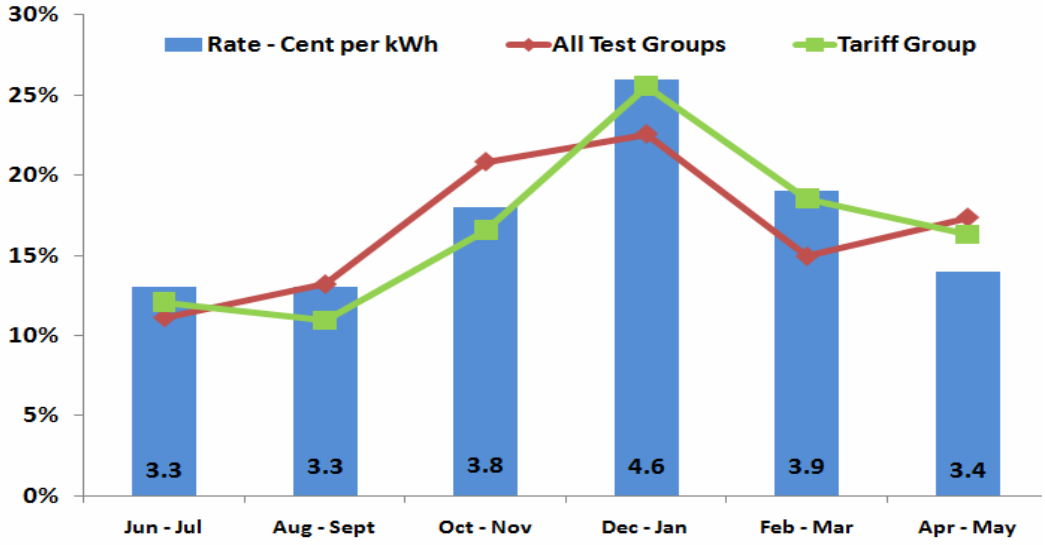


Figure 15: % of total reduction from June 2010 to May 2011 for all Test groups and Stimulus Group 4

reduction is very important. This is particularly the case for the group exposed to the seasonal tariff. Nevertheless over 30% of the total reduction observed was achieved in the Low Usage season.

7.5 Analysis of change in volume distribution during the Trial

The distribution of usage for the test group (**Figure 16**) 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 usage among trial participants is evident on this graph and is characterised by a lower usage profile among the test group in the very early morning timeframe from 4:30am to 6:30am. A further and more significant reduction occurs in the timeframe from 5:30pm to 11:30 pm. The morning and evening reductions are not mirrored with increases in usage by the test group during other parts of the day with the exception of a comparatively small increase for an hour in the 7:30am to 8:30am timeframe.

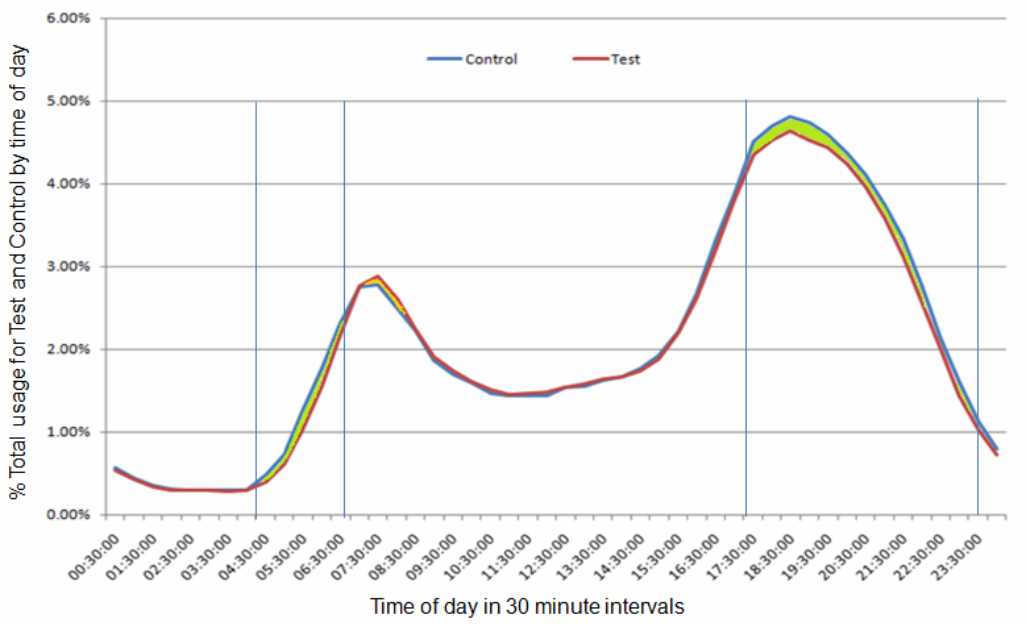


Figure 16: Distribution of total usage within day for Test and Control Groups

It is interesting to look at this in the context of the reduction patterns for the High Usage Period and Low Usage Period to identify if there are contrasting modes of behaviour depending on the seasonal influences. **Figure 17** and **Figure 18** show the distribution of usage for the test group during the trial period (in red) compared with the distribution of usage for the control group during the same period (in blue) separately for Low Usage Period and the High Usage Period.

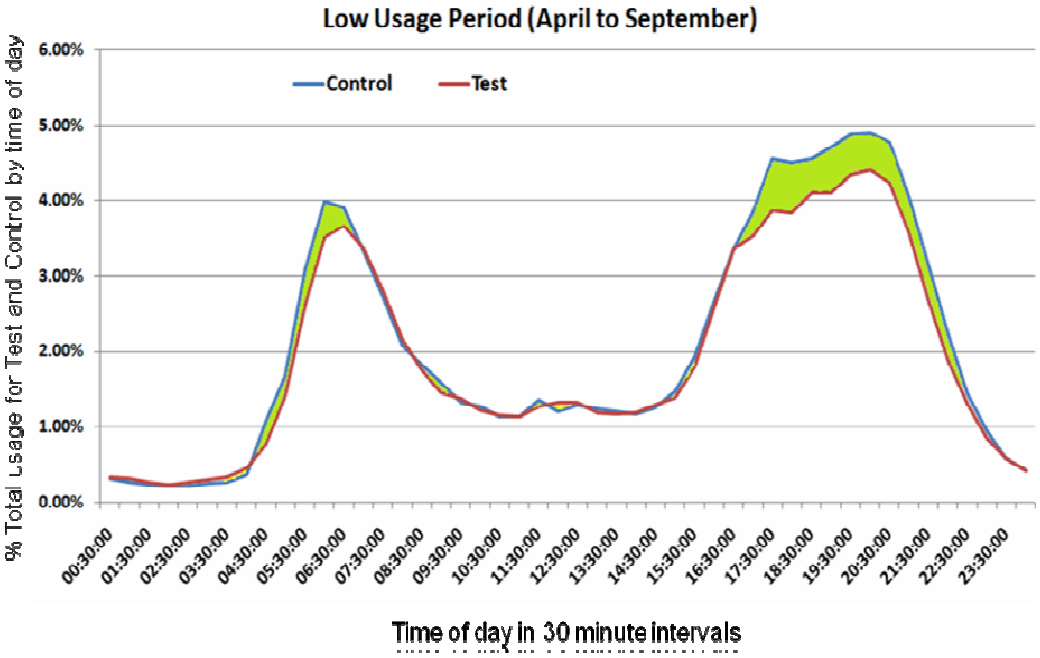


Figure 17: Distribution of total usage within day for Test and Control Groups for Low Usage Period

During the April to September period, it is evident that most of the reduction occurs in the early morning timeframe (4:30am to 7:30am) and in the evening timeframe from 4:30pm to 8:30pm but extending into the late evening towards 10:00pm. This highlights a potential area associated with discretionary use.

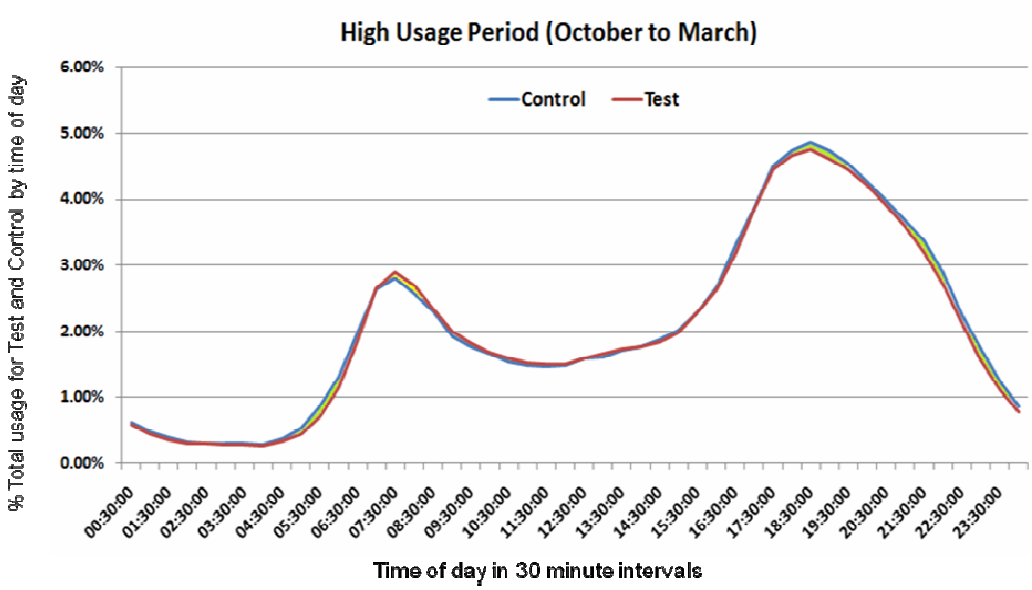


Figure 18: Distribution of total usage within day for Test and Control Groups for High Usage Period

During the October to March period, the usage is also lower in the early morning from 4:30am to 6:30am periods and in the evening period from 5pm onwards. In contrast, the usage among test group participants is higher during the morning peak usage period from 7:00am to 8:30am suggesting some shift of usage during the morning as well as reduction in discretionary usage during the evening.

7.6 Impact on Participant Bills

In the case of three of the four test groups, there were no changes to the tariff structure or price charged. Therefore, the reduction achieved as part of the trial should translate into an absolute reduction in bill size. In the case of the fourth group, the tariff varies over time with a higher unit cost during the winter period (when there is higher usage) and lower unit cost during the summer period (when there is lower usage). Therefore changes in participant usage patterns may impact negatively or positively in terms of total bill size.

In order to assess the impact of participation on bill size, a similar methodology was adopted to that used in the smart meter electricity national pilot. Specifically three measures are used:

Measure 1: Estimate of the reduction on the bill associated with the reduction in usage:

In Measure 1 the comparison is between the bill actually received during the Trial and an estimate of the bill calculated if the participant was not on the Trial (and on average

would have consumed more gas). The actual bill is calculated using the usage recorded and the tariff applied during the Trial (3.932c per kWh for participants allocated to Stimulus 1, 2 or 3 and the variable tariff applied to participants allocated to Stimulus 4). Note that for the purposes of calculating bill impact, only the usage component of the bill is considered as standing charges are unchanged by participation in the trial.

This measure is calculated differently for participants allocated to Stimulus 1, 2 and 3 and for participants allocated to Stimulus 4. For participants allocated to Stimulus 1, 2 and 3, the estimate of the bill if the participant was not on the Trial (the *outside of trial* bill) and from that Measure 1 is calculated in the following manner:

1. Take usage during the Trial and inflate this by the estimated usage reduction. For example, a participant had used 1000 kWh during the trial and was allocated to Bi-monthly bill group (Stimulus 1). As this stimulus group reduced volume usage by 2.2, the 1000 kWh would be inflated to 1022 kWh to provide the estimate of the *outside of trial* usage.
2. The *outside of trial* bill is then calculated by multiplying the *outside of trial* usage by the tariff applied (3.932c per kWh).
3. The average bill saving is then calculated by comparing the average actual bill and the average *outside of trial* bill for all participants allocated to each of Stimulus 1,2 and 3 groups.

In the case of participants who were allocated to Stimulus 4, the same procedure is used for each two month period and then summed to calculate the overall bill impact.

The average bill saving is then calculated by comparing the average actual bill and the average *outside of trial* bill.

Measure 2: Estimate of the impact on the bill of participation in the Trial: Measure 2 is 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 natural gas at the start of the Trial (3.932c per kWh). Note that the tariff tested only differs from Measure 1 for participants allocated to Stimulus 4 as this measure differs only in the cost used for the calculation of the *outside of trial* bill. Therefore, this measure is identical to Measure 1 for all participants not allocated to Stimulus 4.

For participants allocated to Stimulus 4, this measure is calculated by using the flat tariff of 3.932c per kWh when calculating the average *outside of trial* bill and using the applied variable tariff when calculating the average actual bill. As with Measure 1, the average bill saving is then calculated by comparing the average actual bill and the average *outside of trial* bill.

Measure 3: The impact of tariff on the bill: Measure 3 is the comparison between the bill, based on actual usage and the tested tariff and a bill calculated using the same usage

but using the cost of natural gas at the start of the Trial (3.932c per kWh). Note that Measure 3 is equal to €0 for participants allocated to Stimuli 1, 2 and 3 as the tariff tested only differs for participants allocated to Stimulus 4.

For participants allocated to Stimulus 4, this measure calculates the actual bill in the same way as Measures 1 and 2 and calculates the *outside of trial* bill using the recorded usage and the flat tariff of 3.932c per kWh. As with Measures 1 and 2, the average bill saving is then calculated by comparing the average actual bill and the average *outside of trial* bill.

Average annual saving (as % of usage related charge)	Bi-monthly bill and energy usage statement	Monthly bill and energy usage statement	Bi-monthly bill , energy usage statement and IHDD	Bi-monthly bill, energy usage statement, IHDD and variable tariff
Measure 1 saving	-€12.72 (-2.2%)	-€15.74 (-2.8%)	-€16.50 (-2.9%)	-€19.71 (-3.5%)
Measure 2 saving				-€1.97 (-0.4%)
Measure 3 saving				+€18.29 (+3.5%)

Table 18: Impact on participant bills using different measures of saving

(Negative amount indicates annual saving on gas bill; positive amount indicates annual increase in gas bill). Amount expressed as a percentage of the average bill shown in parentheses below

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 and Measure 3 only apply to the test group with the tariff which varies over time. For these participants, 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). Measure 3 estimates the absolute difference between the tested tariff and the flat rate tariff.

For Measure 1, all groups showed some savings on their annual gas bill with the greatest saving recorded amongst the tariff group. These savings varied between 2.2% and 3.5% of the usage related component of the bill (excluding standing charges) depending on the stimuli and tariff applied.

For the tariff group, Measure 2 shows a small decrease reflecting a reduction in bill size compared to expected usage with a flat tariff (i.e. if these participants had not taken part in the Trial). This suggests that participants were able to modify behaviour sufficiently to counter the potential impact of the variable tariff.

For the tariff group also, Measure 3 shows the potential impact of the tariff assuming the usage profile recorded during the test period. This would result in an increase in the annual bill of €18.29 on average which is equal to an increase of 3.5% on the annual bill. This impact may be explained the difference between the usage profile used to calculate the tariff as revenue neutral prior to the commencement of the trial and the actual usage profile exhibited by trial participants from stimulus group 4. When the individual bimonthly prices were set for this variable tariff it was designed to be revenue neutral given a standard consumption profile over the average year. However, this did not prove to be the case in the trial period. Due to colder than normal weather experienced in December and January 2010 there was unusually high gas consumption in this period which coincided with highest price of variable tariff i.e. the variable tariff price of 4.6 cent per unit was higher than the standard flat tariff of 3.932 cent per unit.

Following this, due to milder than normal weather being experienced there was unusually low consumption in April and May 2011 period when the variable tariff was lower (3.4 cent per unit) than the standard flat tariff of 3.932 cent per unit. Thus consumers on the variable tariff consumed more gas at high price period and were unable to balance this sufficiently during the low price period to sustain the revenue neutrality. This is a matter that should be considered in the rollout decision for any such variable tariff.

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 gas consumed was reduced, the Trial 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 stimuli tested (including the variable tariff).

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 Trial in April and May 2010 and one at the end of the Trial in the second quarter of 2011. These surveys were completed using Computer Telephone Assisted Interviewing (CATI). Participants were requested to participate in these surveys as part of their involvement in the Trial and consequently the level of participation was high (86% of participating households completed the pre-trial survey; 77% of households still in the Trial at 31st May 2011 completed the post-trial survey). All received a credit of €25 to their bill once the survey was complete.

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 gas usage

The emphasis moves from measuring the change in the total volume of gas reduced to measuring the average reduction by individual household 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 gas 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 19** shows the relationship of participant to volume consumption and notes that approximately a third of the participants account for over 50% of the usage (during the trial period).

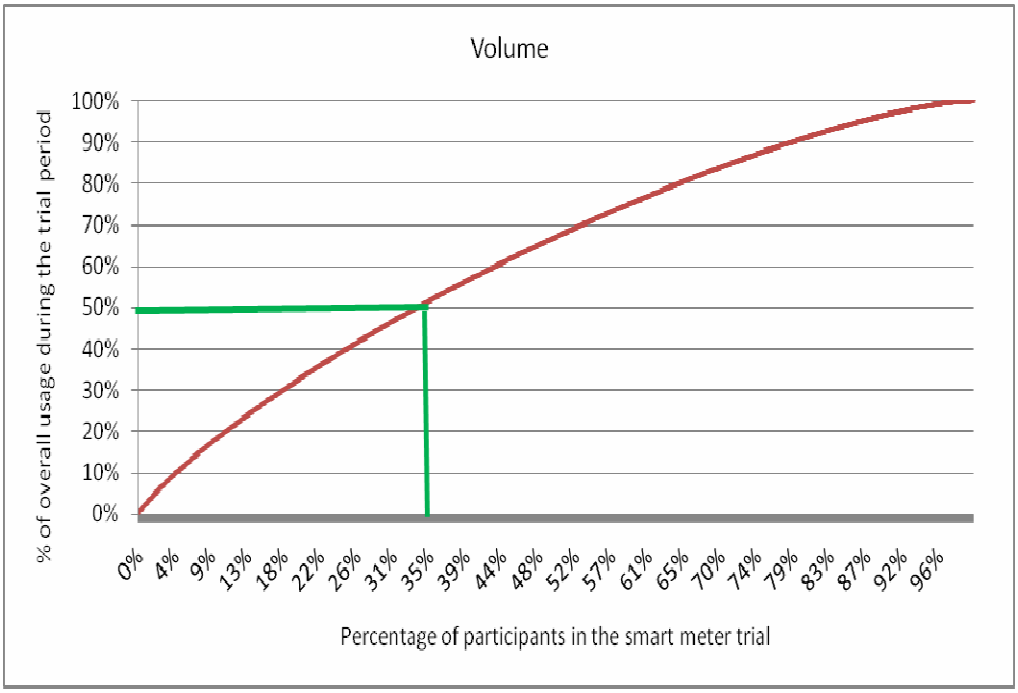


Figure 19: Cumulative Volume by % of participants in the Trial

Table 19 summarises the reductions across individuals and by the test groups. This can be compared with the changes among sub-groups such as fuel poor or more affluent.

	Test groups				
	Overall %	Bi-monthly bill and energy usage statement	Monthly bill and energy usage statement	Bi-monthly bill, energy usage statement, IHDD	Bi-monthly bill, energy usage statement, IHDD, time varying tariff
Overall	-4.16%	-4.52%	-3.24%	-4.21%	-4.61%

Table 19: Overall and Tariff (in conjunction with DSM stimuli) average percentage changes across individuals

It should be noted that the individual average percentage reduction is larger than the overall volume reduction. This reflects the relationship between overall usage and usage reduction achieved during the Trial (**Figure 20**). The percentage reduction is greater among test group participants with lower usage.

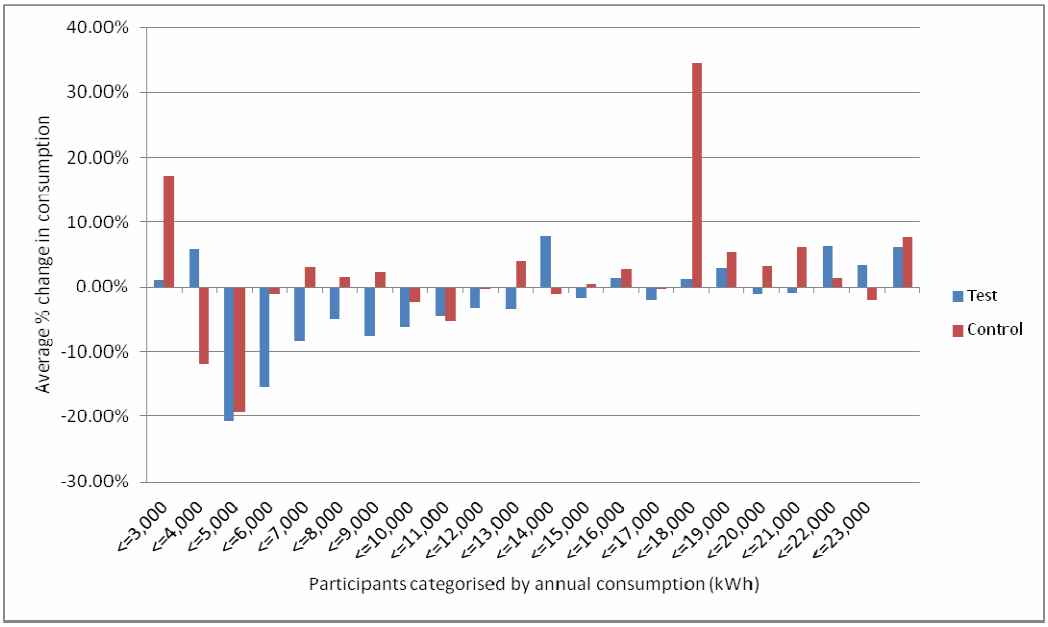


Figure 20: Individual average change in overall usage during trial by annualised usage during benchmark – test group compared with control group participants

7.7.3 Participants' perception of changes achieved

As has been shown in Section 7.7.2 the average impact on test group participants' usage related component of the bill was a reduction of between 2.2% and 3.5% (depending on the stimulus used). The test group participants' stated estimate of the change in both bill and consumption is shown in **Table 20**.

Test groups					
	Overall %	Bi-monthly bill	Monthly bill	Bi-monthly bill + IHDD	Bi-monthly bill + IHDD + variable tariff
Average change recorded during trial	-4.16%	-4.52%	-3.24%	-4.21%	-4.61%
Participants' estimate of change	-5.95%	-6.10%	-6.96%	-5.77%	-5.79%

Table 20: Comparison of reductions estimated by participants and recorded

The participants were asked to estimate the change in the post-trial survey within bands (for instance between 5% and 10%) and, therefore, the figures in **Table 20** are approximations. However, the calculation of these figures is complicated by the fact that trial calculations compare test and control groups to determine the underlying changes and neutralise the impact of changes in climate and other sources of variability. In contrast, participants will not take these factors into account when reporting the change (i.e. if lower ambient temperatures during the trial result in an increased use, participants will factor this into their statements; in contrast, the calculations neutralise these effects through the comparison between trial and test groups). Therefore, the approximate level of concordance between the smart meter data derived figures and the responses from the post-trial survey reflects the fact that participants on *average* exhibited a reasonable perception of the actual change achieved.

7.7.4 Change in usage by socio-economic measure

The analysis sought to determine if the introduction of smart meters with the tested stimuli benefited particular groups in society over others and in particular if less affluent or otherwise socially disadvantaged participants responded in different ways.

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[28]) and the level of usage reduction as shown in **Figure 21**. The level of overall reduction varies across socio-economic groups where C1 achieved the greatest overall reductions and C2 achieved the second highest reduction. The AB Group achieved the lowest level of reduction.

[28] 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).

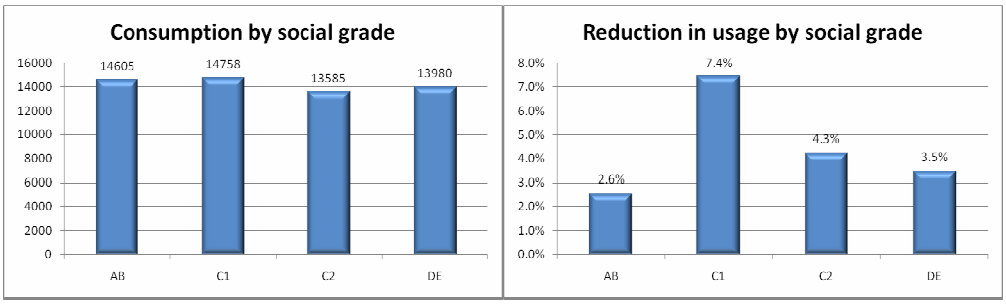


Figure 21: Average energy consumption by social grade (left) with the reduction in gas usage by social grade with the comparison between test and control among those within each category (right).

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 higher groups (AB and C1) tend to consume more natural gas (shown in **Figure 22**). However, the degree of divergence is relatively small (with an 8% difference between C2 and AB). Therefore, the relationship between socio-economic grade and usage reduction during the Trial is partially linked to social grade.

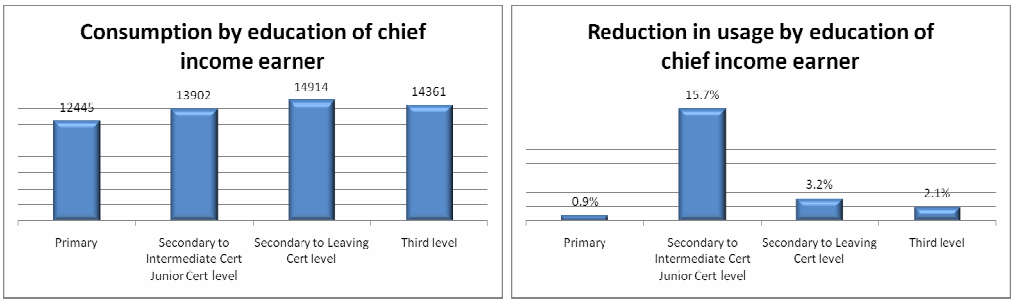


Figure 22: Average gas consumption by education of chief income earner (left) with individual reduction in gas usage by level of education of the chief income earner (right)

Participants were also 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. **Figure 22** shows those with 3rd level education reduced usage least among the education levels captured. The high level of reduction among those with secondary education (pre-leaving certificate) is unexpected but relates to a relatively small group (13% of all participants compared to 55% for 3rd level and 23% for secondary to leaving certificate level).

Therefore, it is concluded that participants with the highest and lowest education and social grade education are least likely to reduce usage. This may reflect motivation (among those with AB social grade) and communication (among those with lower social grades C2 and DE). While efforts were made in the communications strategy to be inclusive, the difference

may reflect more fundamental barriers to engagement among those with lower levels of educational achievement.

The consequences of this relationship in terms of bill impact can be seen in **Table 21** with C1 participants showing the highest level of saving at €25.07 per annum[29].

Social Class	Bill Impact – Measure 1
AB	-€13.27
C1	-€25.07
C2	-€16.42
DE	-€18.22

Table 21 : Impact on the bill by social grade of chief income earner

Figure 23 shows the expected results that households with children (defined as under 15 years of age) use more gas, although the difference in the level of usage is small. However, **Figure 23** also shows that homes with children reduced usage by much less (an average of 1.3%) than homes without children (an average of 6.4).

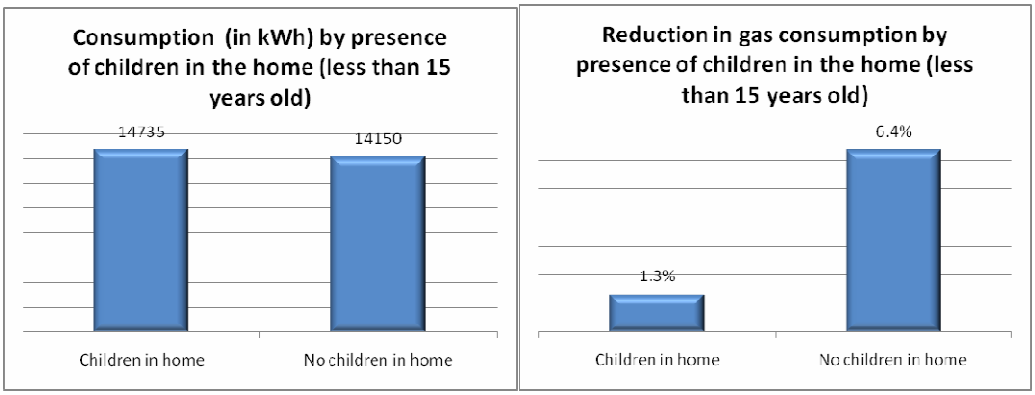


Figure 23: Reduction in gas usage by presence of children (aged 15 or under) in the household.

This was also reflected in the difference in bill size between households with children and those without children.

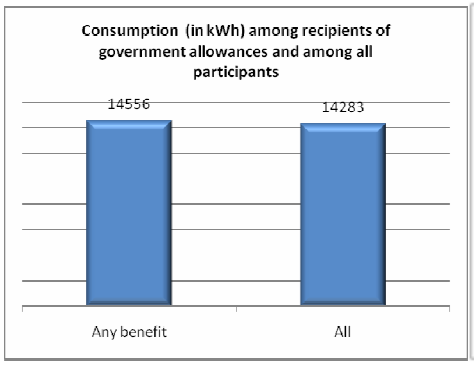
Impact on bill of presence of children in the household	Bill impact - Measure 1
Children in the household	-€3.38
No children in the household	-€29.84

Table 22 : Impact on the bill by presence of children in the household

[29] The change in usage is calculated using the members of the test and control groups who are classified as C1 social grade

7.7.5 Change in usage amongst customers in receipt of benefits

The response of the group of customers self assessed as in receipt of benefits was also explored. This group includes those in receipt of a State payment associated with energy use (including the Free Electricity Allowance, National Fuel Scheme payments, National Gas Allowance, and Smokeless Fuel Allowance). It includes the elderly, carers in receipt of specified allowances and individuals in receipt of specified invalidity or disablement benefits.



Reduction in gas consumption among recipients of government allowances and among all participants

Any Benefit		All participants
Increase		Reduction
1.90%		4.16%

Figure 24: Comparison of overall gas consumption (left) and usage reduction (right) among recipients of government energy allowance and all participants

The graph on the left in **Figure 24** shows that recipients of these benefits use similar amounts of gas as the general population of participants. The graph on the right shows that those in receipt of benefits did not achieve any reduction. The increase of 1.9% was tested and was shown not to be statistically significant at 90%.

Another group of interest is the Fuel Poor, which were identified and classified from the pre-trial survey. This category has some overlap with those in receipt of State allowances 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”.

In the context of the gas smart meter trial, no participants identified themselves as fuel poor under the first definition and only 24 participants (16 in the test groups and eight in the control group) identified themselves as Fuel Poor under the second definition. Therefore, it is not possible to analyse the impact of the Trial on the fuel poor.

7.7.6 Reasons for lack of behaviour change

In the context of the Trial, it is important to understand the level of difficulty of behaviour change and to determine the factors which supported successful change. Participants in the test groups and the control group were asked to assess whether they had reduced gas usage, were equipped with the knowledge to reduce usage and wished to reduce usage (**Figure 25**).

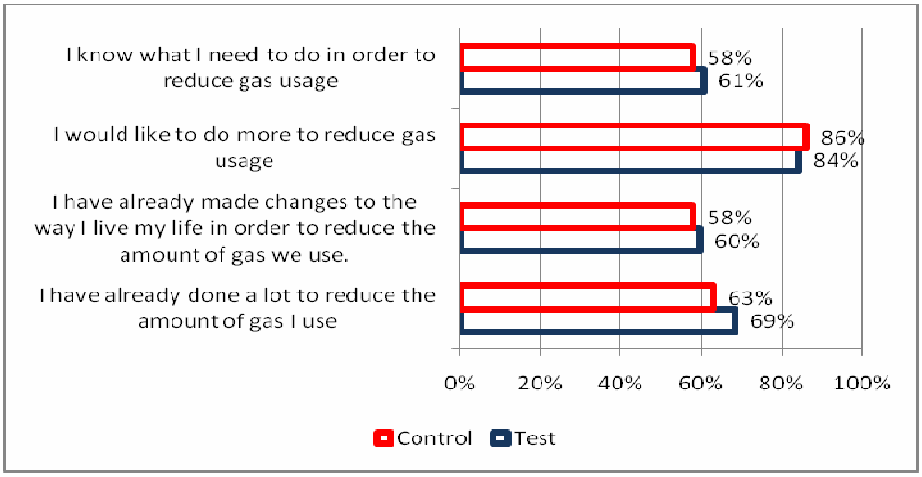


Figure 25: Comparison of engagement with behaviour change between test and control groups

It is notable that the level of engagement and knowledge has not changed among the participants in the test groups when compared to the control group. This suggests that the additional information provided through the Trial has not lead to empowerment. The lower proportion of test participants who state that they would like to do more to reduce gas usage (84%) compared to the control group (86%) reflects the higher proportion of test group participants who believe that they have already made changes in the way they live to reduce their gas usage.

Statement	Test group participants % agree	Control group % agree
It is too inconvenient to reduce our usage of gas	25%	32%
I do not know enough about how much gas is consumed in order to reduce my overall usage	46%	58%
I am not be able to get the people I live with to reduce their gas usage	42%	46%
I do not have enough time to reduce my gas usage	52%	53%
I do not want to be told how much gas I can use	55%	51%
Reducing my usage would not make enough of a difference to my bill	26%	24%

Table 23: Reasons for not engaging in gas usage reduction

Among those who did not report making changes to reduce usage or reported having already done a lot to reduce usage, reasons for lack of change are similar (**Table 23**) with the

exceptions of *"It is too inconvenient to reduce our usage of gas"* and *"I do not know enough about how much gas is consumed in order to reduce my overall usage"* which suggests a minor positive impact of the Trial in terms of empowering gas usage reduction.

7.8 Participant behavioural impact

Participants perceived that they made changes as a consequence of their participation in the gas trial with only 13% of participants stating that they made no change. When asked in the post-trial survey about the types of changes they made, participants indicated whether they made any changes in the options outlined in **Figure 26**.

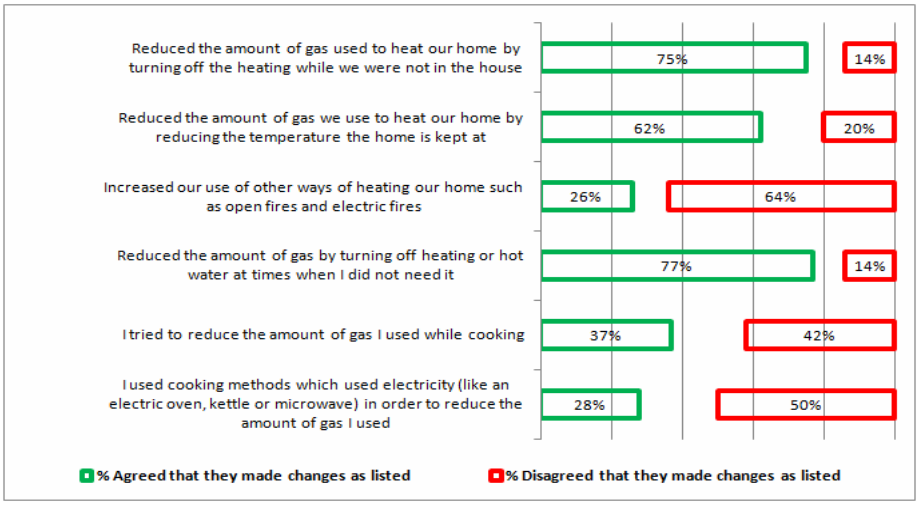


Figure 26: Behaviour changes reported among participants in the test groups

The specific behaviour changes reported are summarised in **Figure 26.** The most commonly adopted changes are supportive of overall reduction in energy consumption (*Switching off the heating when the home is unoccupied* – 75% report this behaviour; *Turning off heating or hot water when not needed* – 77% and *Reducing the temperature of the home* – 62%). In contrast, behaviours leading to substitution of energy usage were reported by a minority of participants reporting behaviour changes (*Increasing use of other heating methods* – 26%; *Increasing use of electricity for cooking* – 28%). Therefore it can be concluded that participation in the Trial encouraged appropriate behaviour changes.

A comparison of the typical home temperature reported in the pre-trial and post-trial survey shows that on average the test group participants reported a reduction in temperature by 0.23°C when compared to the reported change among the control group participants. It is reasonable to assume that this reflects a component of actual change in temperature.

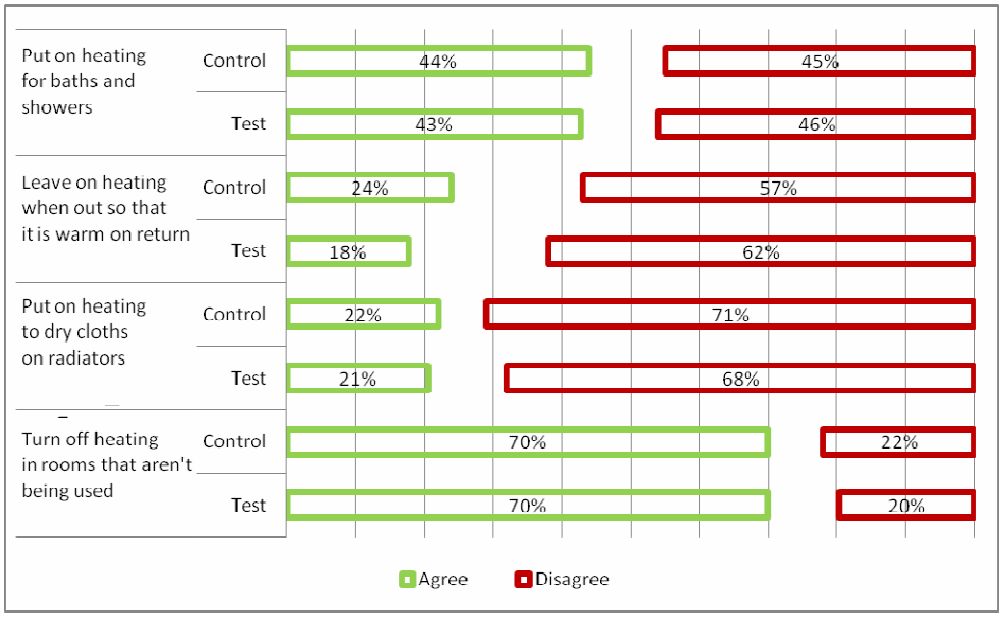


Figure 27: Behaviour changes reported among participants in the test groups

The qualitative research undertaken by the programme identified a range of behaviours liable to lead to inefficient use of energy. The reported prevalence of these behaviours is similar among test and control groups (**Figure 27**) with over 40% of both groups reporting putting on the heating to heat water for baths and showers and over 20% of both groups reporting putting on the heating in order to dry cloths on radiators.

Considering potential positive behaviours, the proportion of test group participants reporting that they leave the heating on while out (18%) is lower than the control group (24%). Finally, there was no change in the proportion of control and test group participants reporting turning off the heating in unused rooms (70%).

Therefore while the Trial encouraged positive behaviours, it did not discourage negative behaviours. This may reflect the avoidance of general energy usage education within the Trial communication (in order to isolate the impact of smart meters from other unrelated stimuli).

The use of a booster button (which over-rides timer settings and switches on heating for one hour) is lower among the test than the control group during both summer and winter periods. For example, 2% of the test group used the booster button several times a day during the summer compared to 5% of the control group during the same period. Similarly, 21% of the test group report using the booster button several times a day during the winter compared to 29% of the control group during the same period.

Considering investment in energy efficiency measures within the home, the research found a lower level of investment in different energy efficiency initiatives among the test groups when compared with the control group (**Figure 28**).

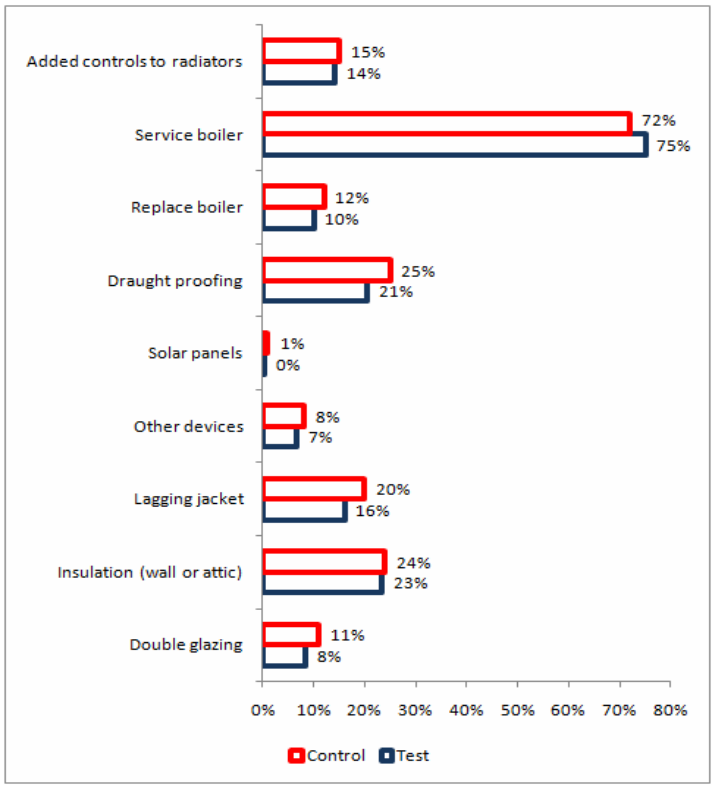


Figure 28: Behaviour changes reported among participants in the test groups compared with those in the control group

While the degree of difference is small, it may suggest that participation in the Trial appears to replace other initiatives such as investment in energy efficiency for a small proportion of test group participants.

Participants were also asked if their participation in the Trial had influenced their decision to invest in energy efficiency measures. Between a quarter and a half of all participants who invested, indicated that this investment was very much influenced by their participation (**Figure 29).**

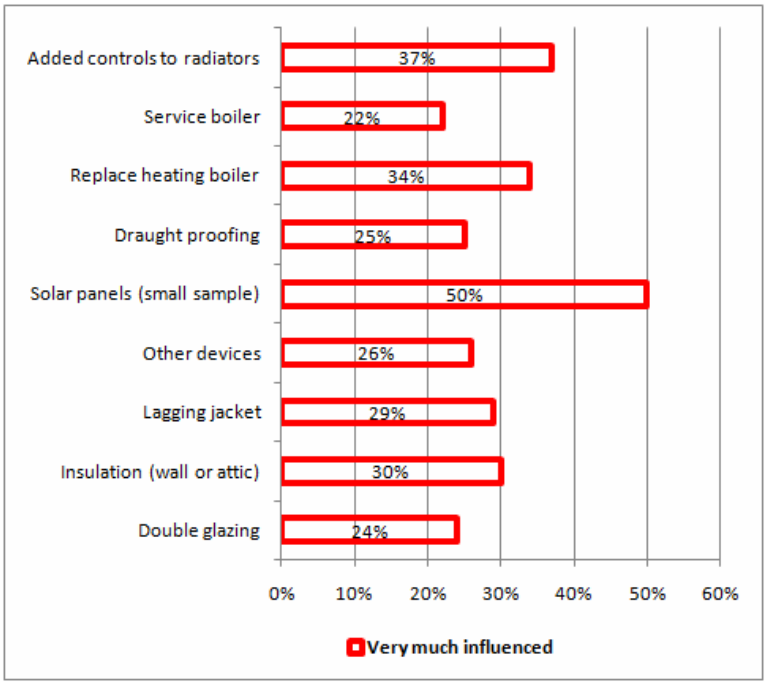


Figure 29: Percentage of participants who indicated that their energy efficient investment was very much influenced by their participation in the Trial

7.9 Participant attitudinal impact

Both test and control group participants were asked a series of questions related to a sense of interest and level of empowerment in changing the way they use gas. **Figure 29** and **Figure 30** show that those allocated to the test and control groups are no different from each other in terms of their sense of empowerment and interest in reducing gas usage.

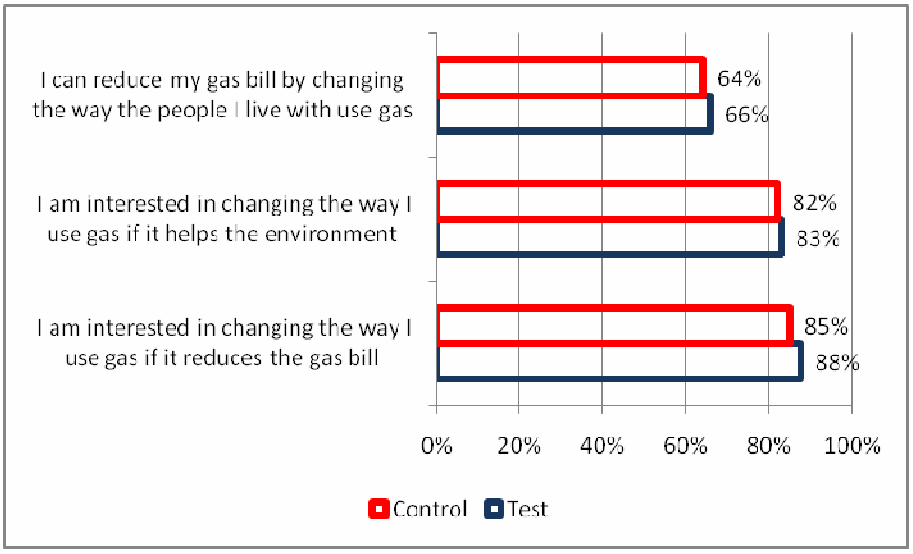


Figure 30: Comparison of empowerment and interest in gas usage reduction between test and control groups

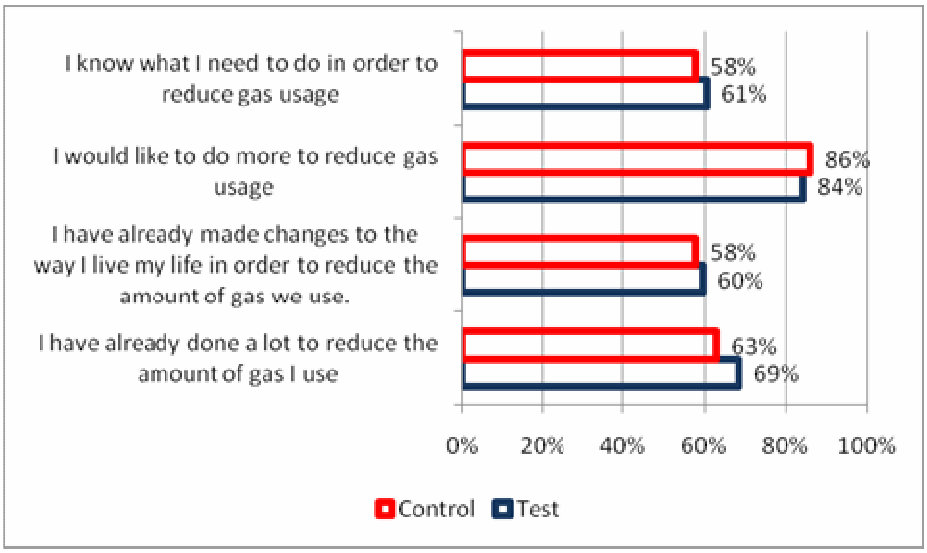


Figure 31: Comparison of engagement with behaviour change between test and control groups

The focus of the Trial was on information enabled by smart meters. It did not seek to measure more general information on how to reduce usage. Therefore it is an unsurprising result that the level of knowledge needed to reduce gas usage did not improve significantly as a result of participation in the Trial (**Figure 32**). The lower proportion of test participants who stated that they would like to do more to reduce gas usage (84%) compared to the control group (86%) reflects the higher proportion of test group participants who believed that they had already made changes to the way they lived to reduce their gas usage.

However, the Trial did have positive impacts in the increased awareness of gas usage. Test group participants reported that they became more aware of gas usage (74%) and the cost of the gas used (77%), 36% stated that there was no impact from their participation in the Trial (**Figure 32**).

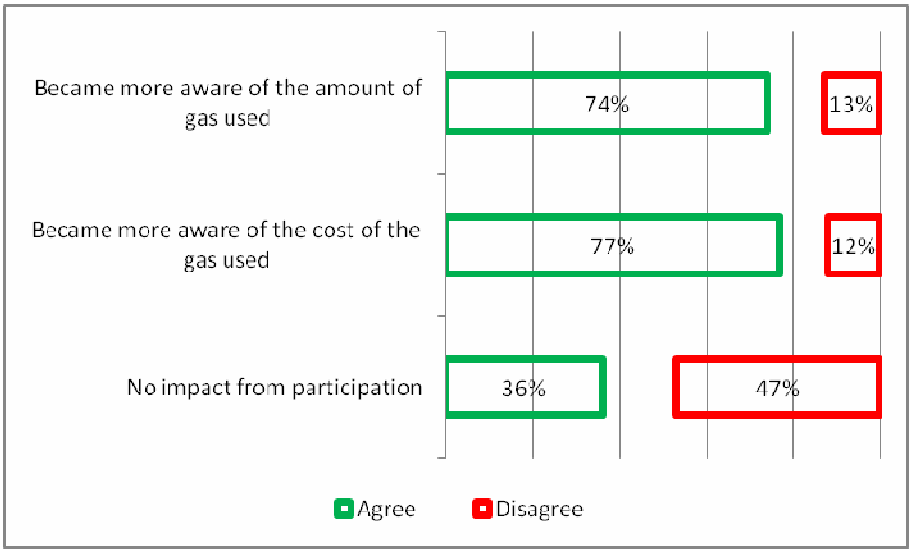


Figure 32: Perceived impact of participation in the trial among test group participants

7.10 Participant assessment of supporting information and stimuli

i) Bi-monthly and Monthly energy usage statements

Most consumers' recalled receiving the energy usage statements (86%) and agreed that the frequency with which it was sent was about right. (77% of those receiving monthly energy usage statements agree; 78% of those receiving bi-monthly energy usage statements agree). The recall score is good given that the energy usage statements were delivered in the bill and qualitative research undertaken found that not all consumers opened the bill (and a larger proportion do not read inserts which the energy usage statement may be mistaken for).

The average amount of time spent reviewing the energy usage statement across the 12 month trial period was 45 minutes with 9% spending no time at all. This reinforces the need to design the statements to ensure that the most relevant messages are immediately accessible within this limited amount of time.

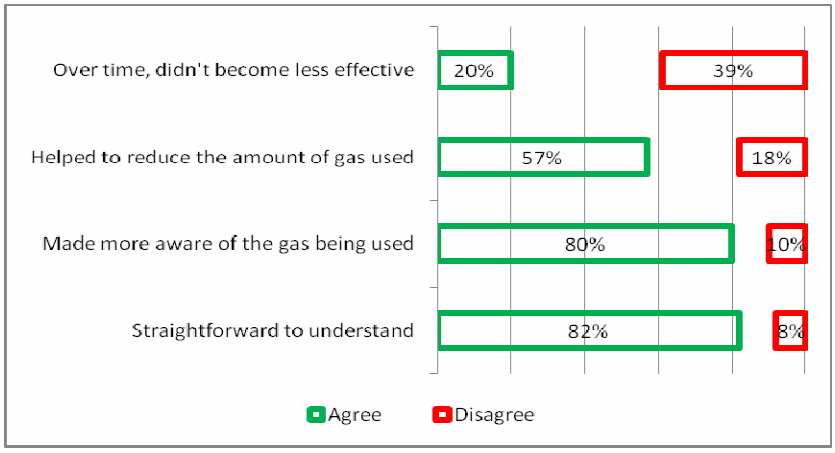


Figure 33: Participants' rating of the impact and benefits of the usage statement

The participants' assessment of the energy usage statement was good with 82% stating it was straightforward and 57% stating that it helped them reduce the amount of gas they used (**Figure 33**). In response to the statement '*Over time, the energy usage statement had less effect on my usage'*, 20% said that it did not become less effective over time, while 39% disagreed.

Of the individual items on the energy usage statement, the element that provided general usage and cost information including the usage averages for the current period and daily usage was recalled most often and rated most highly. Detailed analysis of the energy usage statement is included in section A7.3.

ii) In-home Display Device

62% of participants who received the In-home Display Device (IHDD) rated it as effective in helping them reduce their gas usage. On average participants reported spending 62.5 minutes over the course of the entire Trial understanding the IHDD. However, there was a small group of consumers (8%) who reported spending more than three hours understanding the device. A further 9% indicated that they did not spend any time understanding the IHDD.

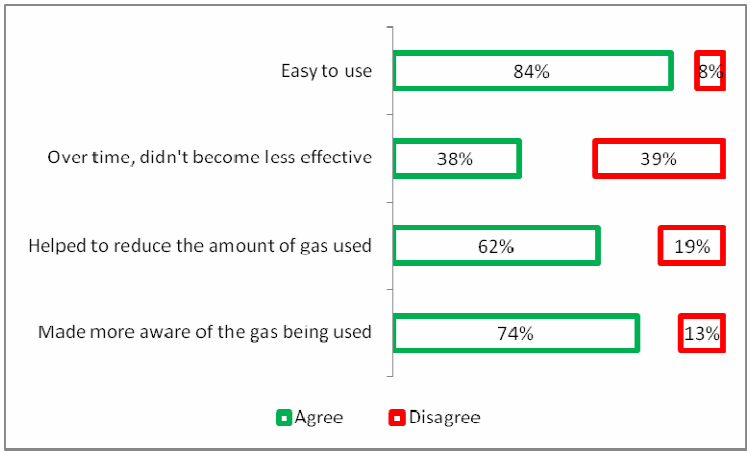


Figure 34: Participants' rating of the impact and benefits of the IHDD

Most participants who received an IHDD perceived it was easy to use (84%) with a majority believing that it helped them to reduce the amount of gas used (62%) and made them more aware of the gas they used (74%). These scores are clearly supported by the larger reduction (although not statistically significant) achieved by participants in the test groups receiving the IHDD.

Among those participants who were no longer using the IHDD (25% of all participants who received an IHDD), the most common reason given was that they had already learnt as much as possible from it (a statement agreed with by 45% of these 25%).

Of the items displayed on the IHDD, the cost of gas consumed was recalled by the highest proportion of participants (92% of participants recalled this element). 86% recalled the graph showing the current usage of gas and 85% the current temperature displayed.

During the Trial, text messages were sent to the IHDD to provide reminders of tariff changes; urging participants to turn down their heating after a period of cold weather; as well as energy saving hints. In total eight messages were sent during the trial period. The fact that there was a low level of recall among participants (at 15%) may reflect the relative infrequency of the messages. Nevertheless, among those who did recall the messages, 26% rated them as effective.

iii) Variable tariff

57% of participants who tested the variable tariff were aware that the tariff varied during the trial period. This is a low figure given the potential impact of the tariff on the bill size. Participants who stated that they were aware of the changing tariff structure on average spent 20.25 minutes understanding the tariff through the trial period with 41% reporting spending more than 15 minutes across the trial period.

Despite this most participants were not able to state the cost of gas. 92% reported not knowing the unit cost of gas during the low usage period and 94% reported not knowing the unit cost of gas during the high usage period. No respondent was able to accurately state the cost. This low level of knowledge was also reflected in the qualitative research and reflects that engagement with gas consumption occurs at the level of bill total and cost.

This lack of knowledge should not, however, be interpreted to mean that the increased tariff did not have an impact. Participants may react to signals delivered through the energy usage statement, the bill or the IHDD. This was reflected in the different usage pattern exhibited by participants in the variable tariff test group when compared to other test groups and the control.

7.11 Conclusions

The main findings may be summarised as follows:

Response stimuli

- The deployment of stimuli was found to reduce overall gas consumption by a statistically significant 2.9%.
- Each of the four stimuli combinations tested was found to reduce usage by a statistically significant amount.
- The combination of bi-monthly bill, energy usage statement, IHDD and variable tariff led to the greatest reduction of 3.6% although this was not statistically different from the reduction achieved by the groups exposed to other stimuli combinations.
- The greatest volume reduction occurred during the High Usage period (from October to March inclusive) and this accounted for 70% of the overall reduction reported. However, this also means that the reduction during the Low Usage period (from April to September inclusive) accounts for 30% overall and is, therefore, not insignificant.
- Participants allocated to Stimulus 4 (the variable tariff) responded to the price signal by concentrating their reduction during the period of highest prices (from December to March) as well as achieving the greatest overall reduction in usage.
- Analysis of intra-day usage patterns showed reduction in overall usage in the evening period (from 4pm onwards) throughout the year and reduction in the morning period during the Low Usage period (from April to September inclusive). However, during the High Usage period, while usage reduction is achieved in the early morning from 4:30am to 6:30am there is an element of load shifting to the 7:00am to 9:00am period.
- The impact on participants' bills was positive amongst all groups. This included the group with the variable tariff, thus reflecting the ability of this group to modify behaviour sufficiently to negate the potentially negative impact of the tariff on bill size.

Demographic, behavioural and experiential conclusions

- The Trial had a positive impact on increased awareness of gas usage with 74% reporting that they became more aware of gas usage and the cost of gas they used (77%).
- Changes adopted were supportive of the objective of reducing overall energy consumption. For example 75% reported switching off heating when the home was unoccupied and 62% reported reducing the temperature of the home (on average reducing the temperature by a reported 0.23^{o}C more than those in the control group).
- Use of the booster button to over-ride other heating controls was slightly lower among the test groups reflecting the level of reduction in usage.
- Other negative behaviours (such as switching on the heating to dry clothes) were not impacted by the Trial with similar proportions of test and control groups reporting these behaviours. This reflects the scope of information provided within the Trial.
- The usage statements were reasonably effective with 57% stating it helped them to reduce the amount of gas they used. The frequency of the statement (monthly or bi-monthly) was acceptable to most participants (77% of those receiving a monthly statement; 78% of those receiving a bi-monthly statement).
- The In-home display device was also reasonably effective with 62% stating it helped them reduce their gas usage and 75% stating that they still used the IHDD at the end of the Trial. Text messages sent to the IHDD were effective for those who recalled receiving the message. However only 15% recalled the messages.
- Most participants (87%) engaged in behaviour change reporting that they made some change to the way they used gas due to the Trial.
- The variable tariff (while achieving the greatest volume reduction) was not understood by most participants (57% were aware that the tariff varied and over 90% of participants were not able to provide any estimate of the unit costs).
- Similar to the electricity trial, test group participants were slightly less likely to invest in energy efficiency measures than those in the control group. This may reflect a perception among a small proportion of test group participants that participation in the Trial appears to replace other investments.
- There were low levels of reported substitution of other heating sources with 64% reporting no increased use of the other heating sources.

8 Design of the SME Trial

8.1 Introduction

The SME Customer Behaviour Trial aimed to measure consumer response (behaviour change) to smart meters and the additional energy usage information provided through a web interface over the period of the Trial. In designing the SME Trial it was recognised that there is a high degree of variability in the usage patterns amongst different types of organisations reflecting diverse sectors, business models and enterprise size. 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 focus on the qualitative assessment of the impact of smart meters by the SME's themselves. This was complemented by observing and analysing their patterns of usage captured by the smart meter data over time considering their access to the Web information stimulus.

The SME trial comprised a study of 50 single and multi-site consumers. SME Gas consumers with more than 73,000 kWh annual consumption, in selected sectors and classified into three usage criteria, were broken down as follows:

	Small Count	Medium Count	Large Count
Restaurants, pubs, takeaways	4	2	2
Government building	3	2	2
Leisure/Hotels/Spa's	3	3	3
Healthcare	3	3	3
Education	3	3	3
Industrial (process load/space heating)	3	3	3

Figure 35: Breakdown of participating SMEs

- Small was defined as between 73MWh and 273MWh
- Medium was defined as between 273MWh and 423MWh
- Large meant greater 423MWh but below daily metered consumers
- 50% of consumers were to be FVT[30] consumers

The sectors were selected on the basis that the Top 10 sectors (the sample comprised 79 different sectors) accounted for over 60% of the consumption). During the recruitment phase,

[30] Fuel Variation Tariff

in order to enhance the recruitment process, the following additional sectors were also included:

NACE Code	Sector
Builders and developers	Industrial
Computer/IT	Industrial
Construction Industry	Industrial
Food, drink and tobacco	Industrial
Paper and Printing	Industrial
Warehouse Outlets	Industrial
Churches	NGO's
Community Centres	NGO's
NGO's/Charities/Religious	NGO's
Caterers	Retail
Chain Retail Stores	Retail
Department Stores	Retail
Estate agents	Retail
Insurance and pensioners	Retail
Motor traders	Retail
Retail/commercial	Retail
Retail outlets	Retail

Figure 36: Additional SME Sectors included

8.2 SME Trial Matrix

The overall sample size was specified at 50 participants and represented a broad cross-section of the population of gas users eligible to participate in the Trial. All 50 SME participants were invited to access the web interface

SME participants were distributed across the control and test groups as follows.

	Bi-Monthly Bill and Web Access	
Test Groups	50	**50**
Control group	N/A	
	Total	**50**

Table 24: SME Matrix allocation as of April 2010

8.3 Stimulus Design and Development

The web interface stimulus was adapted for the Trial based on a web portal from the company Temetra Limited.

8.3.1 Web Access to Energy Usage Information

The web interface provided participants with access to:

- Detailed usage information updated daily to allow easy identification of changes in usage and associated costs.
- Their usage and costs across different time bands (daily, weekly, monthly).
- Reports based on the above.

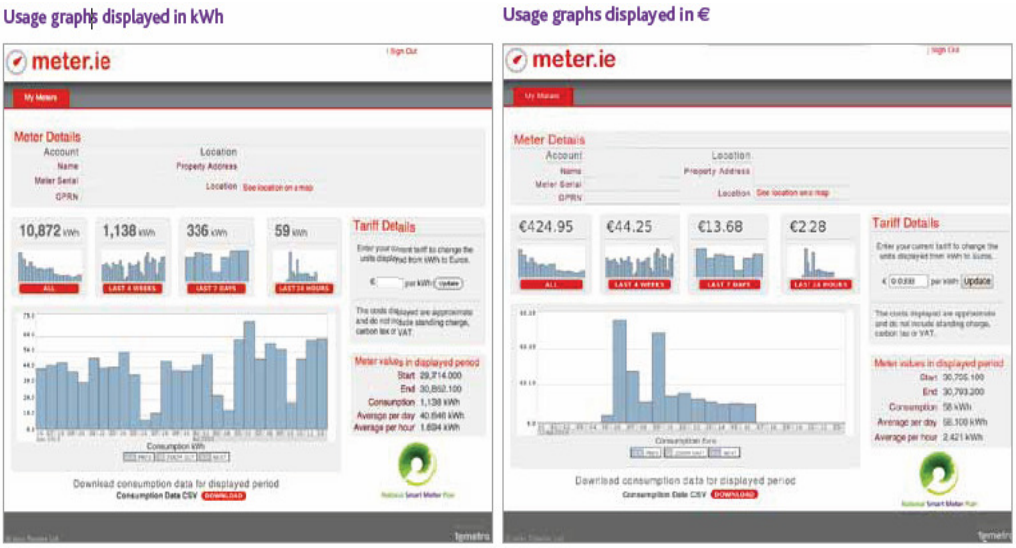


Figure 37: Web Interface

8.4 Calendarisation of Billing

All SME participants were calendarised from the start of the Trial in August 2009 to the end of the Trial in May 2011.

9 SME Participant Communication and Involvement

9.1 Introduction

A communications programme to support the Customer Behaviour Trial was put in place. The aim of this programme was to successfully recruit a representative sample of participants as outlined above and to provide them with details of the web interface.

9.2 Recruitment Communications

Participants were recruited through a voluntary "opt-in" approach, using telephone calling, follow up by an acknowledgement letter and a Frequently Asked Questions (FAQ) brochure. Given the nature of SME consumers this approach was considered essential in gaining opt-in. **Appendix 10**, Sample Communications, contains examples of the acknowledgement letter and the FAQ.

9.3 Trial Communications

In keeping with the on-line nature of this Trial most of the communications to participants was by email. Participants did not receive a detailed bill or other communications which formed part of the Residential Trial. Reminder emails regarding the web interface were sent to encourage use. On conclusion of the Trial a letter thanking them for their participation and reminding them of the survey was also sent.

9.4 Consumer Research

Research of gas 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 June/July 2011, comparing change in attitude, equipment or gas use to the pre-trial findings.

10 SME Trial Participants - Approach to SME Data Analysis

10.1 Approach to SME Data Analysis

The SME meter data were merged with the responses, where they were achieved, of the pre-trial and post-trial surveys. Participants were classified and analysed by integrating sectoral, consumption and survey information such as business profile (including hours of operation, equipment used on business premises and prior completion of energy audits). It also included the impact of the Trial across reported changes in usage, experiential (including the use of the web interface) and attitudinal (such as changes in attitudes towards energy use) information.

The analysis focused on assessing the impacts of the Trial on the participants and assessing differences in this impact across the measured dimensions. The characteristics of sub-groups were examined to determine if there were patterns associated with attitudes, experience or engagement that might provide insight to potential for behavioural change.

10.2 Treatment of Data

In the case of the SME data, it was decided that there was no requirement for treating missing data. 34% of the meters had no missing readings with a further 60% missing 1.5% or less reads over the trial period (equivalent to approximately 4.5 days of missing reads). 9% were reporting on an hourly basis with minimal missing data. One meter exhibited a high level of missing data and was eliminated. No other treatment of the data was undertaken with the SME data.

10.3 Methodological Approach

Data were analysed using exploratory data analysis techniques and non parametric options. Data summaries were created, analysis completed and the results presented in both graphical and tabular format.

10.4 Recruitment Approach and Outcome

Participants were recruited at random but following the quotas provided in order to ensure sectoral and size coverage. An opt-in approach was used in response to a telephone invitation.

10.5 Participant Distribution and Profile

The final distribution of participants is shown in **Figure 38** and **Table 25** below. It includes cross-sectoral participants and participation from both public and private sectors.

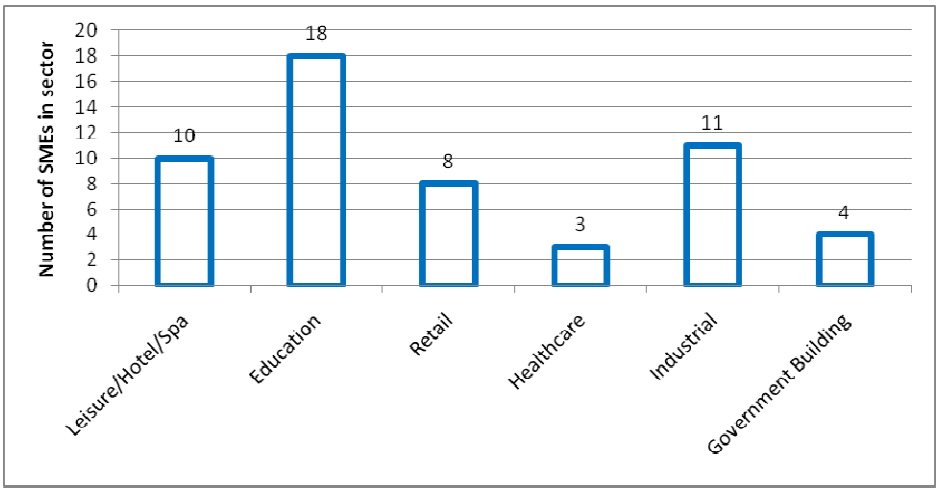


Figure 38: Sectoral profile of SME participants

Sector → / Size ↓	Government buildings	Leisure, hotels, spa's	Healthcare	Education	Industrial	Retail
Small 73MWh - 273MWh	2	3	1	12	7	6
Medium 273MWh - 423MWh	-	-	-	3	1	1
Large >423MWh	2	7	2	3	3	1
Average consumption	888MWh	2,521 MWh	573MWh	291MWh	742MWh	239M Wh

Table 25: Sectoral Profile of SME participants

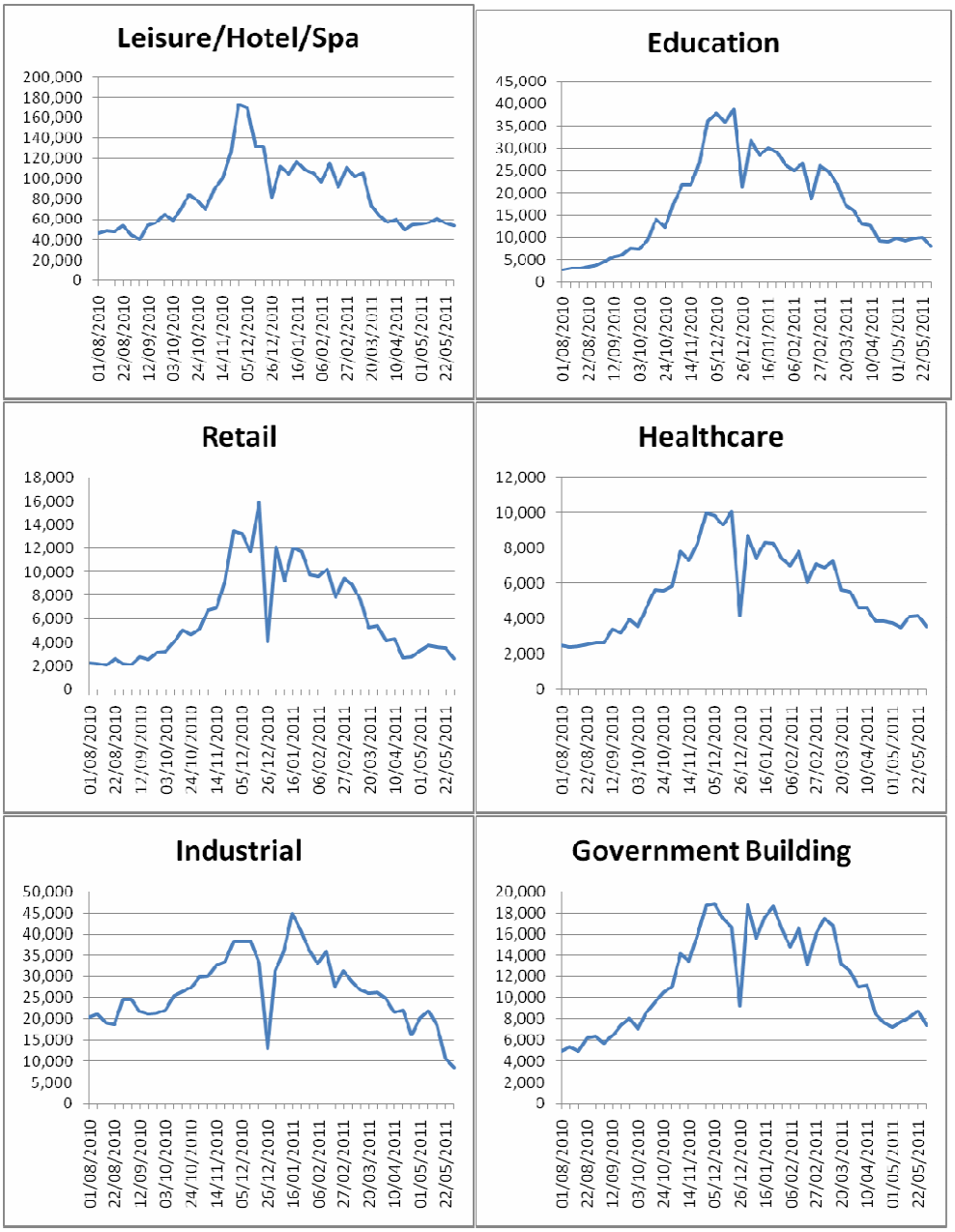


Figure 39: Weekly usage averages (in kWh) by SME sector for each week of the Trial

The sector level usage profiles show distinctive patterns (**Figure 39**) reflecting the different business requirements within the context of the temperature (and hence seasonally) driven patterns. For example, the retail sector shows a sharp peak in the week immediately prior to Christmas while the leisure/hotel/spa sector peaks earlier in December.

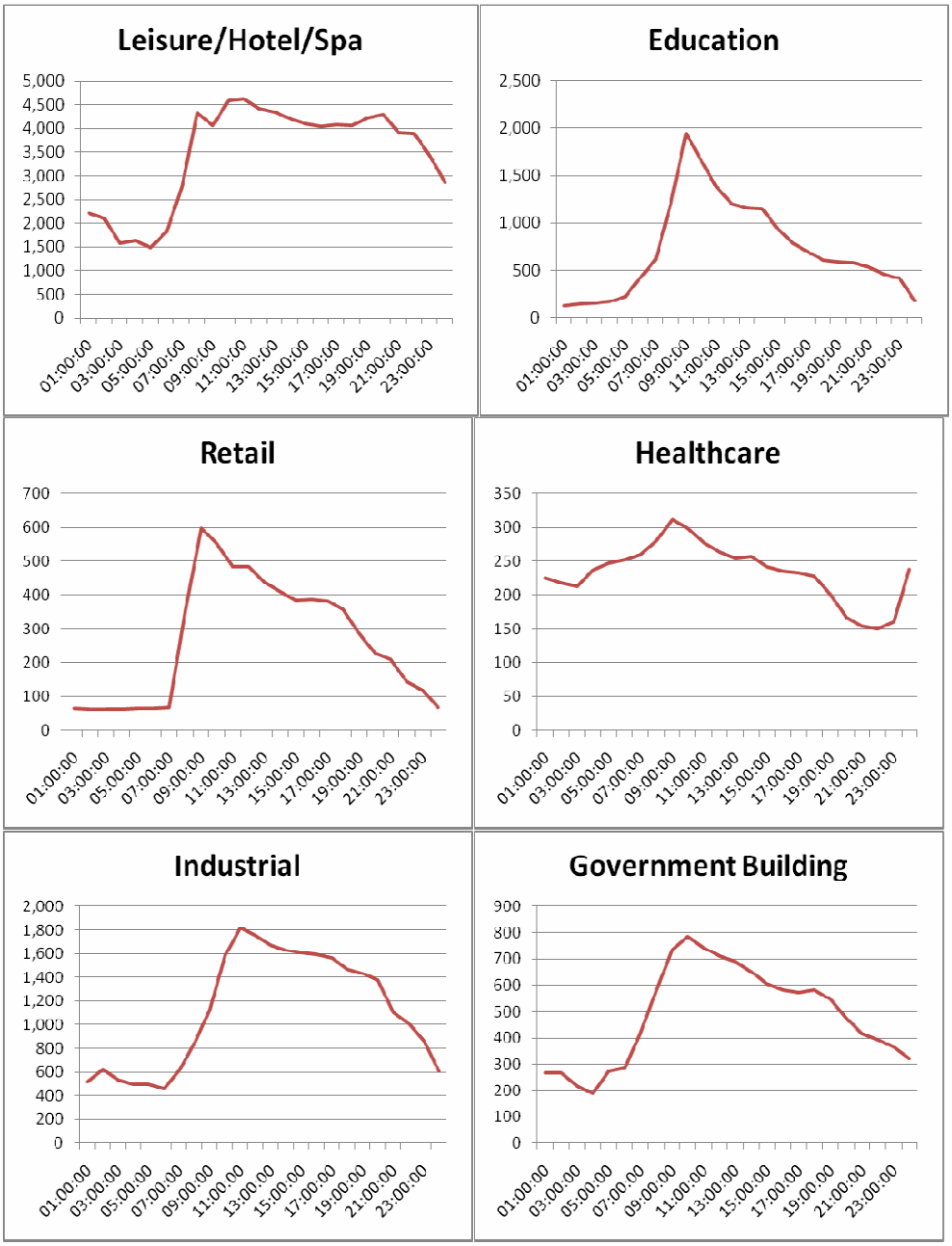


Figure 40: Hourly usage averages (in kWh) by SME sector

As with the weekly average usage profiles, the hourly average usages also reflect the different business requirements (**Figure 40**) with some sectors' usage clearly delineated by restricted hours of operation (such as retail and education) while other sectors (such as healthcare) have requirements which vary less by time.

10.6 Attritor profile

In the case of the SME Trial, attrition was deemed to have occurred if a company went out of business and ceased to use gas (as measured by the smart meters) or if a meter ceased to function because of technical issues associated with the premises, the meter or the installation. Apart from those cases, participants were considered remaining in the Trial, irrespective of whether they availed of the web stimulus option or not. As the web interface was hosted by Bord Gáis Networks a change of supplier did not result in attrition as participants could continue to access their data irrespective of their current supplier.

11 Outcome of SME Trial

11.1 Summary

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

11.2 Impact of the Trial on consumption

The focus of the SME gas trial was a qualitative assessment of impact. The primary information sources were:

- The CATI-based pre-trial survey of SME participants carried out in January 2011 during the Trial. This survey achieved a response rate of 53% (29 respondents from a population of 55 participants) which is a reasonable level of response as completion was voluntary and without incentive (such as that paid to respondents to the residential surveys).
- The CATI-based post-trial survey of SME participants carried out in August 2011. The survey achieved a response rate of 45% (25 respondents from a population of 55 participants).

The respondents were those individuals responsible or jointly responsible for making decisions about each participating organisation's use of natural gas. Reflecting the focus on qualitative assessment, the design of the Trial did not include a benchmark period against which to compare consumption.

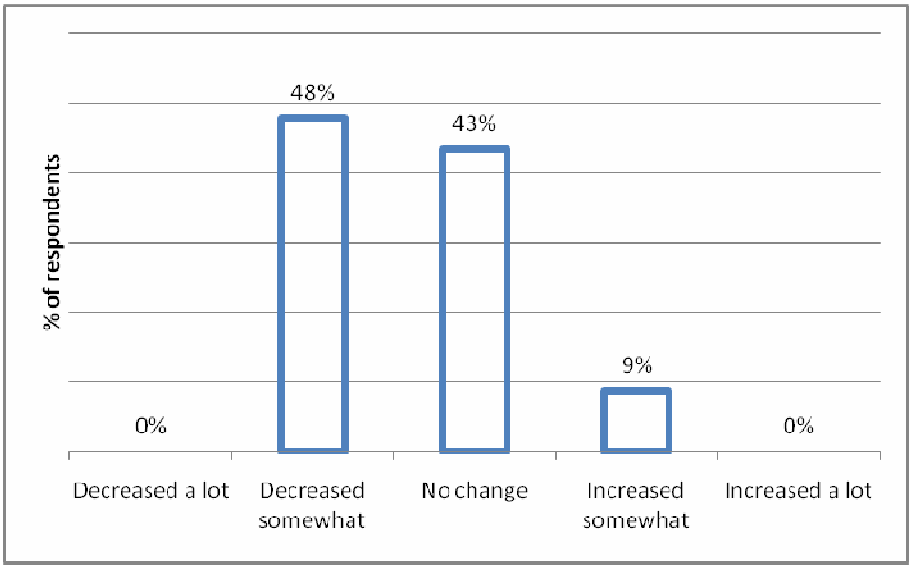


Figure 41: Reported increase or decrease in consumption during the trial period as reported by SME participants

Participants were asked to estimate whether their level of consumption had reduced, held steady or increased during the Trial (**Figure 41**). 48% reported some level of reduction. Reductions were predominantly reported in organisations with lower levels of usage. Only

one of the six organisations participating, which had usage greater than one million kWh reporting a reduction.

Among all SMEs reporting a reduction in gas usage, the average estimate of the reduction was between 5% and 10%.

11.3 Behavioural and Attitudinal impact of participation in the trial

A majority of respondents to the SME post-trial survey stated that participation in the Trial increased their organisation's awareness of the cost of natural gas used (74% as shown in **Figure 42**) and increased their organisation's awareness of where gas is used (70%).

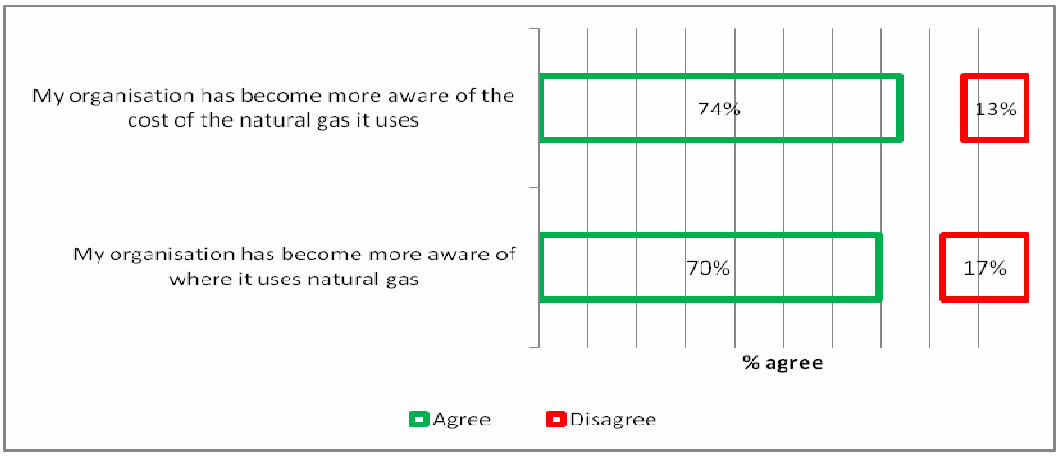


Figure 42: Reported increase or decrease in consumption among respondents to SME post-trial survey

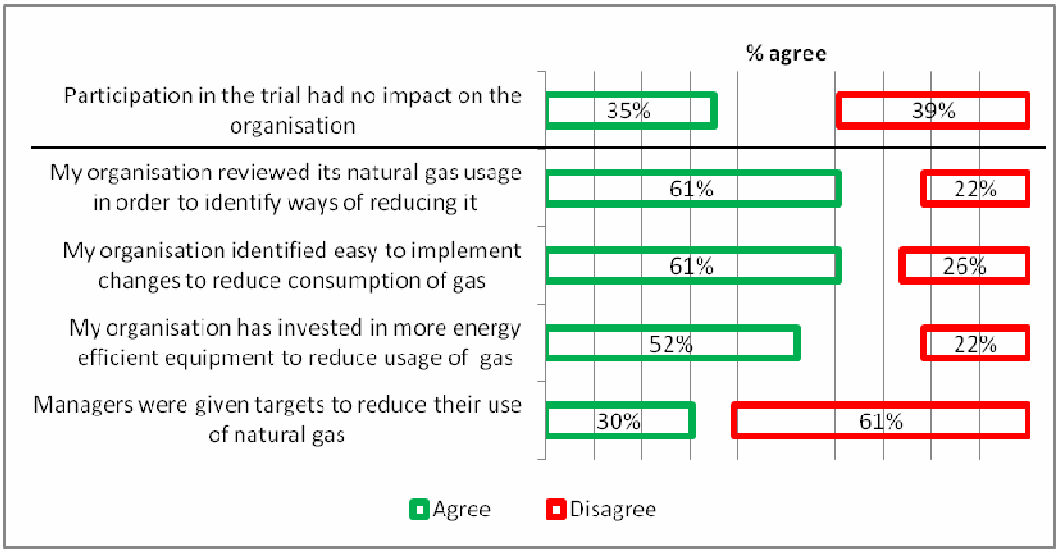


Figure 43: Impact of the Trial on SME behaviours

A majority of respondents to the post-trial survey stated that their organisation had taken steps as a consequence of their participation in the Trial. This included reviewing usage to identify opportunities to reduce consumption, identifying easy to implement changes and invested in more energy efficient equipment to reduce usage of gas (**Figure 43**). In each case, analysis showed that there was no clear association between the behaviour, consumption level and the sector of which the organisation was a member.

Areas where the Trial had an impact on the behaviour of participating SMEs included:

- **Carrying out of energy audits:** Of the SMEs which had carried out an energy audit[31] within the last 12 months, 10% stated that this was a consequence of participation in the Trial;
- **Introduction of monitoring and tracking of energy usage trends: :** Of the SMEs which had introduced monitoring and tracking of trends in energy use, 33% stated participation in the Trial was a significant factor to the decision;
- **Appointment of a person responsible for energy usage checking, monitoring and feeding back:** Where a person had been given these responsibilities, 33% stated participation in the Trial was a significant factor;
- **Frequency with which gas equipment is serviced:** 91% stated that the frequency with which they serviced their gas equipment had not changed over the previous 12 months. Of the 9% that stated that it had, 100% rated participation in the Trial as a very significant factor in the decision to increase servicing levels;
- **Investment in more energy efficient equipment:** 52% stated that the organisation had invested in more energy efficient gas powered equipment as a consequence of their participation in the Trial.

11.4 Assessment of the Web Interface

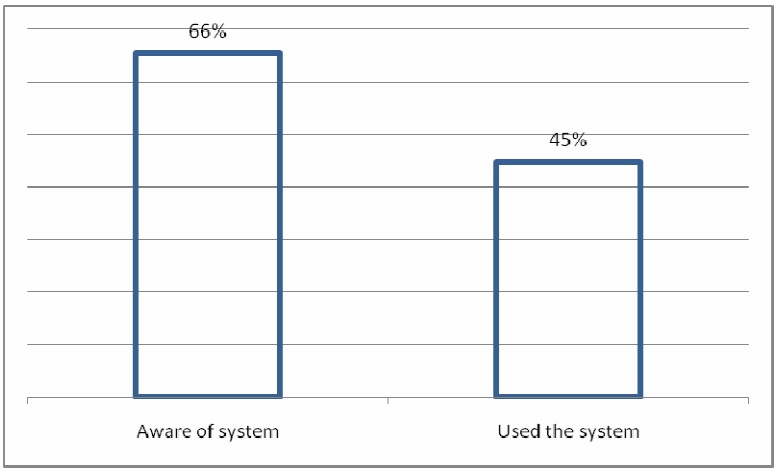


Figure 44: Awareness and use of web interface among SME participants

[31] measured in the post-trial survey.

The Web interface was available to all participants and promoted through communications both at the start of and during the Trial. 66% of participants stated that they were aware of the existence of the web interface with 45% stating that they, or somebody else in their organisation, had used it (38% had used it themselves). Both awareness and usage of the web interface was higher among SMEs with lower consumption levels and conversely lower among those SMEs with higher consumption. SMEs who were aware but didn't use the interface perceived duplication between it and existing energy management systems in use. This tended to be in organisations with higher levels of consumption.

Among the participating SMEs who were aware of the interface, but chose not to use it, the most common reasons given were forgetting the password or the website address. Only 17% of these stated the reason was that the web interface was not easy to use.

Among SMEs who did use the system, the greatest proportion used the system approximately once a month (45%) with 27% using it every two months and 27% using it less frequently.

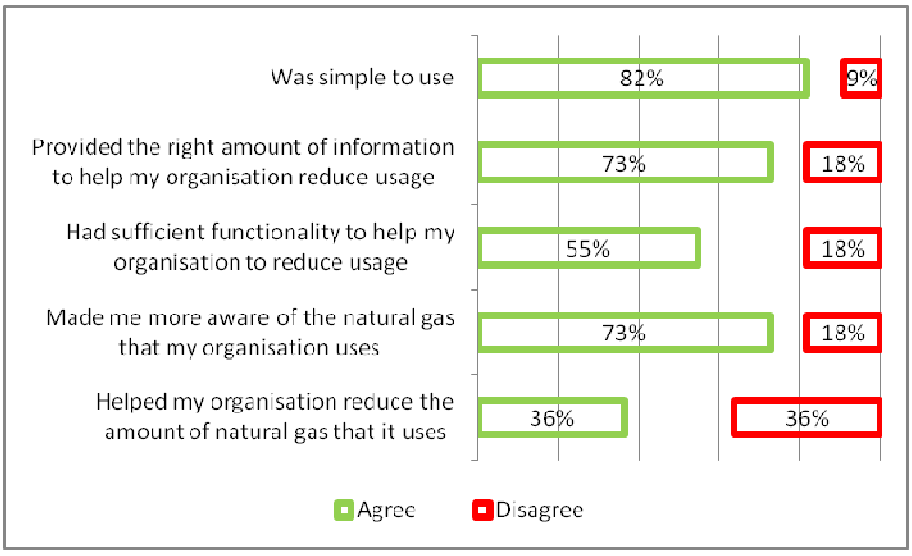


Figure 45: Assessment of web interface among SME participants who used the system

Among users of the web interface, the assessment was positive in terms of simplicity (82% found it simple to use), the information provided (73% stated it provided the right amount of information) and impact on awareness (73% stated that it made their organisation more aware of consumption). However, a lower proportion found that it helped in reducing the consumption of natural gas in the organisation (36%). This suggests a gap between the type of information provided by the web interface and the type of information and other support required to achieve usage reduction. It may reflect a need to integrate the web interface within a broader range of supports (spanning information and consultancy) to achieve greater usage reduction with SMEs.

11.5 Conclusions

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

- 48% of participating SMEs reported reduced gas consumption during the Trial with a typical estimated reduction of between 5% and 10%.
- The Trial increased awareness of both the cost of natural gas consumed (74% of SMEs) and where natural gas it was used (70% of SMEs).
- Participation in the Trial led to reviews of natural gas usage (61%), identification of easy to implement changes (61%) and investment in more energy efficient equipment (52%).
- Participation in the Trial also led to some increase in the level of energy audits, introduction of monitoring and tracking and assignment of responsibility for energy usage monitoring;
- Most impacts of the Trial were not specific to any sector and not related to level of consumption;
- The Web interface was used by 45% of participants who assessed it as simple to use (82% of users) and providing the right amount of information (73%).
- The Web interface was considered effective in helping actual reduction in natural gas usage by 36%. In contrast a further 36% stated that it was not effective. This suggests that the web interface is not sufficient to drive reduction without other interventions.