APPENDICES

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Appendix 1: Experimental Design of Residential Gas Trial and Qualitative Design of SME Gas Trial

A1.1 Introduction

The objective of the Customer Behaviour Trial (CBT) was as follows:

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

Specifically in the context of the Residential Gas Trial, the objective was to determine the extent to which the amount of gas consumed by domestic consumers is reduced by the stimuli to which they are exposed, when compared with a similar group not exposed to that set of stimuli.

In answering these questions, it was essential to design the Residential Trial in a manner most likely to produce a statistically reliable and robust conclusion. On that basis an experimental design measurement approach was developed, with the following focus:

- A clear definition of the individual behavioural trial objectives (hypothesis);
- A statistically robust methodology for conducting trials that will give meaningful and measurable results for analysis;
- A participant selection and recruitment process to produce a statistically representative sample.

The specific objective of the Residential Trial was to detect a reduction in usage of 3% or more (*the effect*) at a 90% confidence level, among consumers who are supplied with a smart meter and DSM stimuli. The Trial included a *control group* of individuals with smart meters, against which change was measured and who were not exposed to the DSM stimuli.

The experimental design matrix set out the combinations of DSM stimuli to which the participants would be exposed. To deliver the objective of detecting a 3% change over the entire trial at a 90% confidence level, the number of participants in each cell of the matrix was established from a statistical analysis of the variation in gas usage present without the interventions. This analysis was done on two different data sets. The first was data with bi-monthly usage generated through the FAR[1] model, currently in place to measure gas usage of the subscribers. The second source was a smaller dataset of daily meter reads made available from a Logger Meter (196 meters with daily data captured from April 04 to June 06).

[1] The FAR data programme is a gas industry process used in order to estimate how much gas is required by the gas network on a daily basis. FAR stands for Forecast, Allocation & Reconciliation. Data loggers are maintained on a statistical sample of customer premises to monitor consumption of Natural Gas with a correlation to National Weather data. Data from this correlation is used to more accurately forecast the daily requirements of gas demand on the National Network and to ensure both sufficient and efficient supply to all Natural Gas Customers.

As well as defining the structure and size of the experimental design matrix, other decisions needed to be made as part of the experimental design, many of which are related to the assessment of variability usually present in gas usage data:

1. The need for and duration of a benchmarking period during which usage data could be collected by installed smart meters before the DSM stimuli were deployed.
2. The duration of the Trial – related to the duration of the benchmark with the duration of both set at the minimum period required to deliver reliable results within the tolerance of a minimum of 3% detection at a 90% confidence level and with a reasonable number of deployed meters.

Finally, the experimental design also needed to incorporate the following dimensions of the Trial

- The management of meter installation and key transition or communication points in the Trial in a manner which would not distort the overall result. This meant all participant bills during the Residential Customer Behaviour Trial had to be calendarised (i.e., each bill comprised a discrete bi-monthly or monthly billing period from the first day of the month to the last day of the month). Similarly, credits, such as the thank you payment or the balancing credit, were made outside of the Test period, so as to ensure any impact on customer behaviour was minimised.

A1.2 The Experimental Design Matrix

The key constraints for the design of the trial were:

- Maximum 1,925 meters/consumers.
- The ability to test four stimuli in order to determine their relative impact in terms of energy reduction
- The requirement for the identification of behavioural change at a 3% effect at the aggregate level, 4% effect at the stimulus level and 5% effect at the cell level to be discernible at 90% confidence

The experimental design matrix is shown in **Table Ax. 1:** Experimental Design Matrix**.** The analysis outlined in the next sections established the number of participants in each cell and in the control group required to deliver the required accuracy of results.

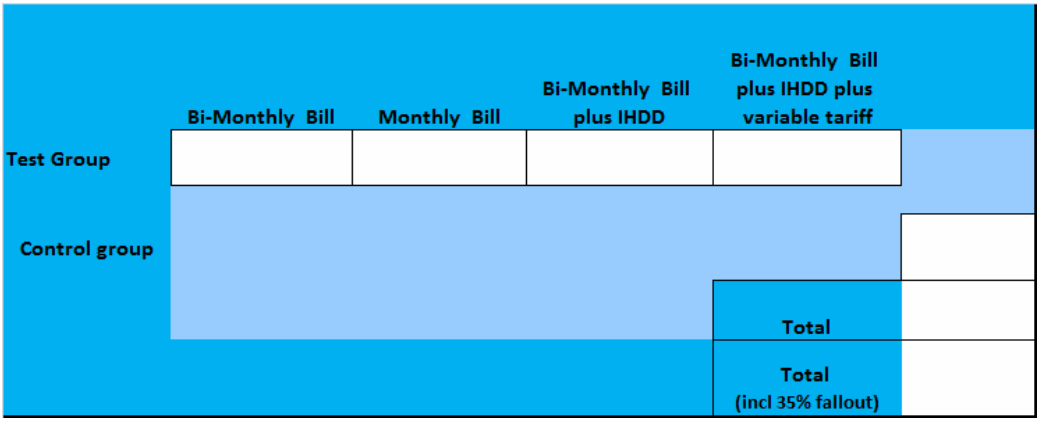

Table Ax. 1: Experimental Design Matrix

A1.3 Determining the structure of the Residential Trial

The accuracy of the results is determined by the number of the participants in the Trial and the natural variability associated with the phenomenon under investigation. There are three sources of variation which tend to mask detection of the effect by increasing the variability in the data not associated with the impact of the DSM stimuli:

a) **Temporal variation:** The level and pattern of usage varies over time driven by economic, cultural and weather variations. Cultural events such as the timing of Easter will also impact usage levels between years.

b) **Individual variation:** The level and pattern of usage varies greatly between individual consumers due to individual economic circumstance, life-styles, household size and method of home heating.

c) **Seasonal variation:** The level and pattern of usage varies within each year with day length and climate.

The methodology used for the Trial controls for these sources of variation in order to allow measurement of the underlying effect.

a) Controlling temporal variation: Temporal variation was controlled by examining the change in usage in a group of consumers who were equipped with smart meters but were not exposed to any stimulus (*the control group*) and a group of consumers who were equipped with smart meters and exposed to the DSM stimuli (*the test group*). This allowed the temporal variations to be removed to expose the effect. For example: If there is a period of low temperatures, usage in both the control and test group is likely to rise. If smart meters in combination with the DSM stimuli are determined to impact on usage, this impact is measured by the extent to which the usage in the test group was lower or higher *when compared* with the control group.

b) Controlling individual and seasonal variation: Individual and seasonal variation are closely linked and were controlled for by comparing each individual's usage against their historic usage. In an ideal situation, data would be available for each participant for one year

or more in order to provide a robust estimate of 'normal' usage against which to measure usage during the Trial. However, no data was available on usage by time of use and limited data (at a two monthly meter reading level) was available for overall usage for trial participants.

Moreover in order to determine the required number in each experimental cell, an estimate of variability had to be reached. This estimation process used existing Logger data. It should be stressed that this set of meters is distinct from the meters installed for the purposes of the Customer Behaviour Trial.

The average usage across the time period is shown in **Figure Ax. 1.**

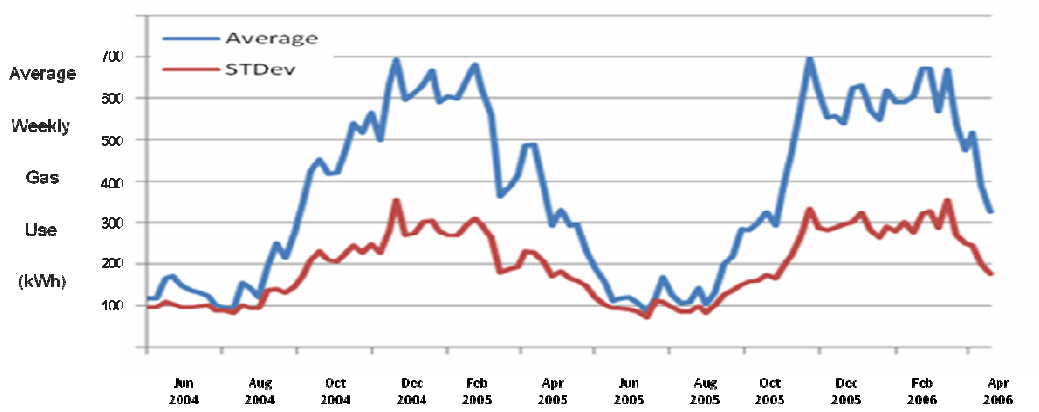

Figure Ax. 1: Average weekly usage across the time period June 2004 to April 2006 (using Logger data)

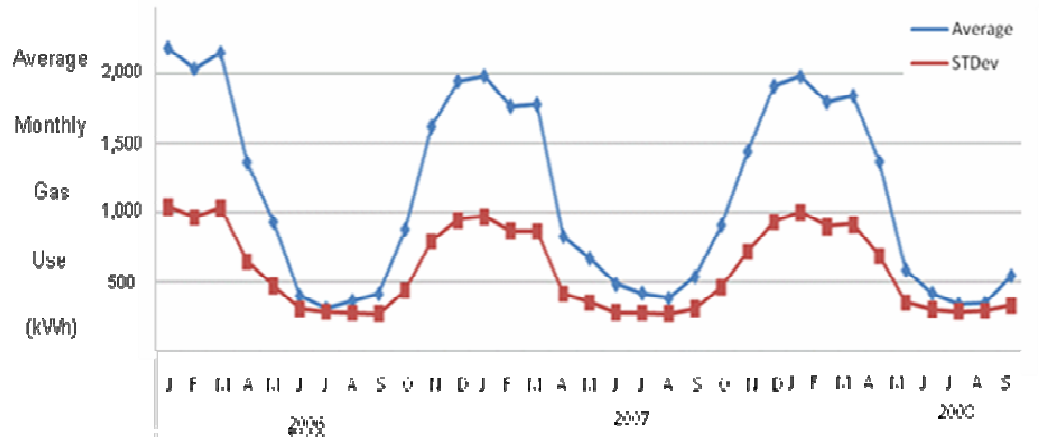

Figure Ax. 2: Average Residential Usage across the time period January 20064 to September 2008 (using FAR data)

The average usage in **Figure Ax. 2** shows that gas usage is highly seasonal as expected. The variability also displays seasonal patterns and is comparatively less in winter compared with summer. This can be explained intuitively as during the summer some consumers will use no

gas (if gas is used for heating only), some will still use a lower level of gas (if gas is also used for water heating and cooking) and finally, some consumers will be away on holidays and hence use no gas for a period. In contrast during the winter, most consumers will use gas for heating and hence the level of variability will be comparatively less.

Gas usage is heavily associated with temperature as most gas is used for home heating (secondary usage includes cooking and heating water which are likely to vary only to a small degree across the year). Temperature will vary from location to location. Focus group research on gas usage behaviour indicates that use will tend to vary at a localised level in line with the typical levels of reaction to temperature change:

- Switching off/on the heating which causes a significant level of shift in usage. The trigger point will vary by individual customer
- Increased load on the heating as temperature drops below the trigger level. This will vary by the quality of insulation within the home and the customer's reaction to dropping temperature (heat for fixed hours or increase the number of hours the house is heated for).

The analysis of the patterns of the pre-trial data also informed the design of the Trial in terms of:

- Including a benchmark period to identify baseline usage by each individual user.
- Ensuring both the test period and benchmark period capture periods of peak annual usage.
- Facilitating monitoring of covariates (such as temperature) which can externally impact on usage.

Awareness of the different sources of variation was critical in order to ensure that the analytic approach, the allocation procedures for the cells and the procedures for the treatment of missing data were the optimal approaches to generate a robust estimate of impact.

A1.4 Length of the benchmark period

The length of the benchmark required was considered in detail and the informed decision in relation to the gas trial benchmark was:

- If the timescale of the project and other deadlines allowed, an optimal standard design could make use of a 12 month benchmark with a 12 month test period for comparison
- It was possible to use a shorter benchmark period if the seasonality of the model was such that the between-individual variation captured therein is sufficient for analysis purposes. This is the case where there are no critical features in annual usage that occur outside the benchmark period that cannot be determined by data therein. This is described with reference to the FAR and Logger Meter data.

Given that the results of the Trial will be used to inform policy and decision making regarding usage across time periods, in the context of the Trial it would be necessary to make inferences

about the differences between these means considered over an entire year. In doing this, and noting that there is a finite sample of meters, it was necessary to account for sampling variability and the temporal variability of the estimator, examined by reference to sample data provided. A critical feature of this estimator was that both the benchmark and test periods contain data where volatility in usage patterns is high, hence the importance of the timing of the December to May benchmark period.

To provide a contiguous measurement period, this translated into a benchmark which ran from December to May and a trial period from June to May.

A1.5 Estimating the trial size in order to achieve the sensitivity

Based on the conclusions of the previous section, the experimental design matrix was populated to ensure required levels of accuracy of testing (**Table Ax. 2**).

	Bi-Monthly Bill	Monthly Bill	Bi-Monthly Bill plus IHDD	Bi-Monthly Bill plus IHDD plus variable tariff	
Test Group	200	200	200	200	600
Control group					450
				Total	1,050
				Total (incl 35% fallout)	1,925

Table Ax. 2: Experimental design matrix with required cell populations shown

Table Ax.3 shows the approximate sensitivity of the potential hypotheses to be tested. It should be noted that these approximate figures did not take into account corrections for multiple tests.

An important decision in any experimental design is the confidence level at which testing should occur. For the purposes of the Trial, 90% was set as the 'cut-off' confidence level.

Treatment	Matrix numbers	Overall Reduction
Combination of all stimuli v's control group	800 v's 450	3%
Any stimulus versus control group	200 v's 450	4%
Any stimulus versus any stimulus	200 v's 200	5%

Table Ax. 3: Expected precision of potential hypotheses

A1.6 Other considerations in the Residential experimental design

i) Impact of communications

It was important to distinguish between the impact of smart meters and DSM stimuli directly enabled by smart meters and DSM stimuli which could be applied independent of smart meters. For example, the energy usage statement provides additional information enabled by the smart meter such as half-hourly usage, daily usage and usage at different times throughout the year. This information is only available if smart meters are deployed thus allowing half hourly data to be translated into graphical form for the consumer. The consumer communications avoided additional advisory information that would be available independent of smart meters (for instance general information on appliance usage). Finally, participants in the test groups were not targeted with any additional energy efficiency advice (other than the DSM stimuli) which might have encouraged usage reduction or shifting, but would not have been available to the control group.

This decision was made in order to allow the true effect of the DSM stimuli to be measured. It does not preclude such activities as part of any national rollout where the effectiveness could be demonstrated.

ii) Calendarisation

The Trial sought to control as many external influences as possible with the objective of correctly attaching changes in behaviour to the stimuli deployed, as opposed to other extraneous factors. Research to date had indicated that the arrival of the bill can act as a trigger for behaviour change. Gas focus group participants described an amplified response to the arrival of the bill, particularly in the case where the bill is unexpectedly high. The response is typically characterised by increased vigilance in household energy usage with immediate effect. Some examples include turning off radiators, reducing shower time, turning down the heating etc. This increased vigilance can last for a short period of time, in others for slightly longer. The potential impact of this phenomenon on each individual customer is a periodic and temporary reduction in usage associated with bill arrival.

In the context of the Trial, it was of concern that this effect would be measured and the different bill timings resulting in these amplified effects would contribute to the random variation not associated with change caused by the trial stimuli.

It was of concern that if calendarisation was not implemented, the bill related behaviour change would occur randomly (across time or among different cohorts) and, therefore, the overall random variability would increase. This would result in a reduction in the power of the Trial to detect true effects and an increase in the potential for a small true effect not to be detected.

If only the test group was calendarised, the test group and control groups would have systematic differences in billing cycle (i.e. one is calendarised and the other is not). The effect would be to make the results of the Trial more difficult to interpret as detected differences may partially be related to this rather than the impact of the stimuli deployed.

Calendarisation was considered beneficial in the context of the residential measurement because it controlled the impact of the bill arrival on behaviour as a source of variability between the test and control groups and within the test and control groups. It was also considered beneficial in terms of minimising any impact for those participants on the variable tariff structure of receiving a bill containing a mix of the flat tariff and the new variable tariff. A decision was, therefore, 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.

To that end it was decided to synchronise the billing cycle across the participants from the start of the benchmark period to the end of the Trial and to include both the test and control group participants in this calenderisation process.

iii) Changes in supplier during the Trial

As outlined previously, one of the Attrition definitions for the Residential Trial was Change of Supplier - it was decided that changing supplier would be considered a reason for excluding a participant from the Trial because it was likely that the alternative supplier chosen would be offering lower tariffs thus having the potential to influence gas usage.

A1.7 Introduction to the SME trial

The objective of the SME Customer Behaviour Trial (CBT) was to ascertain the potential for smart meters to effect change in energy consumption when operated in conjunction with DMS initiatives.

In the preparation for the trial design, a sample of consumption data based on the monthly allocated FAR consumption of 5,000 SME's between Jan 2007 and July 2007 was analysed. The objective was to explore the nature of consumption over time and to determine the optimal design that would give insight into SME's gas usage. It was hoped that this insight would act as a further support to existing research on SME energy usage patterns[2] rather than duplicate existing research.

[2] Carbon Trust Report

A1.8 Determining the structure of the SME Trial

Analysis of 2½ years of usage data for 5,000 SME consumers showed:

- High variation from year to year
- High level of variability between consumers (shown by standard deviation)
- Usage levels strongly skewed to the left with a smaller number of consumers with higher usage

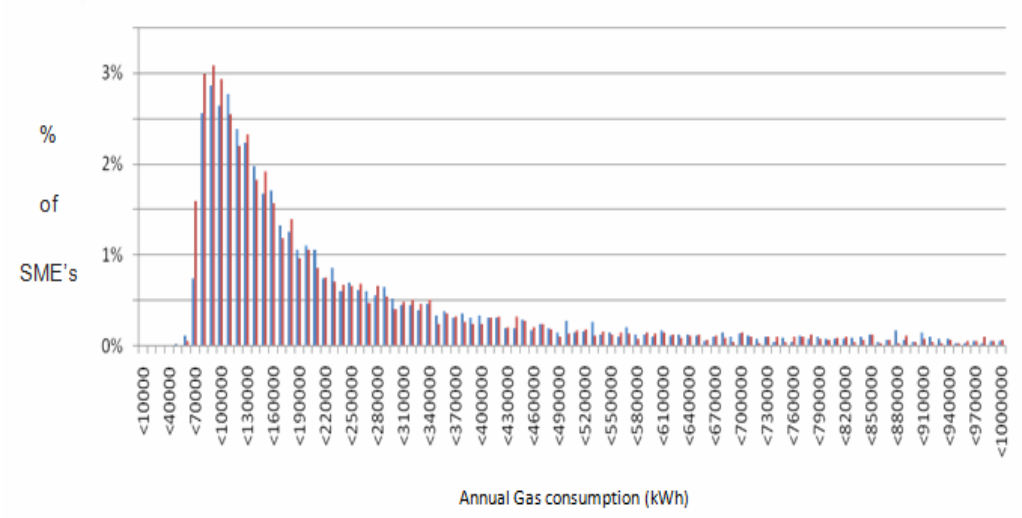

Figure Ax. 3: Distribution of SME usage from January 2006 to Sept 2008 (using FAR data)

In addition to the skewed distribution, the analysis also showed clear seasonal patterns in SME gas usage, consistent with that of the residential usage pattern. The seasonal patterns are also impacted by high variability, particularly in periods of high consumption, notably the winter period.

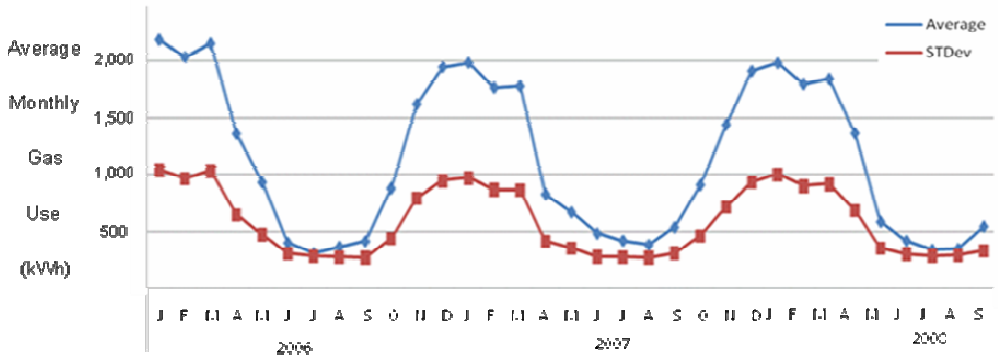

Figure Ax. 4: Average SME Usage across the time period January 2006 to September 2008 (based on FAR data)

The final attribute of the SME data analysed was the large differences between different sectors in terms of overall usage and usage patterns through the year:

- Public houses, government agencies and educational establishments are highly seasonal in usage
- Industry, take-aways and restaurants are much less seasonal in usage

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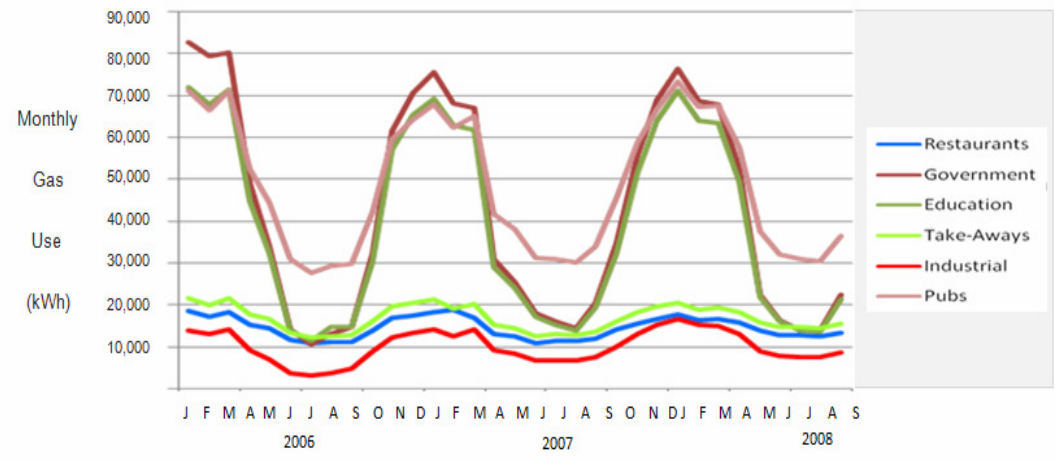


Figure Ax. 5: Sectoral gas usage January 2006 to September 2008 (based on FAR data)

On the basis of the analysis completed, it was clear that, in order to effectively understand gas consumption and given the level of variability within the SME gas consumers, a sector level approach would be more appropriate. Also given the very high levels of within sector variability in usage it was clear that a comparatively small sample of two to three hundred would facilitate the measurement of change in some sectors while others would require samples of over 1,000 to detect differences in usage at the 3% level. On that basis it was decided that a trial based on insight and understanding as opposed to experimental design would be the optimal model.

The final approach agreed was to recruit a total of 51 consumers to represent different sectors and monitor the usage of those companies over the lifetime of the Trial. These consumers were distributed 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

Table Ax. 4: Distribution of participants

- 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 FVT3[4] consumers

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

Table Ax. 5: Additional sectors included

A total of 59 meters was installed in order to allow for a small degree of fallout associated with technical issues in the installation or to allow for changes in business structure and operation. The reasons for attrition that applied to other trials were slightly different in the context of the SME gas trial. In other trials a change of supplier tended to account for a large proportion of fallout. However, in this trial, even if the SME changed supplier, their usage

[4] Fuel Variation Tariff

information was still supplied to the web portal and their usage patterns were still viewable by the SMEs, if they decided to access the web interface.

The final structure can be represented by the following schematic:

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

Figure Ax. 6: Final Structure of SME Trial

A1.9 Other considerations in the SME experimental design

i) Impact of communications

Given that the SME trial measurement was not based on an experimental design structure, it was possible to communicate with the SMEs during the Trial without concern about impact on the measurement of the true effect of the stimuli.

The level of access to the web interface was monitored. Where individual SMEs did not access the web interface within the first weeks of the Trial they received a letter reminding them of their username and address. If this did not yield a response, the non-accessing companies received a telephone call confirming that they could access the system if they wished to do so. In addition emails reminding participants of the web offering were sent intermittently to all participants.

ii) Calendarisation

For ease of management all SMEs participating in the Trial were calendarised at the start of the SME trial in August 2010.

Appendix 2: Methodology for Analysis of Customer Behaviour Trial Data

A2.1 Introduction

This appendix sets out the approach used in analysing the data for the Gas Customer Behaviour Trial (CBT). Specifically, in the case of the Residential Trial, it outlines the hypotheses required to be tested; the analytical approach used to test the hypotheses; a description of the treatment of the data in terms of missing and partially missing data; and details of the outputs generated from the data. In the case of the SME Trial, it outlines the approach to analysis.

A2.2 Hypothesis Tests

The Residential Customer Behaviour Trial aims to measure consumer response (behaviour change) arising from exposure to the trial stimuli. The design of the measurement was derived from the requirement to assess overall energy reduction as the result of the application of different DSM stimuli made possible by the introduction of a smart meter over the period of the Trial. The findings from the CBT could then be used to make predictions about how the wider consumer base may respond to the DSM stimuli.

The structure of the Trial was based on a nested measure where the change in usage associated with the 'before' and 'after' (benchmark versus test usage) of the test group was compared with the change in usage of a comparable group (the control group) for the same time period.

The testing for evidence of behaviour change requires testing a number of hypotheses at an overall level both across and within the various test groups.

A2.2.1 Residential CBT

Four DSM stimuli (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 are used in the residential CBT. The null hypothesis (testing hypothesis) to detect if there is a reduction in gas usage at an overall level is as follows:

- H_0^{RES}: the deployment of DSM stimuli during the trial period have no effect on gas energy usage when compared to the benchmark period;

In addition to the above the following hypotheses are to be tested *for all* DSM stimuli for overall gas usage:

- $H_0^{RES,1}$: the bi-monthly bill and energy usage statement has no effect on energy usage;
- $H_0^{RES,2}$: the monthly bill and energy usage statement has no effect on energy usage;
- $H_0^{RES,3}$: the bi-monthly bill, energy usage statement and In-home Display Device has no effect on energy usage;
- $H_0^{RES,4}$: the bi-monthly bill, energy usage statement, In-home Display Device and variable tariff has no effect on energy usage.

Each stimulus was tested against the other stimuli, as follows:

- $H_0^{RES,12}$: a bi-monthly bill and energy usage statement is as effective as a monthly bill and energy usage statement;
- $H_0^{RES,13}$: a bi-monthly bill and energy usage statement is as effective as a bi-monthly bill, energy usage statement and In-home Display Device;
- $H_0^{RES,14}$: a bi-monthly bill and energy usage statement is as effective as a bi-monthly bill, energy usage statement, In-home Display Device and variable tariff;

- $H_0^{RES,23}$: a monthly bill and energy usage statement is as effective as a bi-monthly bill, energy usage statement and In-home Display Device;
- $H_0^{RES,24}$: a monthly bill and energy usage statement is as effective as a bi-monthly bill, energy statement, In-home Display Device and variable tariff;

- $H_0^{RES,34}$: a bi-monthly bill, energy usage statement and In Home Display Device is as effective as a bi-monthly bill, energy usage statement In-home Display Device and variable tariff.

The Residential Gas Trial was designed to detect changes in behaviour in relation to overall usage, where such changes occur, and to detect a minimum effect, of:

- 3% on hypotheses conducted on the overall sample of participants (H_0^{RES}),
- 4% on hypotheses conducted on any stimulus compared with the control group ($H_0^{RES,1}$, $H_0^{RES,2}$, $H_0^{RES,3}$, $H_0^{RES,4}$)
- 5% on hypotheses ($H_0^{RES,12}$, $H_0^{RES,13}$, $H_0^{RES,14}$, $H_0^{RES,23}$, $H_0^{RES,24}$, $H_0^{RES,34}$)

A2.2.2 SME CBT

In the case of the SME Trial, the outcome was structured to be driven by a qualitative assessment of impact, supported by data collected from pre-trial and post-trial surveys and merged with meter data. Analysis was conducted on both the meter data and on the survey

data. Insights as to the impact of the web based information were derived from those combined sources.

Due to the small sample size and the qualitative intent of the design, statistical testing for the SME CBT was considered to be a secondary objective, with the primary objective being to gain an understanding of the impact of DSM stimuli through the analysis of data.

A2.3 Statistical Significance

The interpretation of a statistically significant result in the context of the overall test was to reject the null hypothesis and conclude that "*there is evidence from the CBT data that the deployment of DSM stimuli results in a change in energy consumption*". The outcome of this test should not be interpreted as specific to a stimulus but is across all stimuli.

A 90% confidence level was applied to all tests conducted. This was consistent with the approach followed in other relevant international benchmark studies and facilitated statistical testing within the individual groups given the sample size and an acceptable margin of error.

The Residential and SME trials were powered differently, which means they were likely to class different 'effect sizes' as statistically significant. Statistical testing can be done with smaller groups, but failure to find significance must be interpreted with caution.

A2.4 Data Processing and Dealing with Missing 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.

A number of checks were undertaken as the data files were downloaded. These included that:

(i) a data file existed for each day of the Trial;
(ii) data for each meter alias were present in the file; and
(iii) all half-hourly reads were present for each meter.

A check was also undertaken for duplicate reads and none was found.

The results of these checks were cross-checked with internal Bord Gáis Networks reports.

Dealing with missing data

At an early stage in the Trial it was identified that a number of meters had missing data. This was where:

i) the rate of energy usage was recorded as being greater than 16.383 kWh for a half-hourly read. This was a default setting where a meter reading could not be recorded. However, it was also possible that this could be an actual recording of high usage. Accordingly, it was decided to re-assign the default value to 65.535kWh – a usage value which, it was believed was unlikely to be reached in a half hourly period. The data was subsequently regenerated to identify actual readings from missing meter readings.

ii) the meter alias was not present in the daily data file. Substantial work was carried out by Bord Gáis Networks to establish why data was missing for some meters, including visiting such sites and implementing local adjustments where possible. It was also agreed that Logica (Bord Gáis Networks' data management company) would re-poll such meters in an attempt to recover data which may have been missed due to a transmission failure. .

Of the 1,575 meters that remained in the Trial on 31st May 2011, only 103 had complete data (i.e. a valid rate of energy usage >=0 recorded for every half-hour of the trial period) and the remaining 1,472 had at least one missing half-hour entry. The extent of the missing data is outlined in the table below:

Period Missing	Number of Missing Half-hourly Entries	Number of Meters	Cumulative % total
No missing	0	103	7%
<=1 day	1-48	208	20%
>1 and <=2 days	49-96	321	40%
>2 and <=3 days	97-144	276	58%
>3 and <=4 days	145-192	256	74%
>4 and <=5 days	193-240	130	82%
>5 and <=6 days	241-288	66	86%
>6 and <=7 days	289-336	34	89%
>1 and <=8 weeks	337-2,668	137	97%
>8 weeks	>2,669	44	100%

Table Ax. 6: Extent of missing data

Case Deletion

Two approaches were used to deal with the missing data. The first approach was case deletion. The purpose of this approach was to ensure there were no substantial differences between meters where data was missing, compared to the rest of the population.

Meters with more than eight weeks (i.e. at least 10% of half-hourly reads in the Trial) of missing data were deleted. This left data for 1,531 meters, of which 1,428 still contained some missing data.

As more than 15% of the total number of meters had data missing on six days (8th, 22nd, 23rd and 24th September 2010; 19th and 20th May 2011), the data from these days was deleted for all meters.

An analysis of the available demographic profile information available about the missing meters was undertaken and it was concluded that the exclusion of these meters did not introduce a bias to the trial.

Imputation

The second approach for dealing with missing data was the use of imputation. Missing data introduces an element of uncertainty into the dataset, which needs to be taken into account during the statistical analysis of the data, typically through using a method of multiple imputation.

Simple imputation involved estimating a mean for the missing value of interest. This was done by taking an average of six values - the two values immediately preceding and after the missing value; the values during the same half-hourly period one week before and one week after; and the values for the same half-hourly period two weeks before and two weeks after. An example of this imputation approach is as follows:

Day	211	...	218	...	225	225	225	...	232	...	239
Time	15.00	...	15.00	...	14.30	15.00	15.30	...	15.00	...	15.00
Usage	0.78	...	0.63	...	1.59	-	3.69	...	1.56	...	0.82

Table Ax. 7: Example of imputation

For the purposes of imputation, the value at 15.00 on day 225 was replaced by a mean of 1.51, which was the arithmetic mean of the adjacent observations and those both one and two weeks before and one and two weeks afterwards.

The second parameter that needed estimation was the uncertainty associated with the imputed value, measured by the standard deviation. In the example above, the standard deviation of the six values used to impute the missing value is 1.44. In the event the standard deviation for

the imputed value was not available (e.g. the arithmetic mean is zero), a standard deviation of 0.5 was recorded, which is likely to be a conservative estimate of the uncertainty.

Imputation was successful for 1,389 meters and was not possible for 39 meters.

The multiple imputation process involved replicating the data series for the missing meters, completing the data with values obtained by reference to the distributions given by the mean and standard deviation described above.

Impact of case deletion and imputation

Complete data (including imputed values) was available for 1,492 meters. As a result, the data cleaning exercise resulted in 5% of meters being removed due to incomplete data. A summary of the impact of the data cleaning exercise on each allocation group (i.e. control or test groups) in the Trial is provided below.

Data cleaning and imputation by meter allocation								
Allocation	Number of meters for which data was downloaded	Number of meters with no missing data	Number of meters with missing data				Complete data available including imputed	% dropout due to incomplete data
			Total	>8wks missing	Some missing, but <=8wks			
					Total	Imputation Successful		
1	256	13	243	7	236	222	235	8%
2	248	23	225	8	217	205	228	8%
3	263	25	238	9	229	226	251	5%
4	265	16	249	8	241	238	254	4%
C	543	26	517	12	505	498	524	3%
In trial as at 31-May-11	**1,575**	**103**	**1,472**	**44**	**1,428**	**1,389**	**1,492**	**5%**

Table Ax. 8: Summary of impact of data cleaning on allocation groups

The imputed values in the dataset account for just 0.5% of all values. In addition, 59% of all imputed values were equal to zero, which is not unusual given the nature of daily gas consumption. This suggested the imputation would have relatively little impact on the data analysis and could be confirmed by way of multiple imputation.

Preparing the SME Gas Data for Analysis

The data on gas usage by SMEs contained the cumulative volume consumed (in m^3) on a half-hourly, daily and weekly basis covering the period 17th June 2010 to 8th July 2011. Hourly volume data was reported for five meters.

The file was restructured so that it contained a matrix of cumulative usage recorded for each meter for the relevant date/time period during the Trial. The data were checked for duplicates and none were found. The actual volume consumed was then calculated based on subtracting the cumulative volume usage at a given time from that recorded one half-hour earlier (one hour earlier for the five meters with hourly volume data). One meter recorded zero usage throughout the trial period and was omitted. No imputation was carried out for the SME data as it was not intended to subject it to formal statistical testing.

Finally, the volume consumed was converted into the rate of energy usage by applying the relevant conversion formula (discussed below). In order to facilitate the above calculation, Bord Gáis Networks provided details on the relevant zone (for calorific values) and volume correction factor for each meter.

It should be noted that a timestamp, adjusted for British Summer Time was used for SME data. This meant that for each meter two extra half hour readings were collected when the clocks went back (October) and there were two half hour readings less when the clocks went forward in March. As a result, 50 readings per meter were recorded on Sunday 31st October 2010 (normally 48) and 46 readings per meter were recorded on Sunday 27th March 2011.

Converting Volume of Gas Consumed into Energy Used

Gas meters normally measure the volume of gas consumed in cubic meters (m^3). However, the power associated with each m^3 is not necessarily constant due to variation in the energy content of the gas. This depends on where the gas is sourced from, its physical composition and the local temperature and pressure. Therefore, it is possible for a meter to record the same volume of gas consumed at different time periods, yet these identical volume reads may result in more energy being used in one time period and less in another.

In order to capture the true amount of energy used, the volume of gas consumed is converted from m^3 into kilowatt hours (kWh). This requires the use of a conversion factor, which is the amount of energy (in kWh) released from burning $1m^3$ of gas. The formula for this conversion factor is as follows:

$$\text{kWh} = \frac{m^3 \text{ x Calorific Value x Volume Correction Factor}}{3.6}$$

The calorific value (CV) is a measure of heating power and is dependent upon the composition of the gas. It is usually quoted in mega joules per cubic metre (MJ/m^3). The CV is measured by Bord Gáis Networks using a chromatograph at eleven locations throughout the distribution network, with a measurement recorded approximately every 3-5 minutes.

The volume correction factor is used to account for changes in the atmospheric pressure due to altitude, which will affect the effective mass of gas for a given volume. A nationalised value of 1.0325, based on average elevation and atmospheric pressure, is used for residential meters and smaller SME installations. Some SMEs have a site specific correction factor calculated based on their location and elevation, details of which were provided by Bord Gáis Networks.

While the residential smart meter data files already contained meter readings in kWh, this was initially calculated using a single fixed CV for all zones (set at 39.5 up to 1st July 2010) and then a zone-specific CV that was updated on a weekly basis. In order to calculate a more accurate kWh measure, an adjustment was made to the data. This required multiplying the rate of energy usage (kWh) recorded for each half-hour period for each meter by the appropriate daily CV and dividing by the CV downloaded with the data.

The SME data were provided in m^3 and therefore required the application of the conversion factor as described above, using the appropriate calorific value and volume correction factor.

A2.5 Analytical Approach

The assessment of energy reduction by individuals over time and in response to stimuli is based on statistical hypotheses testing. The objective of the testing is to determine if the observed effect in consumption, if present, is statistically significant at an agreed confidence level (90%).

The level of effect is measured by estimating the change in consumption between the test period and the benchmark period for the test group and comparing that outcome with the equivalent change among the control group. Similar estimates will be applied to different stimulus groups. The analysis is required to provide evidence of test group effects over sampling variability (p-values), as well as an estimate of the size of the effect (confidence intervals for parameters).

There are two components of calculation, involving the estimation of the impact of the stimuli. The first measure is the volumetric ratios, specifically the difference in change in consumption ratios over time as measured by the volume for each of the groups under consideration. The second considers the ratio of the usage for these periods calculated on a per individual basis.

A2.5.1 Calculating Volumetric Ratios of Usage

The approach used in calculating the percentage change in the volume of usage for the test groups during the trial period relative to the control group is to calculate volumetric ratios for each group. At an overall level, the ratio of total volume of gas usage for the test group during the trial period relative to the benchmark period is calculated (R_T). This is then

compared to the corresponding ratio for the control group (R_C). The ratio is calculated using the following formula:

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

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 again compared to the ratio for the control group, as well as being compared to each of the other stimulus group. It is then repeated for the different time periods under consideration (high usage period, low usage period, first six months of the Trial, second six months of the Trial, monthly totals). The percentage difference in the ratios between the test and control groups quantifies the extent to which the DSM stimuli impact on gas usage for those meters participating in the Trial.

The use of the data for decisions in relation to different samples of the residential gas user population as a whole, require inferences to be drawn. Statistical procedures and tests are required to make such inferences about the likely impact on the wider residential consumer population. The first step in this requires the estimation of a measure of variance around the total volume usage figures. In order to generate this estimate a statistical procedure called bootstrapping is used. The second step is to calculate a p-value to test the hypotheses as outlined and assess the extent to which any change is statistically significant. This was done directly using the bootstrap replicates.

A2.5.2 Bootstrap Re-sampling

In comparing the groups, a 90% confidence interval of volumetric change in each of the groups was derived. Since this is done by aggregating the data within each cell, it is not possible to come up with an asymptotic estimate of uncertainty for this change. However, using bootstrap replications of the data, the underlying sampling distribution of these statistics can be derived.

Bootstrap re-sampling is a method used to enable an assessment of the uncertainty associated with a sample statistic. It involved taking repeated draws of samples of the same size from the original sample and recalculating the statistic of interest on these new samples. The standard deviation of this sampling distribution was used for statistical testing.

A2.5.3 Alternative Approaches

Two alternative approaches were considered when analysing the results. The first was to calculate the average (median and mean) volume of usage for each of the test groups and the

control group during the benchmark and trial periods and use these to calculate the ratios. This is based on the participants remaining in the Trial at May 31st 2011.

	Number of Participant Meters	Total Usage (kWh)	Average (Mean) Annual Usage (kWh)
Test	967	13,575,506	14,039
Control	524	**7,510,830**	**14,334**
Total	**1491**	**21,086,336**	**14,142**

Table Ax. 9: Summary statistics for the cleaned data set

The average daily usage based on the arithmetic mean is provided in **Table Ax. 9.** However, **Figure Ax. 7** shows that the distribution of average daily usage within the sample is skewed with a significant number of low usage days reflecting the highly seasonal distribution of usage. On that basis a more appropriate measure of central tendency is the median, which represents the mid-point of usage within the overall distribution. Therefore, the average daily usage as measured is 38.5kWh for the test group and 39.3kWh for the control group.

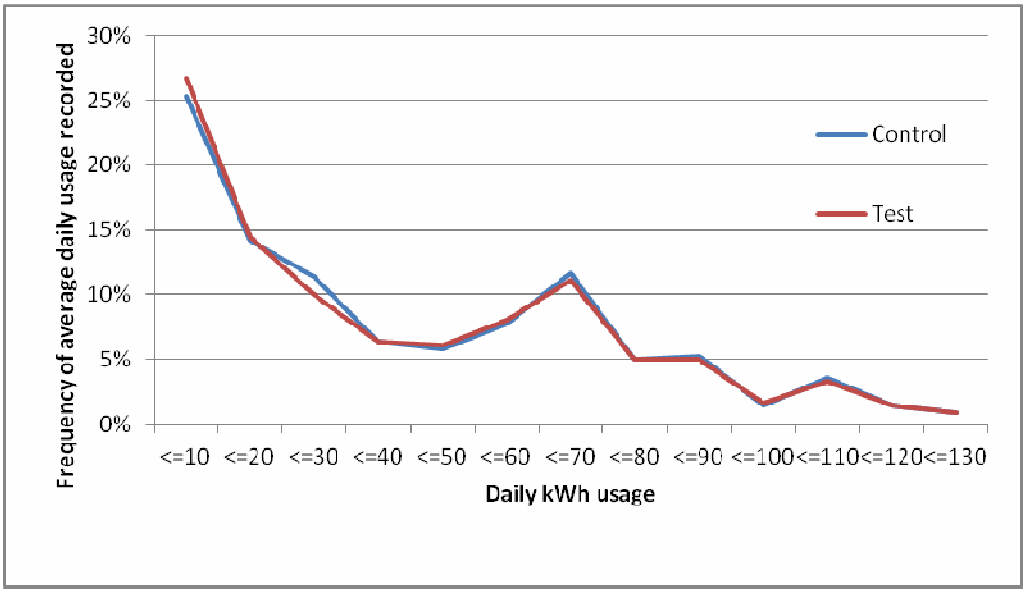


Figure Ax. 7: Frequency distribution of daily usage (kWh)

The use of a measure of central tendency, which yielded a marginally lower reduction in usage at overall level, was considered to understate the overall impact on the test group, particularly given that it did not sufficiently capture the effect of changes in usage by high-volume participants.

The second approach considered was to trim the data, excluding meters that recorded extreme usage ratios (i.e. low volumes of usage in the benchmark period and comparatively high levels of usage in the trial period and vice versa). The exclusion of these meters was found to have relatively little impact on the overall results. They were, therefore, included in the final analysis, with the exception of one meter whose impact was assessed to be an outlier, significant enough to distort results involving that case, as part of other cells.

Appendix 3: Profile of Residential Participation

A3.1 Introduction

In order to ensure that the trial results were truly representative of the entire population, it was necessary to ensure representivity from recruitment to completion of the Trial. Representivity was assessed and interventions or corrections executed at the following points:

- **Recruitment to the Trial:** To ensure that the consumers invited to participate in the Trial were representative of the entire population of natural gas consumers. This was assessed through analysis of the profile of the entire population and the invitation set. The recruitment was undertaken in multiple waves to allow for correction in the subsequent invitation sets.
- **Acceptance into the Trial:** To ensure that the set of participants was representative of the entire population of natural gas consumers. This was assessed through analysis of the profile of set of acceptances and comparison with the population of non-respondents to the Trial (captured through a non-response survey). It should be noted that no participant was excluded from the Trial on the basis of lack of representivity. However, representivity issues were noted for consideration in the final analysis of results.
- **Allocation:** To ensure that the participants in each experimental cell were representative of the entire population of natural gas consumers. The allocation algorithm profiled participants across all available survey and usage data to assign participants across the experimental cells. Corrections were made to improve representivity across each factor.
- **Attrition:** To ensure that attrition did not impact on the representivity of the Trial. This was assessed through comparison of the profile of attritors and non-attritors and an attrition survey.
- **Expectations of the Trial:** To examine the motivations of the participants

A3.2 Recruitment

Recruitment to the Customer Behaviour Trial was on a voluntary basis (with a small financial incentive associated with the completion of the survey). It has been noted in other smart meter trials and more generally in technical innovation trials in the energy field that there is a significant risk of over-representation of more highly educated or affluent consumers. As has been described in Section 4 above, the invitation communication was carefully designed and tested to minimise this tendency. This was achieved through the use of accessible language and addressing of concerns that might disproportionately discourage recruitment from less educated or less affluent groups. However, it was recognised that the recruitment process needed to be structured to further control for this type of bias and other potential biases such as disproportionate participation among higher or lower gas users. To allow for correction of

representivity issues during recruitment a multi-wave approach was chosen with invitations dispatched in five groups.

A3.2.1 Selection of the population for invitation and acceptance into the Trial

The primary objective was that the set of potential recruits would be representative of consumers across the available demographic, behavioural and usage profiles. This objective was constrained by limitations associated with the type of data held by natural gas suppliers and, in a minority of cases, technical limitations.

The information available on the recruitment population included:

- **Contact details**: name of the participant, telephone number and contact address.
- **Location of the meter**: address, county, urban/rural location and region. It was assumed that the location of the meter matched the location of the respondent.
- **Household profile:** House type (semi-detached, detached, terrace, flat, bungalow), number of bedrooms, date of first gas installation at that address.
- **Behaviour and usage information**: Overall recorded consumption for 2007 and 2008 derived from meter reads, payment method (direct debit, at local post office, etc) and number of estimated bills.

It should be noted that no information was available prior to recruitment on demographics, or indications of factors such as presence and use of heating controls.

Additional constraints were placed on the recruitment:

- At the point of recruitment in Quarter 3, 2009, the decision was made to limit participation to consumers who were then customers of Bord Gáis Energy. At that time, Bord Gáis Energy represented close to 100% of the residential gas market and therefore this limitation did not impact on the representivity of the Trial. However, during the period of the Trial competition in the residential gas market increased with associated implications on attrition. The implications of this attrition on the on-going representivity are dealt with in A3.4 below.
- Participation was limited to those who had been at their current address for at least 12 months prior to the recruitment. This restriction was put in place to exclude residential consumers most likely to move during the period of the Trial and hence attrite.
- Consumers who had opted out of sales and marketing contact from their supplier.
- Consumers who used prepayment as their payment method as prepayment smart meters were not included within the scope of the Trial.
- Consumers where the billing address and meter address were different. These were likely to represent second or rented homes and therefore were not appropriate to include in the trial targeting the residential gas market as a whole.

A3.2.2 Methodology

An initial population set of approximately 430,000 residential natural gas consumers provided by Bord Gáis Energy was used to generate a sample population of 50,000 from which to select invitees. The profiles of the 430,000 and 50,000 were compared to ensure that the reduced list was representative of the entire population. The recruitment process used this reduced population of 50,000 consumers and followed the following approach:

1. Consumers were selected in waves of 3,000 at random from the sample population of 50,000.
2. Acceptances against usage and other available profiling information (e.g. location) were assessed.
3. Next wave of invitations was adjusted to compensate for any discrepancies.

The selection of a wave size of 3,000 consumers and profiling of responses to each wave allowed progressive adjustment of subsequent waves. This ensured representivity was achieved over the entire recruitment process.

A3.2.3 Results

As has been outlined in the previous section, the respondent set was compared with the sample population of 50,000 residential consumers after each recruitment wave and this analysis was repeated on completion of recruitment.

The primary factor included in recruitment was the usage information about each potential recruit (the recorded usage for 2007 and 2008). **Figure Ax. 8** shows the usage distribution among the recruitment set (in blue) and among the entire sample population (red).

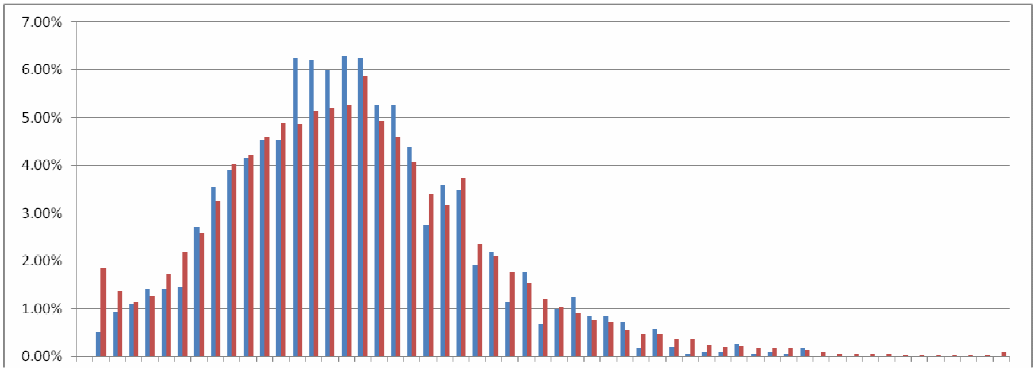


Figure Ax. 8: Comparison in overall 2008 usage between recruitment set installed (blue bars) and total sample population (red bars)

A comparison between the two shows a reasonable match between the two groups with some differences at the low end of usage (where the recruitment set includes fewer consumers with low usage) and in the middle usage levels (where the recruitment set includes a higher proportion of consumers than in the 50,000). This representation issue was expected as those with lower consumption have less incentive to participate. However, the level of over- and

under-representation is relatively low and has a minimal impact on estimates of volumetric changes as the under-represented low usage consumers contribute proportionately less to the total quantity of gas consumed.

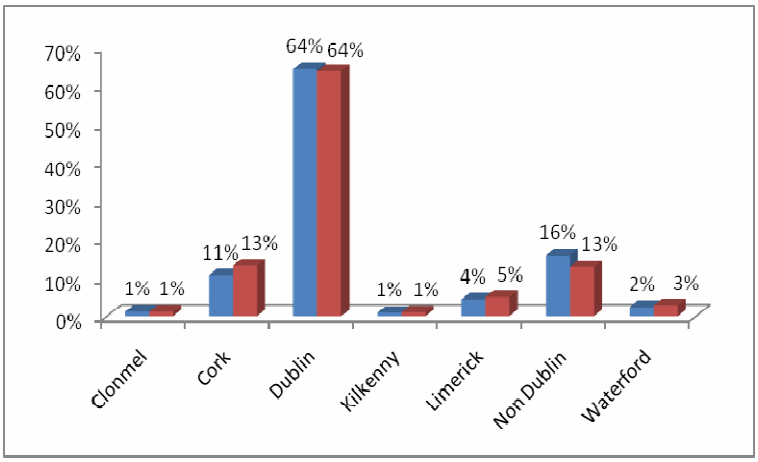


Figure Ax. 9: Comparison in location as recorded in the Bord Gáis Energy customer database between recruitment set installed (blue bars) and total sample population (red bars)

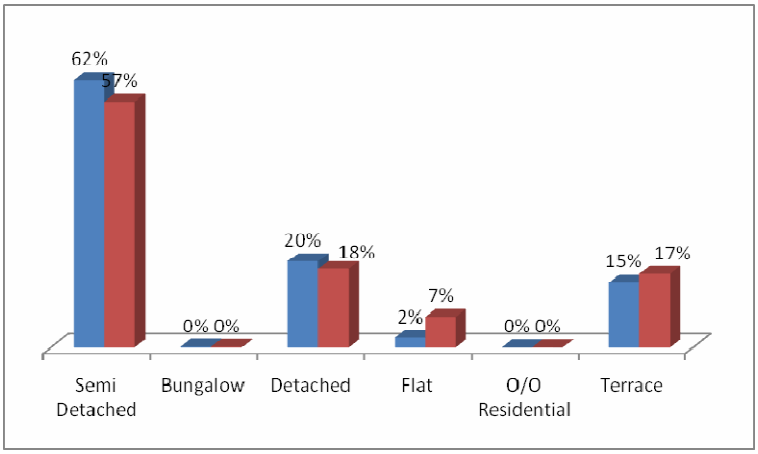


Figure Ax. 10: Comparison in home type as recorded in the Bord Gáis Energy customer database between recruitment set installed (blue bars) and total sample population (red bars)

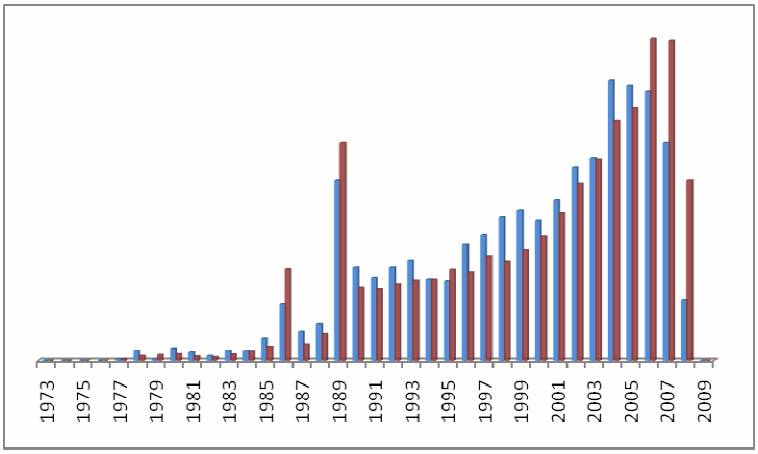


Figure Ax. 11: Comparison in age of home (year of construction)[5] between recruitment set (blue bars) and total sample population (red bars)

Representivity across location, house type and house age (as recorded in the Bord Gáis Energy customer database[6]) was also achieved as can be seen in **Figures Ax.9, Ax.10 and Ax.11.** In the case of the type of home, the under-representation among flat dwellers was expected. This reflected additional challenges associated with postal based recruitment in this category and the greater proportion of rented accommodation. Tenure of less than 12 months is likely to be more common in this category. In the case of the age of the property, there is under-representation of the most recently built properties.

Analysis of other available profiling information also reflected the representivity of the set of acceptances. This included:

- Payment method (i.e. direct debit, post, cash payment at post office etc)
- Average usage by location
- Tariff type
- Urban/rural split

A3.2.4 Conclusions

The recruitment process successfully delivered a set of residential consumers, representative of the entire population of natural gas consumers. Issues identified are unlikely to impact on the overall assessment of behaviour change and overall usage reduction in the Trial.

[5] As recorded in the Bord Gáis Energy customer database.
[6] The objective of this analysis is to establish the representivity of the recruitment set compared to the population using the Bord Gais Energy customer database (which provided the recruitment criteria). Minor discrepancies between this data source and the responses in the pre-trial survey (for instance in age of home or house type) emerged as expected and reflect a combination of sampling variability in the survey,and out of date information or incorrect information.in the customer database.

A3.3 Analysis of exclusion criteria

To ensure that the set of consumers wishing to participate in the Trial was similar to the whole population, the profiles of two categories of consumers were further analysed:

1. **Consumers where the billing address and meter address were different.**

   Analysis of the billing address exclusion set exposed clear differences between this and the entire customer base with those meters excluded due to bill address difference showing a typically lower level of usage. However, this is explained by the higher proportion of flats in this exclusion category and also a higher proportion of two-bedroom units. These findings are consistent with the assumption that these exclusions correspond to rented accommodation where the landlord has retained the bill in his/her name. Therefore, while these differences should be noted, this analysis does not highlight unexpected issues that needed to be addressed in the context of the Trial.

2. **Consumers who had not been at their current address for at least 12 months prior to the recruitment.**

   Among the recent movers, there are also noticeable differences between the entire customer base and the excluded set. In particular, there are again higher proportions of flats (and two-bedroom units). For this group also, there is a lower level of usage overall and this is again consistent with the higher proportion of the smaller units. Therefore, the conclusion is the same as that reached for the first exclusion: this analysis does not highlight unexpected issues that needed to be addressed in the context of the Trial.

A3.4 Acceptance into the Trial: Analysis of Non-response

To ensure that the set of consumers wishing to participate in the Trial was similar to the whole population, a non-response survey was completed and the profile of responses among non-respondents and trial participants compared.

Note that this comparison was only possible once the recruitment process was completed (as the pre-trial survey was undertaken immediately prior to allocation to ensure that information used was as accurate as possible). Therefore, the results of this analysis were exclusively used to determine if there was a requirement to adjust the final analysis of the results of the Trial.

A3.4.1 Methodology

The non-response survey was conducted using Computer Assisted Telephone Interviewing (CATI) once recruitment had been completed in November 2009.

The non-response survey matched the pre-trial survey across the following dimensions:

- Demographic profile of respondents across age, occupation and social classification of chief income earner. This includes participation of individuals deemed to be fuel poor (using the behaviour definition rather than the financial definition – see A3.4.1 (ii).
- Household profile across number and age profile of residents.
- Attitudes towards energy usage and reduction at a societal and personal level.
- Experiential profile across efforts and impact of home energy reduction.
- Profile of home across type, size, age of property and presence of energy efficiency improvements (such as insulation).
- Use of gas for heating and cooking.
- General usage profile and behaviours associated with gas usage.
- Presence and use of heating controls (thermostats, heating zones etc).
- Recall of the invitation letter and assessment of impact of the communication.

i) Representivity across demographic and household profiles

Across age and gender, some divergence emerges between those who agreed to participate in the trial (the ***acceptances***) and those who did not respond to the invitation to participate (the ***non-responses***).

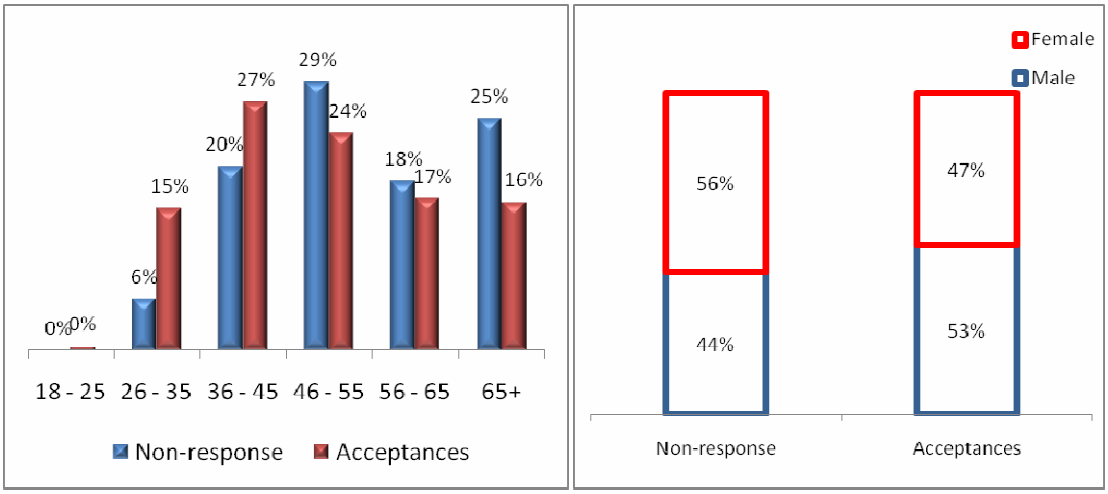


Figure Ax. 12: Age and gender distribution of trial participants and non-respondents to invitation letter

There is a higher level of acceptances among the younger age profiles up to 45 years old and a corresponding lower level of acceptances in the over 65 age category **Figure Ax. 12**. Similarly, there is a higher proportion of males among the acceptance group than among the non-response group. However, it should be noted that an imbalance in the gender does not

imply an imbalance in the profile of the household members as the respondent corresponds to the customer as named on the bill. Therefore while it should be noted, it does not impact on the level of natural gas usage or potential reduction and hence the trial outputs.

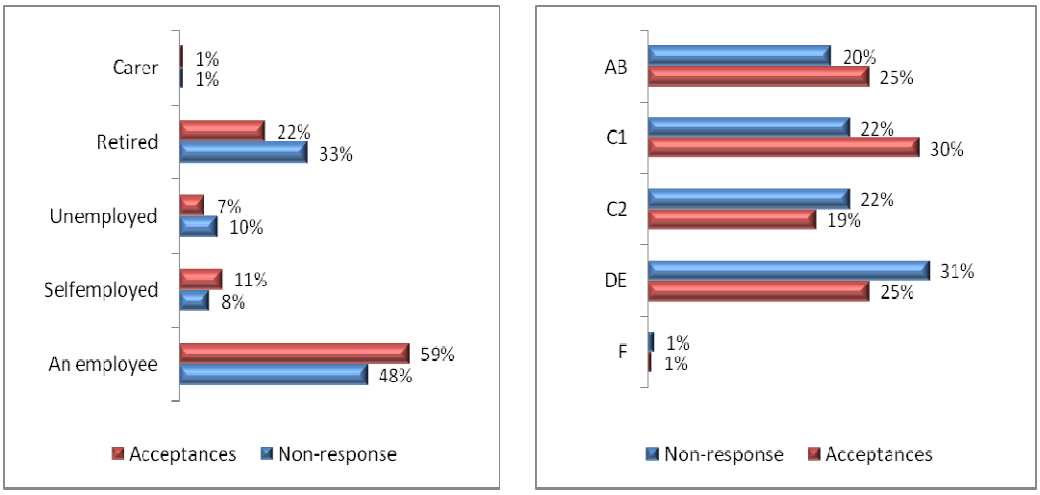


Figure Ax. 13: Profile of trial participants and non-respondents by occupation of chief income earner and social classification

Figure Ax. 13 shows the differences in employment status and social classification between those accepting to participating in the Trial and respondents to the non-response survey (the ***non-response*** group). As was noted in the A.3.2 above, a challenge associated with voluntary recruitment in smart meter trials is the tendency towards over representation of consumers with higher levels of usage; consumers who are more affluent; and more educated consumers. These consumer categories are more liable to engage with and respond to this type of trial. Through the wave-based model of invitation, the Trial was able to address under-representation among lower usage levels. However, correction for social grade and employment status could not be directly included within the recruitment process. This lack of correction is reflected in **Figure Ax. 14** in the lower proportion of retired individuals among the acceptance group (22%) than among the non-response group (33%). Similarly, there is a higher proportion of individuals in social grade ABC1 among the acceptance group (55%) compared to the non-response group (42%). Therefore, it must be concluded that there is greater representation of younger, more affluent consumers, in-line with the experience of other smart meter trials. (It should be noted that the national electricity smart meter trial did not exhibit the same difference.)

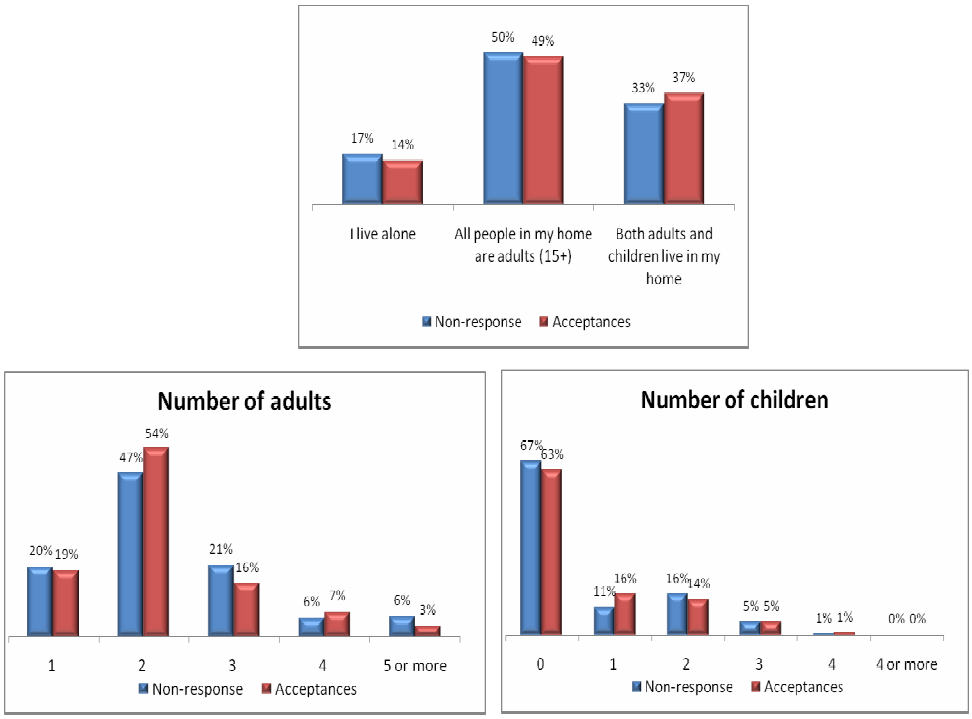


Figure Ax. 14: Proportion of single and multiple person households with breakdown of number of adults and children among trial participants and respondents to non-response survey

Household structure was also investigated as a key driver of overall usage. **Figure Ax. 14** compares the household structure among those who accepted and respondents to the non-response survey. In this respect, there are only minor differences between the non-response and acceptance groups with similar proportions in each category of living alone, with adults or with both adults and children.

In order to estimate the impact of the differences in age profile and social grade between those accepting the invitation to participate in the Trial and respondents to the non-response survey, the change in overall consumption was calculated using bootstrap resampling. This was weighted to reflect the proportions of each age category or social grade within the acceptance group and the non-response group. The use of these 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.

Comparing the estimated reduction calculated using weightings based on the participant group and the estimated reduction calculated using weightings based on the non-response group provides an upper estimate of the impact of the discrepancy between the participant and non-response groups. It is an upper estimate because the actual proportions of age/social grade in the entire population of gas consumers will be a blend of the two groups whereas the use of non-response group proportions assesses the greatest possible discrepancy.

The results of this analysis estimated that the impact of the difference in the social grade proportions between participant group and the non-response group was to increase the

reduction measured in the Trial by, at most, 0.08%. Therefore, the impact is not significant and does not affect the Trial conclusions.

The results of this analysis estimated that the impact of the difference in the age category proportions between participant group and the non-response group was to reduce the reduction measured in the Trial by at most 0.0003%. Therefore, the impact is negligible and does not affect the Trial conclusions.

ii) Participation by fuel poor households

Fuel poor households are defined to be households which cannot afford to keep their home adequately warm. There are two potential approaches to developing a metric for fuel poor:

- **A financial metric**: A fuel poor household is one which needs to spend more than 10% of its income on total fuel use[7]. This definition does not consider the level of actual spend on fuel.
- **A behavioural metric**: A fuel poor household is one which reports behaviours consistent with the definition (stated inability to afford the home adequately, or behaviours associated with an inadequately warm home).

The Trial adopted the second approach while recognising that self-reporting introduces a degree of subjectivity. However, the use of the second definition had the advantage that it could be easily incorporated within the market research element of the Trial. In contrast, assessment of fuel poverty using the first definition would require estimation of household energy needs in order to estimate the associated cost and hence the percentage of total income required to meet this heating need.

The participation by fuel poor households in the Trial is an important component of the Trial as this group could be adversely impacted by the variable tariff tested or may be less able to take advantage of increased information to reduce their usage and hence bill. Assessing this impact was an objective of the Trial. To provide the most appropriate assessment of the presence of fuel poor within the Trial, two alternative behavioural definitions were used:

- **Behavioural definition 1:** Participant states that the home is not kept adequately warm and the reason given for this is lack of finance to keep it as warm as they would like it to be
- **Behavioural definition 2:** Participant states that they had to go without heating during the last 12 months due to lack of money

[7] Definition first used in "Fuel poverty: from cold homes to affordable warmth", B. Boardman, Belhaven Press, London 1991

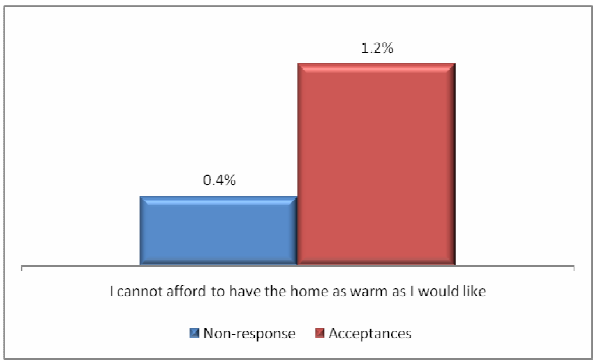


Figure Ax. 15: Proportion of fuel poor among trial participants and among respondents to non-response survey – using Behavioural Definition 1

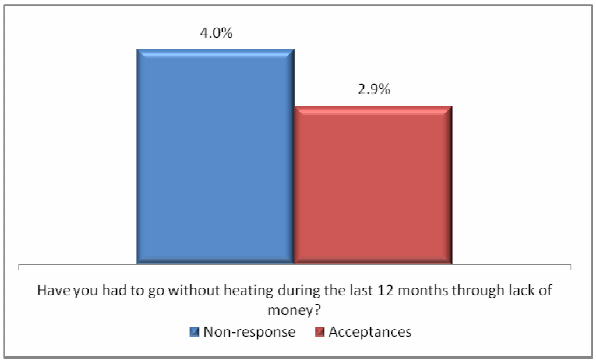


Figure Ax. 16: Proportion of fuel poor among trial participants and respondents to non-response survey – using Behavioural Definition 2

Figure Ax. 15 shows a higher level of participation in the Trial among those matching Behavioural Definition 1 of fuel poor. However, use of Behavioural Definition 2 (which includes the explicit requirement that the individual states they have gone without heating during the previous 12 months due to lack of money) reverses the difference between the two populations (shown in **Figure Ax. 16**). It should be noted that the proportion reported in this research using either definition is much lower than that estimated by the Institute of Public Health in Ireland (10% in 2007[8]) or ESRI (19.4% in 2008[9]) – using different approaches to measurement. Both definitions are used for analysis and reporting purposes in this report.

[8] "Annual Update on fuel poverty and health 2009", Institute of Public Health in Ireland
[9] ESRI reference

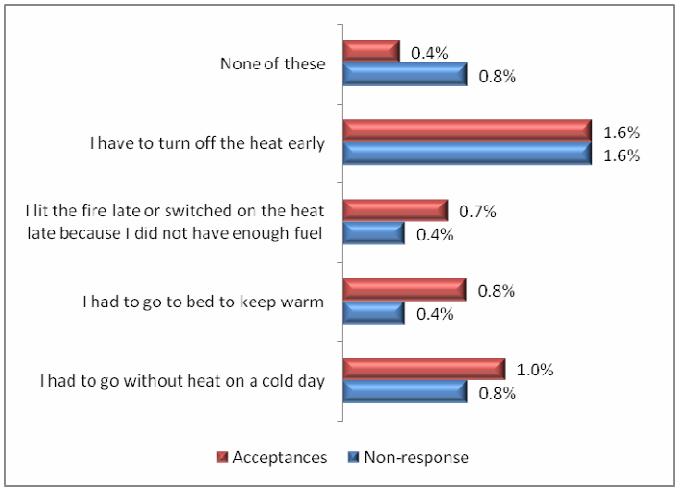


Figure Ax. 17: Behaviours exhibited by fuel poor (percentages on base of entire population)

Given the different proportions of fuel poor (using the second behavioural definition) among non-respondents and participants, it is surprising that the prevalence of fuel poor related behaviours exhibited by participants and non-response survey respondents are very similar (**Figure Ax. 17**). This similarly reflects selection of multiple behaviours by the fuel poor among the acceptance group. An unexpected result should not be regarded as reflecting the underlying prevalence of fuel poor in the two populations.

The sample size is insufficient to further profile differences in the populations of fuel poor – for instance to determine whether this effect is related to the reduced level of recruitment in the older age groups. However, the differences between the level of fuel poor among both the non-response and acceptance groups is relatively small using either behavioural definition and is therefore unlikely to impact on the overall result. Additional analysis is undertaken into the impact of the Trial on fuel poor participants and this analysis is not impacted by the discrepancy.

iii) Participation of recipients of government payments

The Government of Ireland provides a range of payments to assist consumers with the cost of home energy bills. These are paid to specified categories of consumers including qualifying consumers such as elderly, some disabled and those on low incomes. Payments of this type include the Free Electricity Allowance (FEA) and the National Gas Allowance (NGA), National Fuel Scheme and Smokeless fuel allowance.

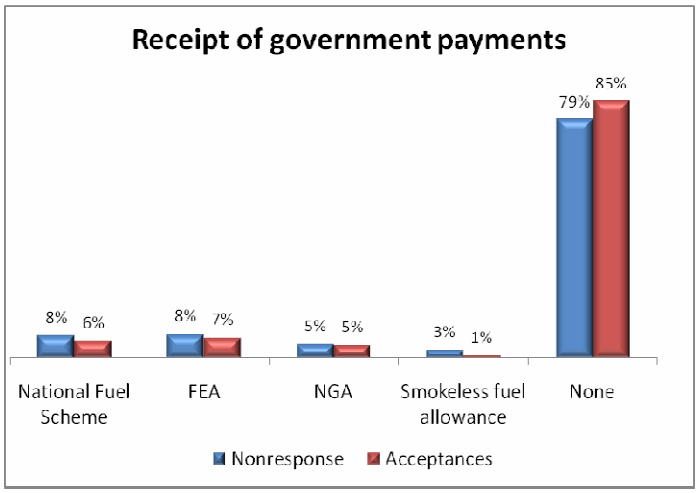


Figure Ax. 18: Distribution of owner/renter among trial participants and respondents to non-response survey

Figure Ax. 18 shows the proportion of recipients of these payments in both the non-response and acceptance groups: The proportion of the acceptance group in receipt is lower than the non-response group, which reflects the younger age profile and higher socio-economic profile of respondents. However, as with the other differences identified between the two populations the degree of difference is still relatively small and unlikely to impact on the overall analysis.

iv) Profile of homes

Home profile was also assessed among trial participants and respondents to the non-response survey to ensure that the two populations were similar. Aspects such as home owner/renter status may impact on the occupant's ability to reduce energy use as might the age of the house, house size and presence of insulation and other improvements.

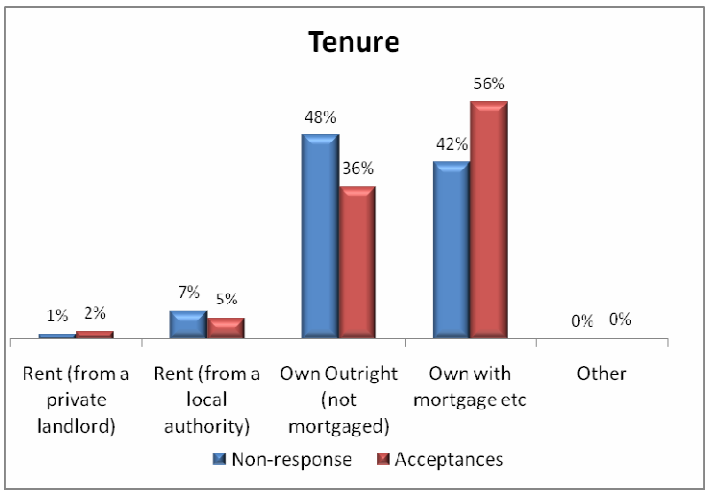


Figure Ax. 19: Distribution of owner/renter among trial participants and respondents to non-response survey

Figure Ax. 19 compares the distribution of tenure types among those accepted onto the trial and non-responses. The level of home ownership is higher among both the non-response and the acceptance groups (at 90% and 92% respectively) when compared to the national figure of 80%. However, this reflects the exclusion of consumers who have recently changed address from the recruitment population who are more likely to be renting.

There is a greater proportion of home owners with mortgages among the acceptance group (56%) when compared with non-responses group (42%). However, it is reasonable assume that this is linked to the difference in age profile already noted rather than reflective of other differences.

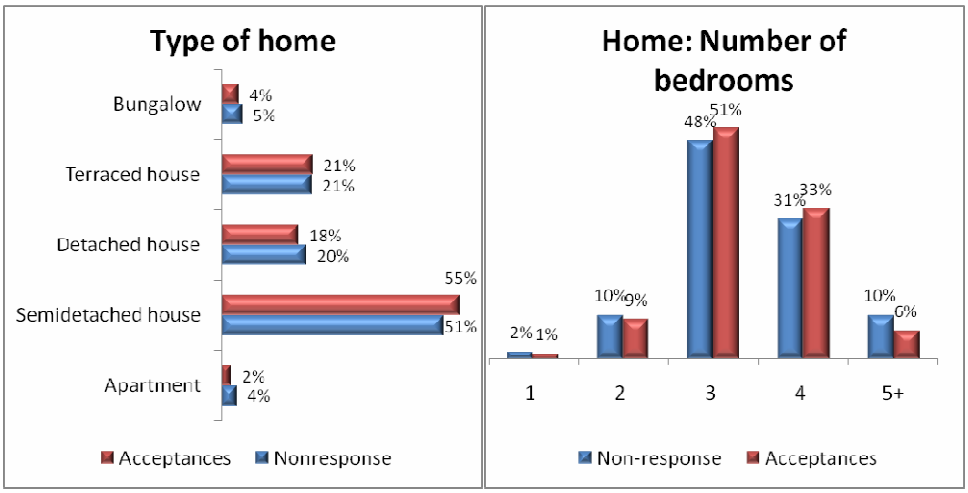


Figure Ax. 20: Distribution of home types and number of bedrooms among trial participants and respondents to non-response survey

In contrast to the differences in tenure, the distribution of home types and number of bedrooms is similar in both populations (**Figure Ax. 20**). This is particularly relevant to the overall comparison between non-response and acceptance populations as home type and size is an important factor in overall energy usage.

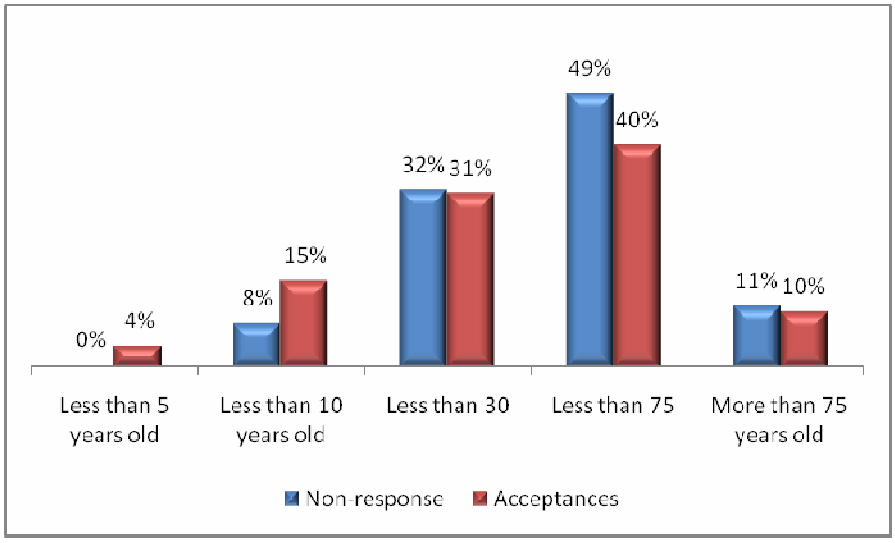


Figure Ax. 21: Distribution of home age among trial participants and respondents to non-response survey

Figure Ax. 21 shows the distribution of home age among the acceptance group and respondents to the non-response survey. Home age is relevant as older homes will typically be less energy efficient and potentially require additional energy consumption to keep adequately warm. The comparison shows that there are differences between the two populations with fewer homes in the 30 to 74 years old category among the acceptance set and correspondingly more homes in the 5 to 9 year old age category. While it must be taken into account into the analysis, the divergence is not sufficient to undermine the representivity of the home age distribution between the two groups.

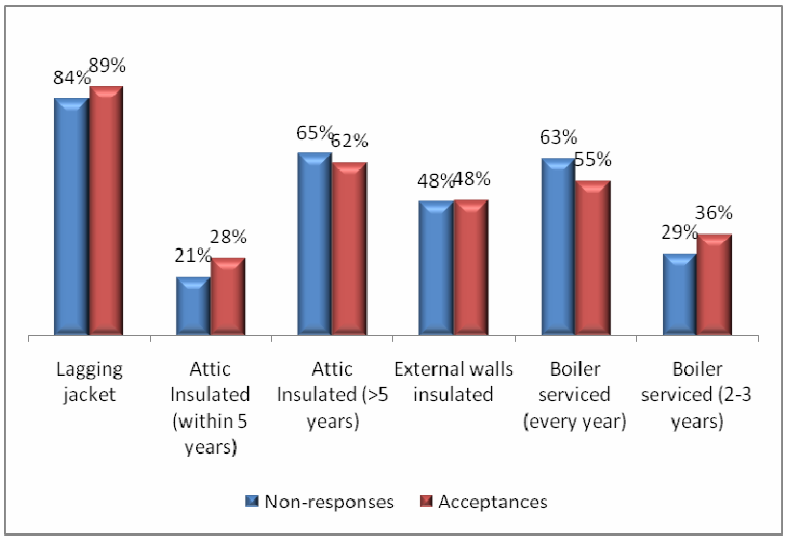


Figure Ax. 22: Prevalence of energy efficiency enhancements among trial participants and respondents to the non-response survey

While there are differences in the age profile of homes, the presence of typical home efficiency enhancements is similar between the two populations (**Figure Ax. 22**).

v) Profile of prevalence and use of heating controls

Almost all of both groups use natural gas to heat their homes (95% of the non-response group and 98% of the acceptance group). In the context of natural gas fired heating, there are a number of energy controls which have a role in enabling appropriate energy reduction behaviour (such as thermostats which control temperature in the home or timers allowing space and water heating to be switched on and off automatically) as well as others which have the potential to be used in a manner which would increase overall energy use (such as booster buttons which switch on space or water heating for an additional hour).

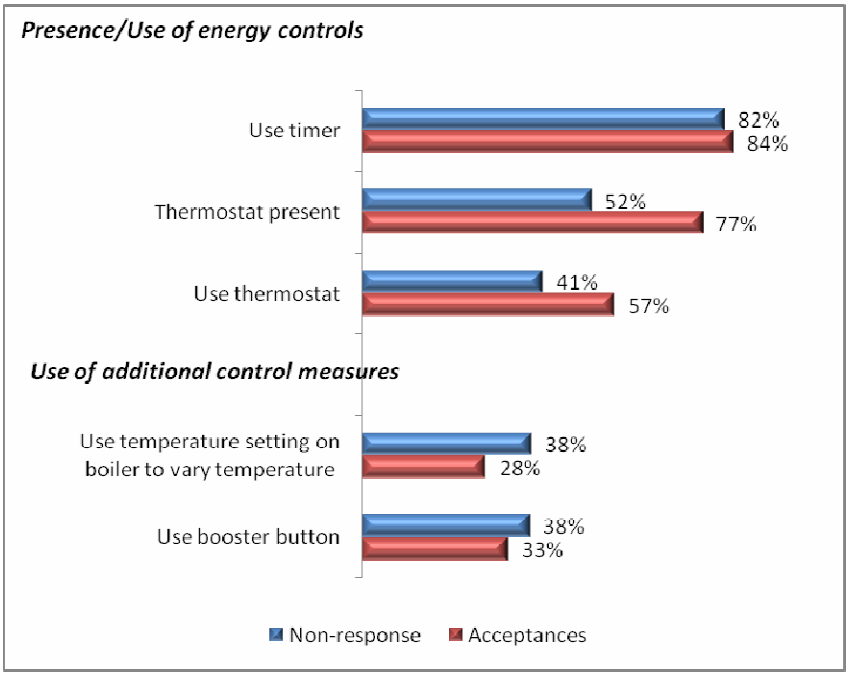


Figure Ax. 23: Presence and use of typical energy control devices among trial participants and non-response survey respondents

Figure Ax. 23 shows that there are significant differences between the non-response and acceptance groups with regard to presence of energy controls (52% of non-response survey respondents stated a thermostat was present in their home compared to 77% of the acceptance group) and the use of thermostats (also lower among the non-response group). The use of the booster button is correspondingly higher among the non-response group. These results suggest that the non-respondents may have less ability to control use of natural gas than the acceptance group.

vi) Attitudes towards and experience of energy reduction

The purpose of measuring the representivity of trial participants across attitudinal and experiential dimensions was to investigate whether trial participants were likely to be more engaged with the topic of energy reduction and potentially respond DSM stimuli to a greater degree than the general population. It should be noted that any tendency to reduce usage in response to societal pressures exerted external to the trial is incorporated to a degree within

the experimental design as the control group is drawn from the same population as the test groups and hence should exhibit the same tendencies.

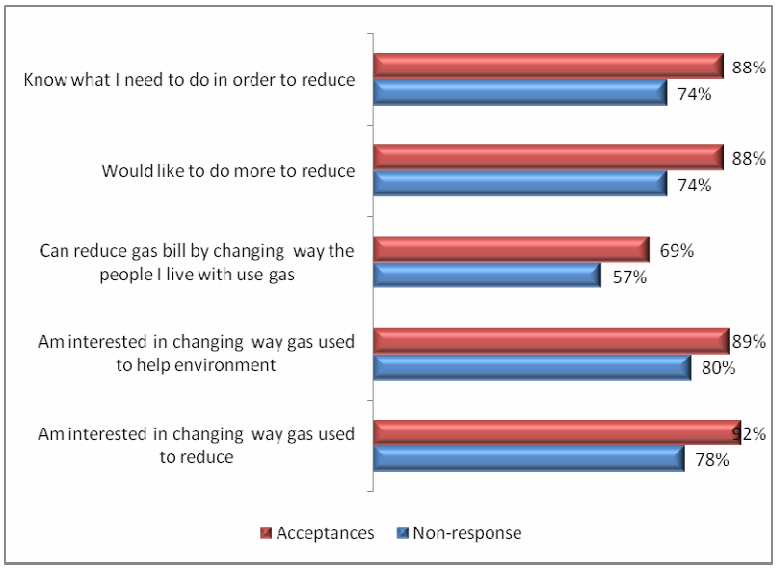


Figure Ax. 24: Comparison of level of interest in energy reduction among trial participants and respondents to non-response survey

Figure Ax. 24 shows when asked to indicate their interest and engagement with energy reduction, the non-response group indicated less interest or engagement than the acceptance group (with the difference in levels of engagement ranging between 12% and 14% and the difference in levels of interest differing between 4% and 9%).

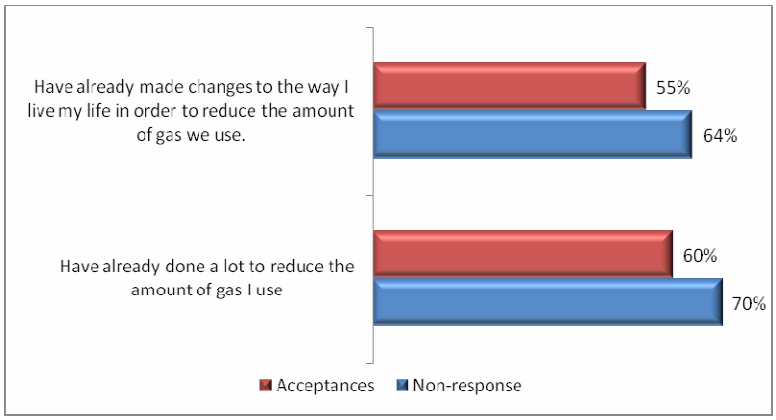


Figure Ax. 25: Comparison of reported prior behaviour change among trial participants and respondents to non-response survey

The assessment of reported behaviour change prior to the Trial (shown in **Figure Ax. 25**) also shows differences between the two groups with the non-response group reporting a higher prevalence of these behaviours compared to the acceptance group

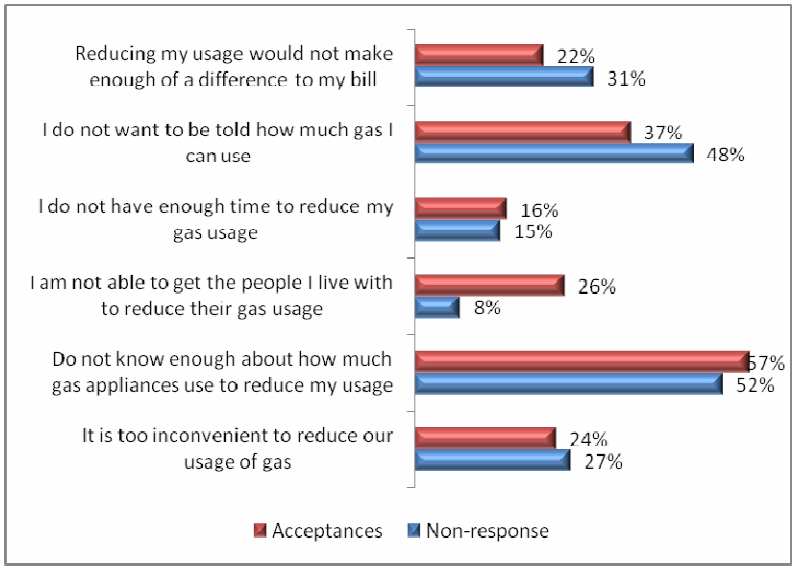


Figure Ax. 26: Perceived barriers to engagement with energy reduction among trial participants and non-response survey respondents who report no previous energy reduction behaviour changes

When potential barriers to energy reduction are considered among those reporting that have not been able to reduce their energy use prior to the Trial (shown in **Figure Ax. 26**), the non-response group is more likely to believe that such behaviour change would make no difference to their bill (31% compared to 22% among the acceptance group) and more likely to object to a perception that they are being told how much gas they can use (48% compared to 37% among the acceptance group).

The results suggest, therefore, that either the lower levels of interest and engagement reflect prior activities or, what is more likely, that the results in **Error! Reference source not found.** and **Error! Reference source not found.** considered together suggest that non-response group is less engaged and reports behaviour changes less objectively than the acceptance group: The non-response group is more likely to believe that they have under-taken behaviour change already and less open to engagement with further change. To ensure that these differences did not bias the results of the Trial, the analysis included comparisons between the actual energy reduction by groups reporting these perceptions.

vi) Recall and impact of invitation communication

In the context of determining the factors associated with the communication which might have led to the decision not to participate, non-respondents were asked about their recall and reaction to the letter. The assessment of the proportion of non-respondents that did or did not make an active decision not to respondent for trial related reasons has a significant impact on interpreting the results from the non-response analysis overall: If non-responses are driven by some aspect of the Trial, divergences between acceptance and non-response groups are much more likely to impact on the Trial than if non-responses are driven by factors external to the Trial. The analysis of reasons for non-response should also be used to enhance any future communication related to the potential national roll-out of smart meters.

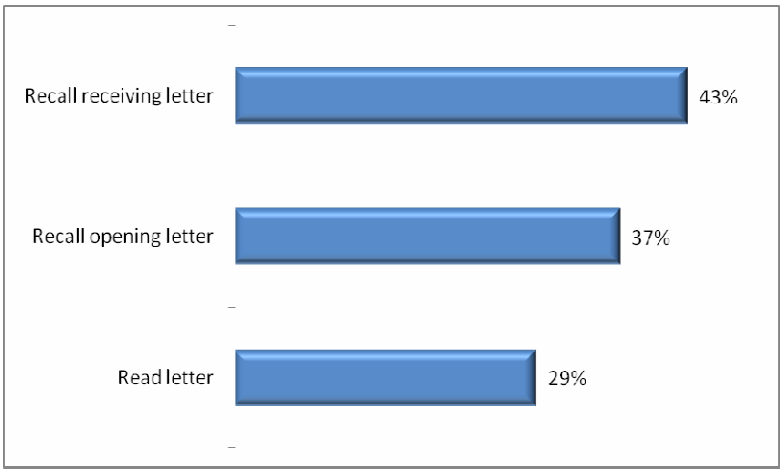


Figure Ax. 27: Recall of the arrival of the letter and recall of action upon receipt among respondents to the non-response survey

Recall of the letter (**Figure Ax. 27**) at 43% (with 37% recalling receipt without additional prompting on the design of the envelope) is relatively low given the survey was carried out within four weeks of receipt of the letter. However, this should be taken within the context of the higher than expected response rate to the invitation letter (at 25%). Reflecting the low recall of receiving the letter, the recall of opening and reading the letter was also low at 37% and 29% respectively. This low level of recall of receipt, opening and reading the letter may reflect the higher level of disengagement with energy usage already noted. In the context of determining if the contents of the communication and the presentation of the Trial negatively impacted on participation and potentially introduced bias, the lower level of recall and reading suggests that this is not likely to be the case.

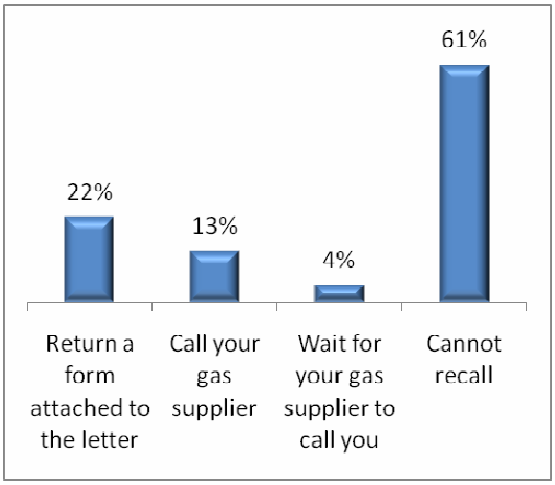


Figure Ax. 28: Recall of call to action in communication among respondents to non-response survey

Among the 29% of the non-response group who recalled the letter, 61% were not able to recall the call to action (**Figure Ax. 28**). It should be stressed that low recall of the call to action is expected given the participants did not act on the call.

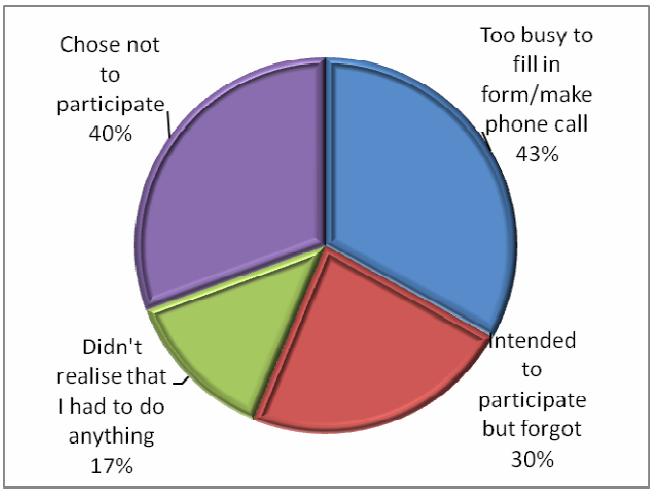


Figure Ax. 29: Stated reason for non-participation among respondents to non-response survey

Among respondents who recalled receiving and reading the invitation letter, 40% stated that they had made a decision not to participate (**Figure Ax. 29**). This represents 14% of all non-respondents.

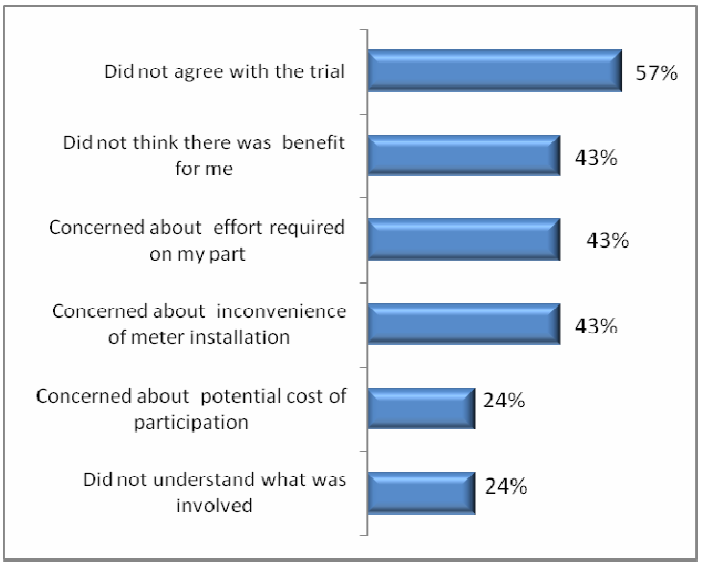


Figure Ax. 30: Stated reason for decision not to participate among respondents to the non-response survey who recalled receiving and reading communication and who has decided not to participate

Among non-response group consumers who had made a decision not to participate (14% of the total non-response group), the most common reason was a disagreement with the concept of a trial (57% of the 14% of the non-response group as shown in **Figure Ax. 30**). Concerns about lack of benefit, effort required and potential inconvenience associated with the meter installation were each identified as reasons by 43% of this group of respondents.

vii) Conclusions

There are a number of differences between the set of participants and the population of consumers who were invited to participate but did not respond. In particular, it should be noted that there was some over-representation of more affluent and younger consumers among those who accepted the invitation. This is in-line with prior-expectations for a trial of this nature but is not at such a level to raise major concerns about the reliability of the Trial overall. The analysis of the impact of this over-representation of more affluent and younger consumers was determined to have had no effect on the conclusions of the Trial.

The non-response group was also less engaged in energy reduction generally and less motivated to reduce than the acceptance group. They were also less likely to have energy controls and to use those controls. However, some of the key characteristics which would drive usage such as the make-up of the household and the size and type of house were very similar between the two populations. In addition, a majority of the non-response group did not recall the letter or did not read the letter 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.

In conclusion, the differences between the two groups may make the acceptance group marginally more likely to engage with energy reduction in general. It should be stressed that as the control and test groups are both drawn from the acceptance group, the higher general interest in energy reduction in both groups would have a lesser impact on the behaviour change measured when these groups were compared. With regard to the specific energy reduction behaviours which the Trial sought to encourage in the test groups, demographic and socio-economic analysis should determine whether the differences in the two populations impacted on the overall result of the trial.

A3.4 Analysis of attrition

Within the experimental design, it was assumed that there would be a certain level of attrition (as outlined in Section 4). Reasons for attrition included a consumer request to withdraw (or in some cases medical incapacity or death of the participant), change of tenancy where the participant moves home and changes of supplier. Switching was deemed to be a reason for removal from the Trial because a primary reason for switching was a reduced price offer from competing natural gas suppliers and the impact of price changes on participant behaviour would add additional variability and potential bias to the Trial. During the lifetime of the

Trial, market changes lead to significant increases in the level of competition from other natural gas suppliers and this made change of supplier the main reason for attrition.

Analysis of attrition was conducted along two dimensions:

1. Assessment of the level of attrition at a cell level within the experimental design to identify, prior to the completion of the Trial, whether the ability of the Trial to identify the target effect was impacted.
2. Assessment of the attritors to determine if the act of attrition was an impact of the Trial which would need to be incorporated within the analysis; or random events unconnected with the Trial. This was assessed through the attrition survey, which investigated the degree to which tariff, technology or the additional information might result in attrition.

A3.4.1 Methodology

Attrition levels were reported to the programme by Bord Gáis Networks at regular intervals and compared to the level of attrition incorporated within the experimental design.

The attrition survey was conducted using Computer Assisted Telephone Interviewing (CATI) periodically throughout the Trial with attrition since the previous survey included within the subsequent wave.

A3.4.2 Attrition

The attrition threshold[10] for the Trial was 35% overall or in any cell. The final total attrition since the start of the Trial (i.e. post recruitment but before allocation) was 18%. Therefore, the overall level of attrition was significantly less than the original target. The attrition level at a cell level is shown in **Table Ax. 10** below:

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	
Test groups	15.5%	18.5%	13.2%	12.3%	14.9%
Control					20.3%
Overall					16.8%

Table Ax. 10: Percentage attrition since allocation overall and at a cell level within the experimental design

The level of attrition varies by cell (between 12.3% and 18.5%) and between test groups (14.9%) and control (20.3%). The determination of whether this is a random or systematic effect and, in the later case, if this in turn introduces bias, is addressed in the next sub-section analysing the results of the attrition survey.

The overall attrition target was derived from assumptions on the likely source of attrition and this is compared with the sources recorded during the trial in **Table Ax. 11** below.

	Residential allowance	Residential actual (overall)	Residential actual (pre-allocation)	Residential actual (post allocation)
Overall attrition	35%	18%	1.7%	16.4%
Change of tenancy	22%	3%	0.6%	2.3%
Change of supplier	10%	12%	0.3%	12%
Disconnection	0.5%	NA	NA	NA
Non specific attrition	3%	3%	0.8%	2.1%

Table Ax. 11: Percentage attrition since deployment of ToU tariffs and DSM stimuli across experimental cells

It can be seen that the main reason for the lower overall level of attrition experienced compared to the original target is the lower level of recorded change of tenancy. This counter balances the higher level of attrition associated with change of supplier (with 12% recorded against a 10% target). The lower level of change of tenancy reflects the exclusion of tenancies of less than 12 months from the recruited population and may reflect the low levels of home sales during the period of the Trial.

[10] The attrition threshold is the rate of attrition beyond which the power of the trial to detect the level of reduction required would be impacted if the variability was equal to the level estimated prior to the trial. The overall level and the level in the cell corresponding to the combination of Tariff A and a bi-monthly bill. However, the degree of variability was also lower and therefore the power of the trial was not negatively impacted.

A3.4.3 Reasons for attrition

The reason recorded by Bord Gáis Networks for attrition among 73% of post-allocation attritors was change of supplier with change of tenancy (where the participant had moved home) the second most common reason at 14%. The remaining 13% of attrition was recorded as caused by a variety of technical and non-specific reasons.

Among respondents to the attrition survey, the reasons varied with a higher proportion (84%) stating that they had changed supplier and 17% stating that they had changed tenancy within the previous six months. The discrepancy between recorded and stated levels of change of supplier is larger than expected but may reflect a proportion of attrition caused by non-consumer activated reasons (in the technical and non-specific reasons which were recorded in 13% of cases) as well as sampling variability.

It should be noted that 62% of respondents were not aware that they were no longer in the Trial with 69% of participants who had switched supplier being unaware that this had excluded them from the Trial. The relatively low level of knowledge of attrition is surprising given the fact that any participant who attrited was sent a final bill and any on the variable tariff received a reconciliation by Bord Gáis Energy.

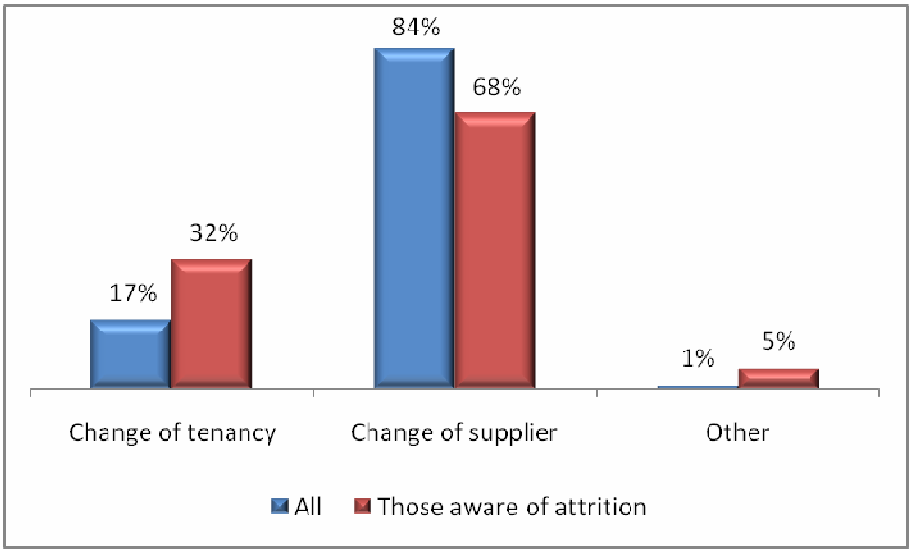


Figure Ax. 31: Reason for attrition

The differences between the reasons for attrition among those who were aware that they had attrited and among the overall group are shown in **Figure Ax. 31**.

The objective of the attrition analysis is to determine whether this attrition represents normal market movements or reflects an impact of the Trial which should then be incorporated within the measurement. For the 62% of attritors who were unaware of their attrition, it is

unreasonable to associate the attrition with the Trial. For that reason, this analysis focuses on those attritors who are aware that attrition occurred.

Considering the 38% of attritors who were aware of their attrition (approximately 6% of all recruited participants), 68% has changed suppliers while 32% had changed tenancy. Asked to rate potential reasons for leaving the Trial (among those who were aware of their attrition), increased awareness of energy used (**Figure Ax. 32**) was most commonly cited. However, 68% selected other reasons with the most common reason being a wish to switch gas supplier for reasons external to the Trial.

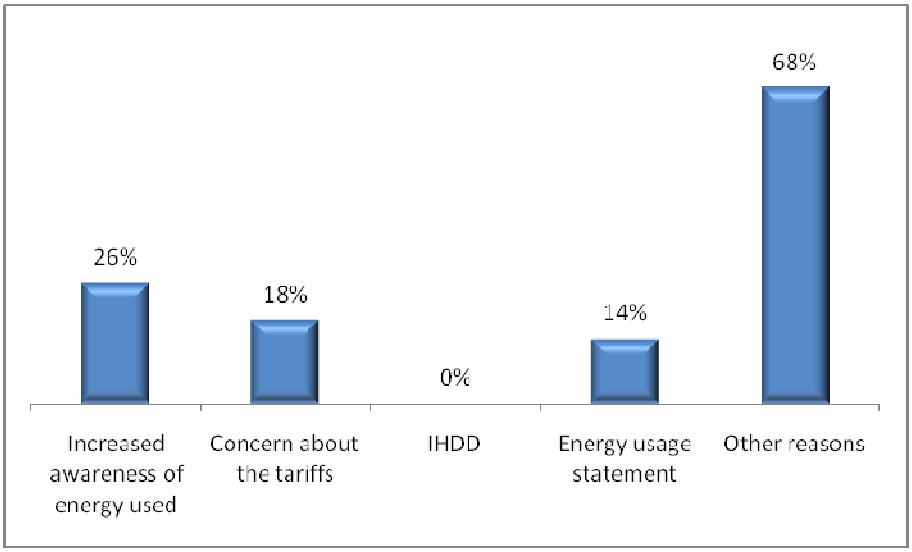


Figure Ax. 32: Reasons rated as significant reasons for leaving the trial among those participants aware of their attrition (IHDD and energy usage consumption only rated by those in the experimental cells with these stimuli)

Attritors who were aware that they had attrited and who had also changed supplier were asked to identify reasons which contributed to this decision (shown in **Table Ax. 12**). 93% of this group (approximately 40% of attritors) stated that increased awareness of the potential to save costs encouraged them to look at alternative suppliers. In addition, approximately a third in the experimental cell with the variable tariff who had switched supplier and were aware that they had attrited (23% of attritors in this cell) stated that the winter rate was a factor in their decision to switch.

It can be concluded that participation in the Trial appears to have 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 2% of attrition in the experimental cell with a varying tariff).

Reason for attrition (among attritors aware that they have attrited from the trial and changed supplier)	% stated factor contributed to change of supplier
Potential of saving costs made me look around for cheaper prices more generally	93%
The tariff with the winter peak rate which I was assigned to	33%
The potential cost to me of participating in the trial	32%
My ability to change my usage of gas	32%
Other reason	14%
The physical smart meter installed in my home	10%
The lack of information about the trial	10%
The amount of time required for me to participate in the trial	7%
The paper bill that is sent out	5%
The incentive was not sufficient considering the effort required from me to participate in the trial	5%
The In-home display (the box that shows you how much gas you are using)	0%
Others having access to my gas usage data	0%

Table Ax. 12: Significance of factors in switching decision among attritors who changed supplier and were aware of associated attrition

When asked to rate the importance of factors related to the technology (the smart meters for all test group participants and in-home displays for those in those experimental cells) which may have had an impact on their decision to leave the Trial, a low proportion (<5%) rated any such factor as significant. Similarly low scores were recorded for the impact of other aspects of the Trial such as bill complexity or the information provided on the energy usage statement.

A3.4.4 Conclusions

There is no evidence to suggest that attrition is linked to allocation to specific experimental cells or the test groups more generally. There is some linkage to the increased level of awareness engendered through participation in the Trial which in turn encouraged switching of natural gas supplier. However, this affects a small proportion of the overall trial participants and there is no evidence that this would introduce bias.

Appendix 4: Allocation of participants

A4.1 Residential Allocation

A4.1.1 Introduction

Allocation of the trial participants into one of the experimental cells or the control group was performed in May 2010. Allocation occurred after completion of the pre-trial survey and used this information as well as actual smart meter usage data captured since installation.

Participants were allocated to each experimental cell using an algorithm which ensured that each cell was representative across the measurable dimensions. The allocation achieved this by characterising the set of participants across multiple dimensions and then allocating similar individuals into each test cell and the control group.

The dimensions available for characterisation varied as some individuals did not respond to the survey. Therefore the allocation algorithm also allowed allocation based on non pre-trial usage data only.

The population of 1,892 acceptances remaining in the Trial at the time of allocation were allocated into four test cells and the control group. 35 of the 1927 acceptances attrited prior to allocation and were excluded.

A4.1.2 Constraints and Exclusions

In addition, there were a number of constraints in place on allocation to ensure:

- Allocation of consumers in the non-in-home-display cells where technical issues precluded the use of an in-home display device.
- Allocation of consumers who were in receipt of a paperless bill to the control group
- Allocation of consumers on the basis of technical reasons to cells other than the tariff cell

A4.1.3 Allocation

The population to allocate was made up of 1,626 respondents to the pre-trial survey and approximately 266 participants who had not responded to the survey.

Each participant was assigned to one of a set of "categories". Each category was defined such that:

- Each category was sufficiently *coherent* to ensure representivity when participants were randomly allocated across the cells
- Each category had sufficient members to allow placement of members into each of the four experimental cells and the control group in the required ratios.

The factors considered for inclusion in the allocation included:

1. 2008 usage
2. Paid by direct debit
3. Region (county level)
4. Overall Usage level measured from meter data for 19 weeks of usage data available at allocation or secondary read data provided by Bord Gáis Energy for those meters with missing data over a specified level (10%)
    - Divided into four categories (Category 1 containing 11% of the population; Category 2 containing 21% of the population; Category 3 containing 30% of the population and Category 4 containing 39%)
5. Level of variation in weekly usage level measured from meter data for 19 weeks of usage data available at allocation for all meters with meter reads available for at least 10 of the 19 weeks
    - Divided into four categories (Category 1 containing 10% of the population; Category 2 containing 20% of the population; Category 3 containing 30% of the population and Category 4 containing 40%)
6. Size of household and profile of home:
    - Number of occupants
    - Number of bedrooms
    - Size of house
    - Type of house
7. Social and demographic classification
    - Socio-economic classification
    - Income coded into five bands
    - Reported education
    - Employment status: outside of the home, carer/retired or unemployed
8. Existence and use of home heating controls
    - Presence of thermostats in the home and the temperature setting on thermostats installed
    - Presence and use of timers controlling when heating is used
    - Use of booster switch
9. Presence and use of gas fires (such as flame effect fires)

10. Reported behaviours associated with use of heating (such as switching off heating in rooms unoccupied, switching on radiators to dry cloths, leaving heat on when the home was unoccupied and use of heating system to heat water)
11. Reported behaviours associated with water heating (including use of timer, immersion and sink/bath control on system)
12. Investment in energy saving as an indicator of likelihood to invest further in change
13. Interest in behaviour change in order to reduce usage
14. Engagement in energy usage reduction

Each dimension of classification was tested to determine whether it was orthogonal to the other dimensions of measurement using **Proper Orthogonal** Decomposition (also known as **Principal Component analysis**). This analysis identified four main combinations of factors which explained 48% of variability in usage. The definitions of the vectors are shown below:

Composition of Eigen vectors	**Eigen Vectors**			
Factors	**V1**	**V2**	**V3**	**V4**
Usage band	-0.185	0.54	-0.123	0.017
Week Variability	-0.192	0.532	-0.095	0.022
Payment method (direct debit)	-0.12	0.084	0.036	0.1
Number of occupants	-0.194	0.158	-0.193	-0.092
Number of bedrooms	-0.289	0.346	0.036	-0.063
Social grade	0.342	0.133	0.01	-0.344
Education	-0.284	-0.105	0.071	0.247
Employment status	-0.293	-0.208	-0.048	0.335
Fuel allowance	0.285	0.168	0.094	-0.283
Home owner	-0.188	0.137	0.055	0.199
Have thermostats	0.146	-0.096	-0.275	0.3
Use timers	0.056	-0.076	-0.226	0.307
Common temperature control method	0.124	-0.02	0.038	-0.075
Heating usage behaviours	0.016	0.029	0.006	-0.074
Water heating approach	-0.074	0.075	0.095	0.024

Composition of Eigen vectors	Eigen Vectors			
Energy saving investment	-0.324	-0.161	0.413	-0.227
Interest in energy reduction	-0.262	-0.201	-0.468	-0.365
Engagement in energy reduction	-0.324	-0.161	0.413	-0.227
Gas fires - heavy use	-0.262	-0.201	-0.468	-0.365

Table Ax. 13: Definition of Vectors

It can be seen that V2 is linked to usage profile, V3 is linked to interest and engagement with energy reduction, while V1 and V4 is less clearly interpretable with a mix of engagement and socio-demographic elements.

The value of each Eigen vector was calculated for each participant and then allocated to a level to classify participants into the profiles.

Using this classification, participants for each profile were randomly allocated to each experimental cell.

Distributions were examined to ensure that the cells were representative across each factor included in the Eigen vectors and all other available factors. Where significant discrepancies were identified participants were reallocated to ensure representivity at an individual factor level. Participants who had not responded to the pre-trial survey were allocated using the same algorithm using factors 1 to 4 identified above.

Appendix 5: Outcome of Focus Groups conducted during the Customer Behaviour Trial

A5.1 Introduction to Consumer Research

During the Gas Customer Behaviour Trial a number of focus groups were conducted by The Research Perspective Ltd in order to explore different aspects of the trial design. The purpose of the groups was to incorporate consumer feedback for critical consumer impacting stimuli to be deployed during the course of the Trial. In addition the understanding from the groups was to inform customer communications with a view to enhancing their effectiveness and efficiency. The specific areas to which the research was directed were as follows:

Aspect requiring Research	Approach
How consumers use gas	Focus Groups on **Understanding gas usage and profiling attitudes** (Residential) – September 2009
Detailed Bill Design	Focus Groups to capture **Customer evaluation of the Energy Usage Statement options under consideration** (Residential) – December 2009

The participants of the focus groups were selected on the basis of attributes such as usage and socio-economic profile in order to be representative of the trial participants – the trial participants themselves were specifically excluded from this qualitative research component.

Details of each of these are outlined in the following pages.

A5.2 Focus Groups on Customer Attitudes to Gas usage, consumption patterns and potential for reduction – September 2009

A5.2.1 Introduction

A total of four customer focus groups were conducted. These focus groups covered a mix of age, social class, location and usage categories in order to reflect the diversity of participants in the Customer Behaviour Trial.

A5.2.1 Objectives of the Focus Groups

The objective of the research was to understand the Gas consumer and their approach and attitude towards their gas usage focusing on:

- Assessing customer's evaluation and understanding of their level and associated cost of usage
- Typical time and seasonal patterns of usage, with decision factors
- Openness and perceived opportunity to modify usage level & patterns
- Gauging the potential effectiveness/impact of the proposed stimuli on anticipated behaviour
- Reaction to bill arrival – expectation and management

There were a number of specific areas of investigation:

- Identification of the 'Usage' decision maker in the household
- Prevalence of on-off temperature control (up-down) modes of usage
- Role of 'calendar' compared with 'temperature' (once the heat is switched on, does it stay on irrespective of the external temperature)
- Gas usage splits (cooking/heating/hot water)
- Perception of impact of energy related activities (boiler servicing) on usage levels
- Triggers for boiler servicing e.g. such as the arrival of a big bill, prevailing advertising or seasonal activity

A5.2.2 The structure of the focus groups

The structure of the groups was designed to address the objectives in a sequence which is logical and promotes exploration of complex issues by a representative group of gas consumers. The following structure was followed:

Understanding usage context	Relative splits between types of usage Existence of discretionary usage Understanding the context of gas usage
Understanding the bill	Information looked for – understanding of other information Understanding of how bill is made up Impact of bill on usage patterns
Usage pattern & behaviour change	How is usage controlled? What is gas used for? Who makes the decisions? Is/How is the timer used? Is/why is the boiler serviced?
Driving usage change	What are the barriers to usage change? What incentives are needed? What information would encourage usage change?

Figure Ax. 33: Structure of the Focus Groups

A5.2.3 The learning journey for gas usage management

The research concluded that the objective of reduced energy usage requires a transition from passive acceptance of the bill to engaged and effective behaviour change.

- This research found that the consumer of gas is predominantly in the first stage.
- This is a similar conclusion to electricity usage, but is more marked in the case of gas usage.

The stages identified by the participants as likely points along the journey form just paying the gas bill to engagement were characterised as outlined below. The objective of reduced energy usage requires a transition from passive acceptance of the bill to engaged and effective behaviour change:

Figure Ax. 34: Stages from payment to engagement

Participants concluded that as most consumers of gas are at Stage 1, they would need to transition from this stage in order to achieve the reduction objective. This could be attained by developing:

- knowledge of how gas is consumed;
- understanding of how gas total usage is calculated and charged for;
- engagement with the concept of energy usage reduction;
- capability to identify potential for discretionary usage.

A5.2.4 The context of gas usage in participants' lives

The winter gas bill is the largest non-mortgage bill for most participants, notwithstanding the fact that over 90% of participants indicated that they accept their gas bill passively without consideration. Over 70% of participants ware not concerned even when bill size was larger than expected:

- *"It is just one of those bills that has to be paid – so I don't open the bill" [pay by direct debit]*
- *"I have €400 or €500 bills coming in – you get used to paying them"*
- *"In the winter it would be higher than any other bill but you just expect it"*
- *"Sometimes you do dread it – depending on whether the money is coming in"*

This is partly because participants appeared to lack a basis for determining if their usage is abnormal or even changing:

- *"With all the price changes you can't tell if you are using more or less than last year"*

Knowledge of usage and understanding of charging are also major factors which impact on the nature and extent of participants' response to their gas bills and their capability to reduce usage. Consumers accept pricing as valid for gas heating, which is not disputed and regarded as good value. This applies particularly to those participants who had previous experience of other heating methods (solid fuel, storage heating):

- *"Its good value, you push the button and the heat comes on quickly"*

The minority of participants who do tend to react to gas bills, tend to do so in an unsustainable manner:

"When I get the big bill in the winter I am like a lunatic for weeks afterwards saying 'Get the heat off'"

"Every bill we say that we are going to change but it just doesn't happen"

A5.2.5 Seasonal Patterns of Gas usage

Participants were asked to estimate the split in primary gas usage during the winter (which they defined as running from September to April). There was a bias in estimation towards active use (water and cooking) over passive use (heating). The most common estimate of cooking usage was 20%-25% with flame effect fires (where used) associated with 20%-25% of total gas usage.

In the case of the summer usage estimates there was recognition that heating usage declined during the summer. It was interesting to note that the estimation of energy usage associated with heating is simplistic. It primarily focuses on On/off, with little consideration of the relative impact of ambient temperature or hours of usage included. The water usage estimates did not take account of accidental heating usage when radiators were heated at the same time as water.

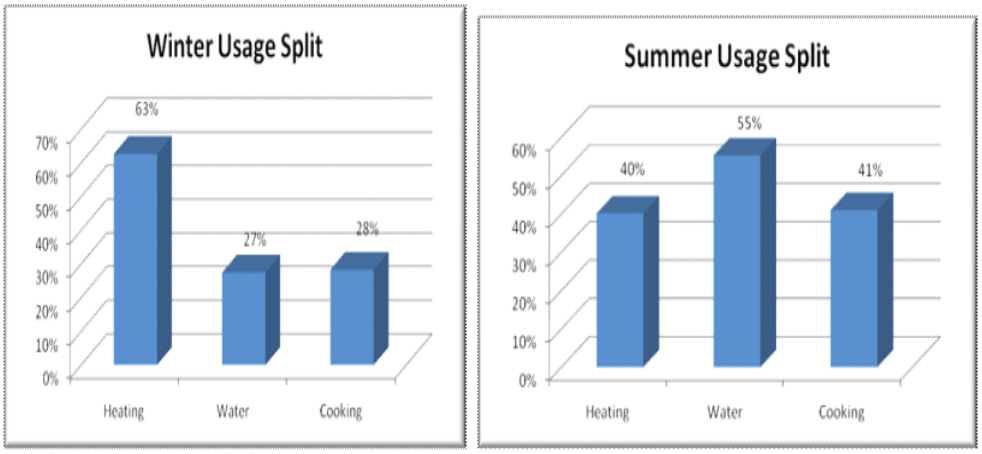


Figure Ax. 35: Estimates of winter and summer Usage

A5.2.6 Exploring discretionary usage

Discretionary usage was identified by participants as being driven by the interaction between perceived needs, knowledge of usage and cost and established behaviours:

Figure Ax. 36: Model of Discretionary Usage

The level of perceived discretionary usage is low. This is compounded by the fact that the participants lack both knowledge about usage and the skills to utilise the available usage controls. In addition, home temperature is measured in subjective terms ("Am I warm enough") and not objective terms ("The temperature is 21^{o} C").

A5.2.6.1 Needs

Participants were not able to engage at all with reducing gas used as a result of cooking and the topic was rejected without discussion. Participants regarded their current use of heating as non-discretionary:

- *"If it needs to be on, it is on"*
- *"You can sit with no lights and have the TV on but if the room is cold…"*

Overall, the house temperature was regarded as a strongly personal choice which is an essential 'right'

- *"We enjoy being nice and cosy"*
- *"My husband is a cold creature and he needs to put the heat right up"*
- *"I put it on for the kids: our daughter is doing her junior cert"*
- *"It is alright saying that – but people do get cold. It is not a luxury – it is a right"*

A5.2.6.2 Knowledge

There was low knowledge associated with how radiator heating and water heating interacted (and how one could be used without the other). This leads to radiators being heated during the summer in order to heat water

- *"We didn't know there was a valve to stop the radiators going [at the same time]"*

Central heating is sometimes used to dry clothes as an alternative to using tumble dryers, as tumble dryers are recognised as heavy users of energy. However, no objective comparison with the heating system was made:

- *"If you are drying clothes, you have to have the radiators going"*

The consumer is capable of absorbing knowledge and adapting behaviour in response to that knowledge. This was particularly noted with regard to the flame effect gas fire which is recognised as a heavy consumer of gas and used with caution, if at all.

- *"It is lovely – it heats a room up but it eats the gas. That is why the bills are so high during the winter time"*

A5.2.6.3 Behaviour

Participants typically claim other people are responsible for driving usage, in particular teenage children. The heating level used in the house is controlled by the person who wants most heat:

- *"Whenever I lower mine down, my daughter says it is like Siberia. I say put an extra jumper on you, no – the heating"*
- *"Young people knock on the heat constantly – my daughter comes in and puts it on and leaves it on."*

In relation to the management of the heat within the house, over 50% of participants indicated they used the booster switch as the primary control mechanism even when the timer was fitted. There was a direct association between pressing the button and heat availability ("The elevator button effect). Very few participants used the thermostat to control usage.

A5.2.7 Understanding the gas bill

Most participants understood that gas was charged on the basis of units used and awareness of standing charges or the purpose of standing charges was also low. Over 30% could not provide any estimate of the cost of a unit - estimates provided varied from 17c to €1.

When given a current bill, most participants could not identify the correct cost of a unit from the bill; over 50% of the participants confused the conversion factor with the unit cost for gas. Among those who correctly identified the unit cost, some expressed difficulty in interpreting it as it was not preceded by a euro sign (€) or followed by a cent sign (c)

- *"How much is 0.05471 in real money?"*

Awareness of the basis for charging for gas is very low among participants with a very small number of participants aware of the way gas usage is measured (i.e. in m3). No participant could interpret the use of the conversion factor or the relationship between meter readings, conversion factor and eventual cost. Participants were surprised at their own lack of engagement and were quick to recognise their own knowledge deficiencies.

- *"It is so stupid that you pay something every month and you don't understand"*

A5.2.8 Expectation of potential savings

The participants stated that they would expect savings of between €20 and €40 per winter bill (10% to 20% overall) if they changed behaviour, but believed that this would be hard to achieve. Most participants relied on removing usage instead of adjusting usage and although the use and value of thermostats had been discussed, most participants did not see opportunities to reduce usage by using the timer or thermostats. The likely stimuli were explained to the participants and about 20% indicated that they believed an in-home device would assist them reduce their usage. Finally the role of boiler servicing was perceived as minimal in the context of facilitating reduced usage. Boiler servicing activity is more typically driven by safety concerns or a wish to extend the life-time of the boiler as opposed to usage reduction. This is because the payback time for the servicing investment was considered unattractive.

A5.2.8 Summary of findings

Participants very much value their choice for gas heating, in terms of its immediacy, cleanliness and value and they report that they are currently getting good value for the money spent. Overall:

- There is a low level of engagement with regard to bill size and usage reduction
- Level of discretionary usage is assessed by consumers to be very low, in particular for heating
- There is a low level of engagement with usage control behaviour related to heating
- Awareness of basis for charging for gas is very low among participants

The challenges for the Trial were identified as:

Communication and Education

- The gas trial would require communication targeting general information about gas usage in order for consumers to be able to reduce usage.
- The smart meter would allow this information to be more personalised and real-time compared with current billing data.

Behaviour change potential

- Without extensive education and communication effort, participants were unlikely to modify behaviour as they lacked engagement with the topic of gas usage and motivation required to attempt behaviour change.

- Behaviour change required understanding of how gas is used and an acceptance that behaviour change is achievable, acceptable and worthwhile.
- A strategy to address the motivation gaps should be considered.

Gap Identified	Description
Understanding gap	the relationship between usage and cost
Acceptance gap	accepting that change is possible
Motivation gap	quantification of the benefit of such changes

Table Ax. 14: Motivation Gaps

A5.3 Focus Groups on Customer Evaluation and design of the Bill and Energy Usage Statement (Residential) – December 2009

A5.3.1 Introduction

A total of four customer focus groups were conducted. These focus groups covered a mix of ages, social class, location and usage categories in order to reflect the diversity of participants in the Customer Behaviour Trial.

A5.3.2 The Energy Usage Statement

In order to be effective the energy usage statement must support the consumer irrespective of the level of engagement they have with their energy usage level and pattern. It must also strike a balance between providing information without overwhelming the consumer, providing graphical displays without distraction and providing customised advisory elements that inform, support and encourage.

A5.3.3 Structure of the Focus Groups

The structure of the focus groups was based on requesting participants to review page 1 of the bill and subsequently review six versions of the energy usage statement (page 2). Page 1 of the bill mirrored the standard bill issued to residential consumers. The Energy Usage Statement (Page 2) was designed to accompany Page 1 and to provide additional consumption information to allow interested users reduce their usage, should that be possible.

In general, participants found Page 1 of the bill to be reasonably clear, but they struggled with the measurement of gas (m^3) and with the conversion factor. Their focus of attention on Page 1 was primarily on the overall amount of the bill, although some found the other measure interesting.

A5.3.4 Knowledge and engagement among gas residential groups

In the case of the residential gas consumer, their response to any gas bill is dependent on their level of engagement with the gas usage patterns within the household. This level of engagement is determined by the level of consumer knowledge of gas usage, units of measurement and bill composition. Therefore when presented with the different Energy Usage Statements for evaluation, the assessment criteria of the consumers were determined by their level of knowledge. Those consumers who had a reasonable level of knowledge tended to evaluate the options presented on the basis of information, data contained therein and interpretability, while those who did not have a good level of knowledge were more concerned with the aesthetics, the simplicity of presentation and the immediacy of impact.

Figure Ax. 37 Unengaged/Engaged spectrum

A schematic was developed to attempt to capture the number and size of the different audiences which the Trial would be likely to interact with. A categorisation was developed based on a combination of engagement and understanding which identified five different classifications. In order to empower users with the capability to reduce usage there was a requirement

- For ***information*** addressing and educating low knowledge/engagement consumers
- For ***data*** supporting average and home expert consumers in usage reduction

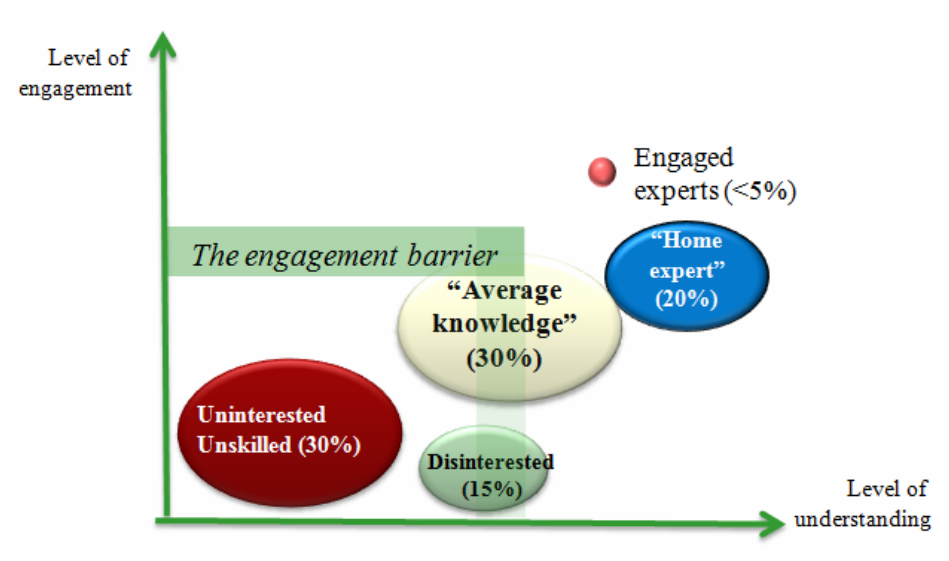


Figure Ax. 38: Schematic of different levels of engagement and understanding

A5.3.5 Perceived opportunity to reduce usage

The focus groups were asked about opportunities to reduce usage, with a view to understanding the potential response to the different stimuli to be rolled out to the trial participants. In general they did not believe there was much discretionary usage potential in the context of their households.

Under half of the participants did not see a possibility of reducing consumption, either in winter (42%) or summer (40%). Among those who acknowledged that there was scope for reduced use, the average estimated level of potential savings was 6% in winter and 8% in summer.

The methods for reducing winter usage, which were unprompted, were identified as follows:

Method of Reduction	% of participants identifying this method
Use the timer	50%
Use the thermostat	46%
Increase level of insulation	42%
Reduce the heat in the radiators	15%
Service the gas boiler	8%
Install double glazing	8%

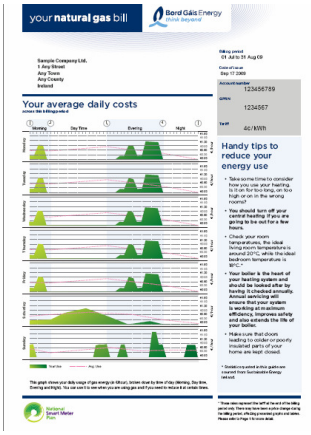
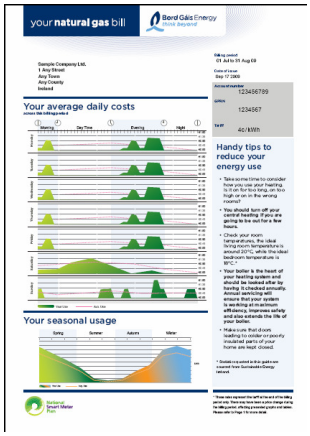
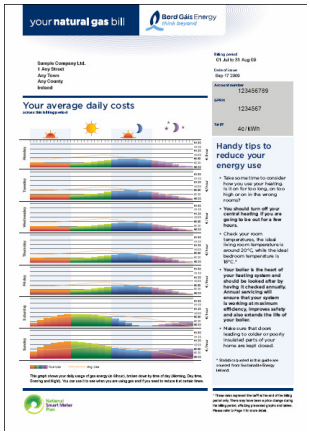
Table Ax. 15: Methods of reducing winter usage

In the case of summer reduction, the unprompted methods tended to be more disparate in nature as the participants struggled to identify opportunities for reduced energy usage. The following options presented:

- Don't use radiators to dry clothes
- Install solar panels
- Service the gas boiler
- Substitute with electricity
- Reduce the use of the gas cooker

A5.3.6 Evaluation of Energy Usage Statement Options Presented

A total of six different Energy Usage Statement options were presented for consumer evaluation. The primary difference across the different options was the display of the core information:

Option	Description	Illustration
Energy Usage Statement Option 1	• Daily cost graph by day, averaged over the billing period with single colour variation within average day • Handy Hints component • Comparison against average usage for the average day	
Energy Usage Statement Option 2	• Daily cost graph by day, averaged over the billing period • Handy Hints component • Colour coded seasonal usage component with a comparison against average use by season	
Energy Usage Statement Option 3	• Daily cost graph by day, averaged over the billing period with multiple colour variation within average day supported by graphical illustration of times of day • Handy Hints component • Comparison against average usage for average day	

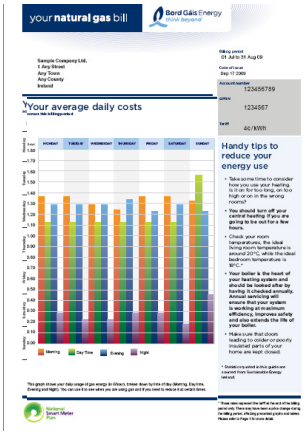
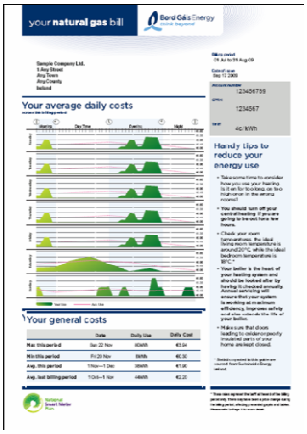
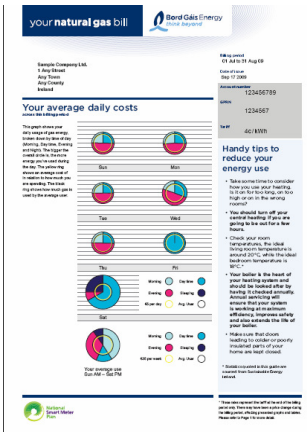
Option	Description	Illustration
Energy Usage Statement Option 4	• Standard histogram displaying daily costs for four segments of the day, for each day of the week, colour coded • Comparison against average usage for average day • Handy Hints component	
Energy Usage Statement Option 5	• Daily cost graph by day, averaged over the billing period with single colour variation within average day • Handy Hints component • Comparison against average usage for average day • Summary table with maximum day cost, minimum day cost, average daily cost and average day usage	
Energy Usage Statement Option 6	• Tiered pie-charts displaying daily costs for four segments of the day, for each day of the week, colour coded with an average use comparison • Handy Hints component	

Table Ax. 16: Summary of Energy Usage Statement Options

The common component across all Energy Usage Statement options was the Handy Hints component, which focused on energy reduction. The advice tended to act as a starting point for participants with less knowledge and who were less engaged, as well as for those who

reported that they tend to be intimidated by the graphical representation of data. The content and format of the Handy Hints Panel was positively received by all participants

"It is in everyday language", "Practical advice"

The participants strongly recommended that the advice should change regularly to ensure continued interest, that it should be personalised wherever possible and that it should be localised.

In terms of the data presented, the Energy Usage Statement preference was decided on the basis of preference for graphical representation, colour and clarity. In general, participants felt a little overwhelmed by the level of data presented, believing that average daily consumption for weekdays did not show enough variation to warrant each day being displayed. The key area of interest was the contrast between the weekday, Saturday and Sunday consumption. This was due to the fact that variations at this level of granularity effectively reflected the pattern of heating and other gas usage within the different households.

There were trade-offs between the attractiveness versus usefulness of the information presented, where the more engaged participants tended to focus on the information while those less engaged were more interested in the display. The use of average comparisons was highlighted as not very useful as participants were not clear on the value of this comparison, particularly if the average was calculated across all gas consumers. There would have been value associated with this measure if it was based on a 'peer group' comparison based on similar households, house sizes, occupancy etc. Furthermore participants believed that they should use gas (heating and/or cooking) if they need it and not be influenced by the approach to or level of usage of others.

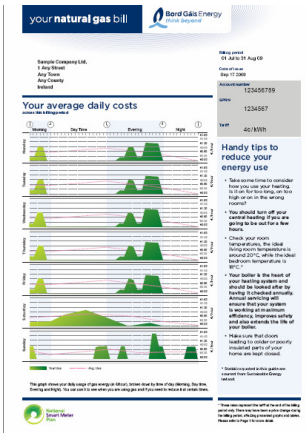
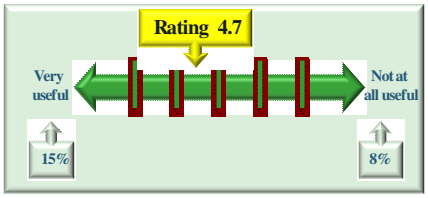
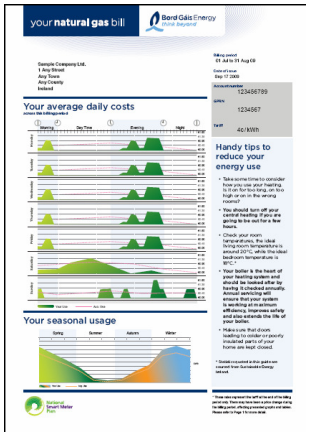
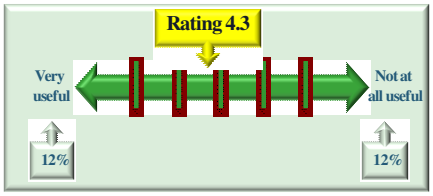
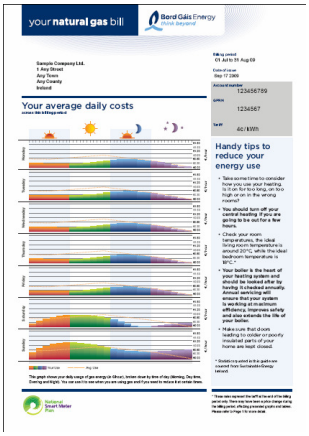
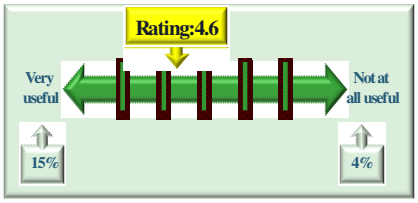
A seasonal view of usage was also not considered useful as consumers '*would know they use more in winter and less in summer*'. The comparison with an average usage profile was also not considered useful as participants believed they only used gas when they needed it. On that basis comparing usage profiles was of limited interest and value.

A5.3.7 Rating of Energy Usage Statements provided

Participants were asked to rate the Energy Usage Statements presented on the basis of the following, (among others):

- Overall Rating (out of 7)
- Assessment of Very Useful
- Assessment of Not at all Useful

The following table summarises the options, illustrations, description and the focus group participants' assessments of each:

Option	Description	Illustration	Customer Average Rating
Energy Usage Statement Option 1	• Daily cost graph by day, averaged over the billing period with single colour variation within average day • Handy Hints component • Comparison against average usage for average day		
Energy Usage Statement Option 2	• Daily cost graph by day, averaged over the billing period • Handy Hints component • Colour coded Seasonal Usage component with a comparison against average use by season		
Energy Usage Statement Option 3	• Daily cost graph by day, averaged over the billing period with multiple colour variation within average day supported by graphical illustration of times of day • Handy Hints component • Comparison against average usage for average day		

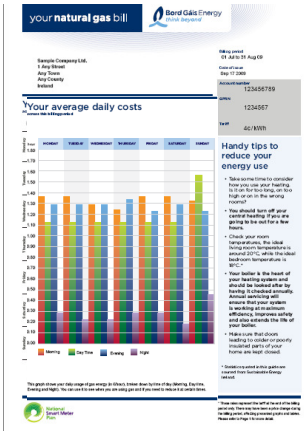
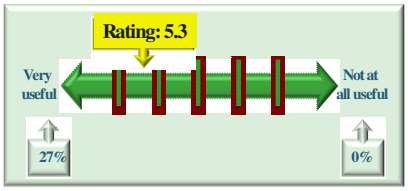
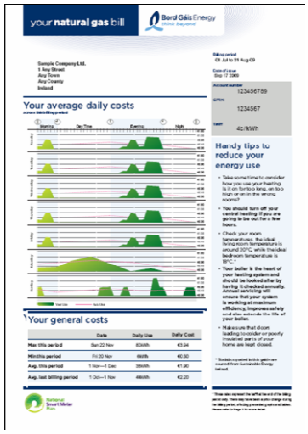
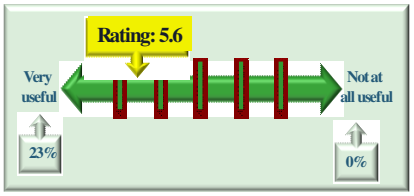
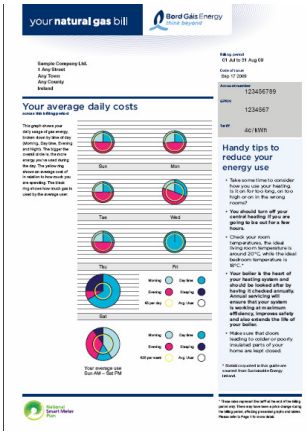
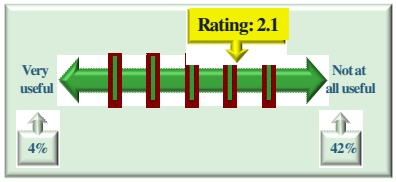
Option	Description	Illustration	Customer Average Rating
Energy Usage Statement Option 4	• Standard histogram displaying daily costs for four segments of the day, for each day of the week, colour coded • Comparison against average usage for average day • Handy Hints component		
Energy Usage Statement Option 5	• Daily cost graph by day, averaged over the billing period with single colour variation within average day • Handy Hints component • Comparison against average usage for average day • Summary table with maximum day cost, minimum day cost, average daily cost and average day usage		
Energy Usage Statement Option 6	• Tiered pie-charts displaying daily costs for four segments of the day, for each day of the week, colour coded with an average use comparison • Handy Hints component		

Table Ax. 17: Summary of Participant Assessment of Energy Usage Statement Options

In general it was assessed that the simple summaries worked best and that an optimal display for the energy usage statement would include a combination of a table and a simple chart with easy to interpret data which facilitated easy comparison and had little distraction in the form of symbols.

A5.3.8 Development of the Ideal Energy Usage Statement

Following analysis of the six different options for the Energy Usage Statement (Page 2) and other information prioritised as part of the focus group discussion, participants were asked to design their own ideal energy usage statement. Each format incorporated common design elements:

- A panel with usage information including dates of highest/lowest usage
- A panel with energy advice and hints

The main design requirements identified were:

- Actionable information to promote energy reduction
- Energy cost based hints and tips
- Clear presentation of easily interpreted data
- Components that facilitated the integration of advisory and educational elements

A5.3.9 Consolidated Design

A final design based on the consolidated outputs of the focus groups was presented to the bill design team.

The key elements of this design were:

- A handy hints section on how to reduce energy usage. This section should contain an advisory element, but should change regularly to reflect seasonal issues and should be customised to the individual consumer.
- A graph showing the cost associated with the consumer's Monday to Friday and weekend average gas usage. The Saturday and Sunday gas usage should be presented either separately or in combination (depending on how this varied throughout the benchmark measurement period)
- Averages (in €) for each time period and each day combination shown
- Inclusion of an average comparison line from previous billing period
- A table showing average use and associated cost for the current and previous billing periods
- Additional rows in the table comparing the average use and associated cost for the same period the previous year

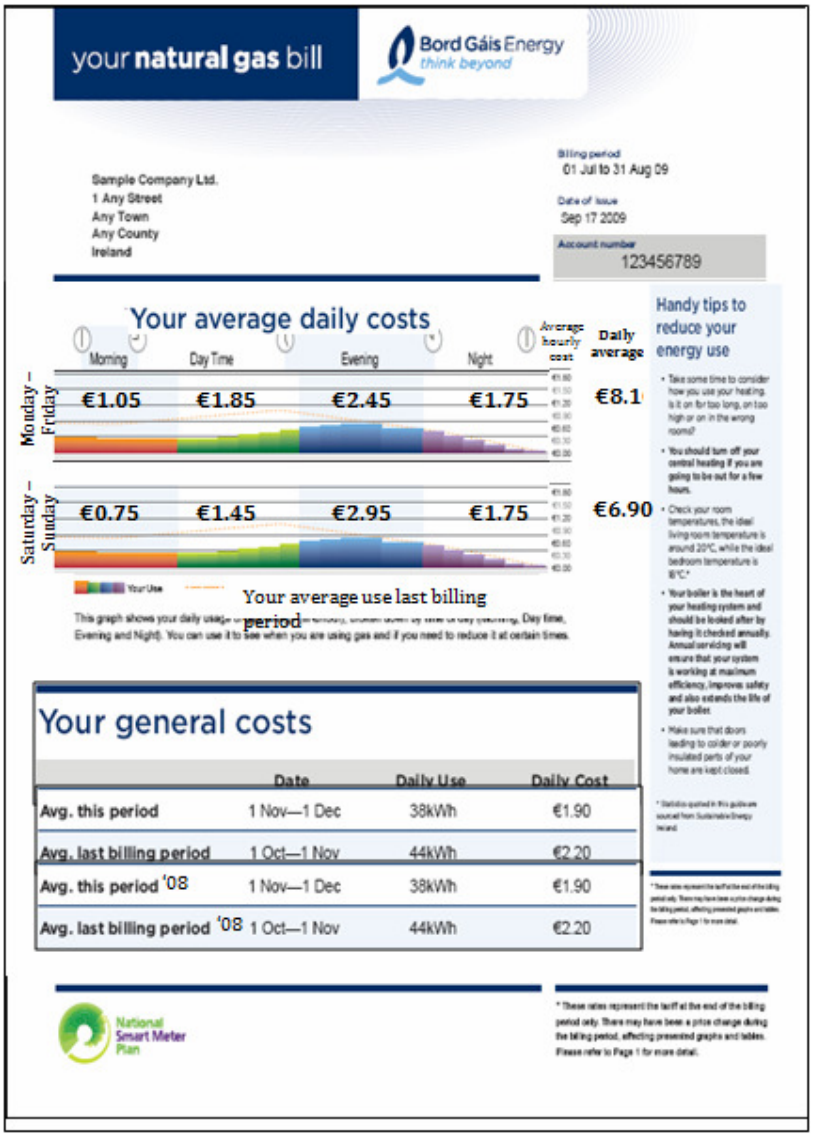


Figure Ax. 39: Consolidated Design of the Energy Usage Statement

Appendix 6: The Residential pre-trial survey

A6.1 Introduction

A survey was conducted by The Research Perspective Ltd among all residential trial participants in April and May 2010. The objectives of the survey included:

- Demographic, home and lifestyle profiling of the participants - *who had opted to participate in the Trial*
- Motivation of the participants– *why they joined*
- Reported behaviours related to the energy reduction – *how they were likely to behave during the Trial*
- Engagement with the topic of energy reduction and behaviour change– *how likely were they to stay for the entire period and become engaged in the objectives of the Trial*

The pre-trial survey outputs were used in three areas:

(1) To compare with the consumers who were invited into the Trial but did not accept (as measured through the non-response survey) and to compare with the set of participants who attrited. This comparison was performed to identify any issues with representivity among trial participants (which would need to be factored into the analysis in order to ensure reliability) and to determine any trial impact which led to attrition (which would again have to be considered in the analysis of usage change).

(2) To compare with the post-trial survey to identify changes in stated behaviour or attitudes which might be associated with participation in the Trial.

(3) To provide insight into the attitudes and behaviours of residential natural gas consumers which could be used to inform future policies and programmes related to energy usage.

This appendix will provide information on the methodological approach and summarise the findings in the context of the third output. The first two outputs are dealt with in specific sections elsewhere in the report.

A6.2 Methodology

The survey was conducted using Computer Assisted Telephone Interviewing (CATI) between April and May 2010. Respondents had agreed to participate in the pre-trial and post-trial survey as part of their agreement to participate in the Customer Behaviour Trial. This greatly assisted in the response rates achieved and 1,628 completions (corresponding to 86% of the population of allocated participants of 1,892).

A6.3 Demographic profile of participants

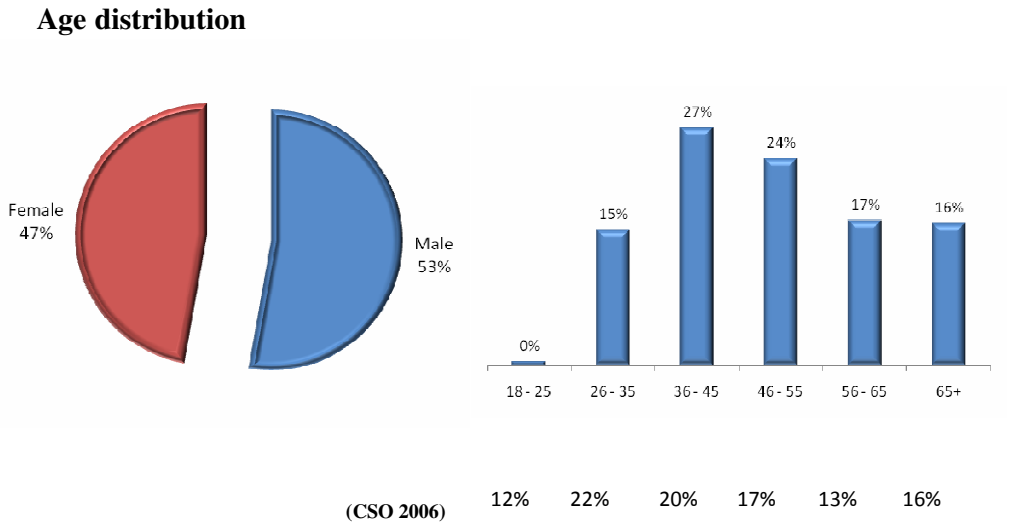


Figure Ax. 40: Gender and age distribution of participants

Figure Ax. 40 shows the gender and age profile of the participants with the 2006 census data shown across the same age bands (shown in the table underneath the histogram). When the CSO age distribution is compared with the participants' age profile it is clear that there is higher representation of the 26-35 age group and lower representation of the 18-25 age group. The discrepancy between the national age profile and the participant age profile reflects the fact that the participants are heads or joint heads of household (all participants in the survey were bill payers) and hence will include fewer individuals in the 18-25 age bracket compared to the national population. Therefore, there is no basis to assume that the age profile of participants is different from the national age profile of gas consumers.

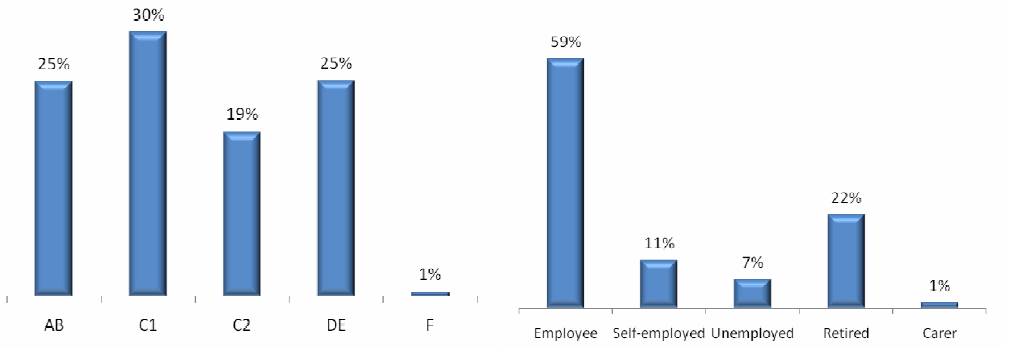


Figure Ax. 41: Social grade and employment status of participants

Figure Ax. 41 shows the distribution of participants by social grade (using the NRS social grade system) and by employment status of the chief income earner of the participating households. There are no national statistics available for social grades in general and no

national statistics available for either social grades or employment status for gas consumers. However, the level of ABC1 is in line with expectations with 55% in these categories. With regard to employment status, the level of unemployment recorded among participants (7%) is similar to the national statistic of 8%[11] at the date of the survey. Therefore, it is reasonable to conclude that the participants are representative of the population across these dimensions

A6.4 Household profile

The survey included questions on the size and composition of the participants' household.

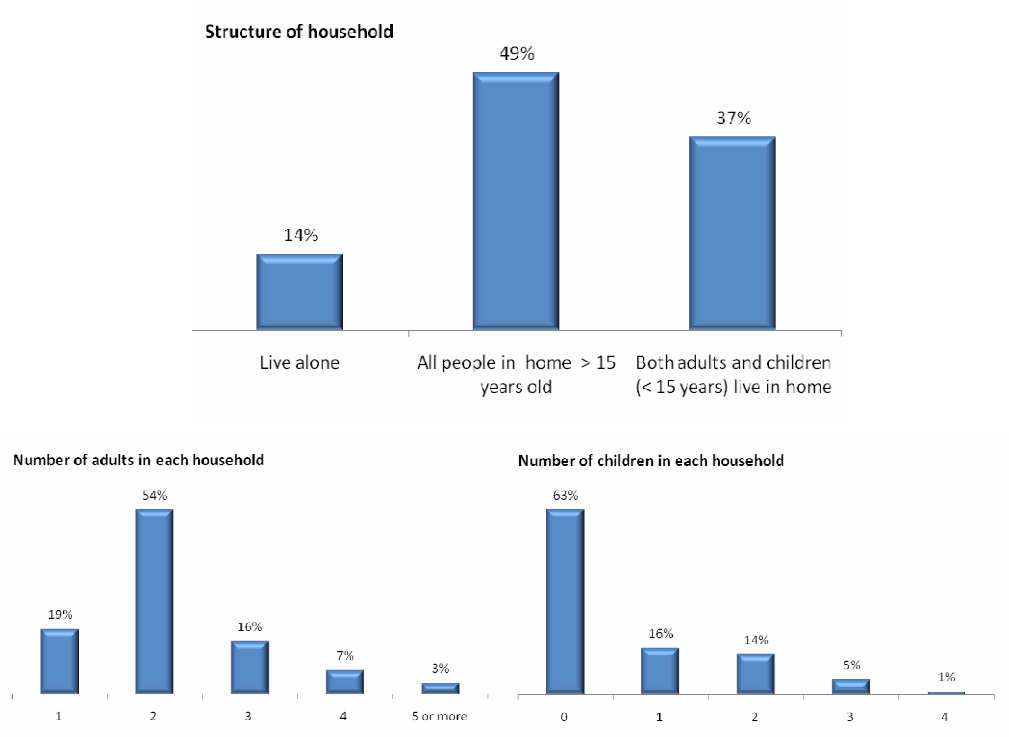


Figure Ax. 42: Size and composition of household

Figure Ax. 42 shows the reported household size and composition. The proportion of single person households is lower than the national distribution of 21%[12]. However, this statistic is again a national statistic as distinct from one for the population using natural gas which has a distinct geographical profile. The analysis of consumers who did not accept the invitation to participate (**Appendix A3**) shows that there are no differences in the distribution of single person households or in the number of children and adults in each household. On that basis, it is reasonable to assume that the distribution among the respondents reflects the national distribution among consumers of natural gas.

[11] The national unemployment rate of 13.7% in May 2010 (as measured by the Live Register) is stated as a percentage of the labour force. The labour force corresponds to 60% of the total population over the age of 15 (CSO2006). Using these figures, it is possible to calculate unemployment as an approximate percentage of the overall population.

[12] "The statistical yearbook of the Economic Commission for Europe 2008"

A6.5 Profile of Homes

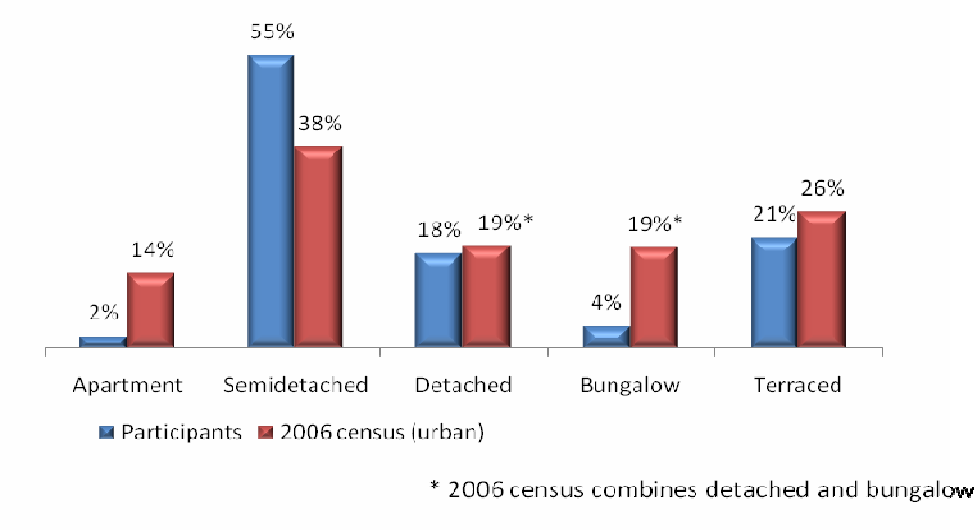


Figure Ax. 43: Profile of house types among respondents

Figure Ax. 43 shows the distribution of house types compared to the CSO 2006 figures for urban areas. It should be noted that CSO census figures do not distinguish between bungalows and detached houses. Therefore, the figures shown for the CSO show the total figure for the two categories against each category captured in this research. The combination of detached and bungalow is 22% compared to the CSO2006 figure of 19%. The exclusion of short term tenancies will reduce the representation of apartments and smaller houses (reflected in the lower proportion of terraced houses among participants when compared to the CSO figures). In addition, there is a lower penetration of gas heating used in apartments compared with other types of housing. While there is a much higher proportion of semi-detached properties among participants than among the urban population overall, the proportion of this house type closely follows the information held by Bord Gáis on house type of natural gas consumers.

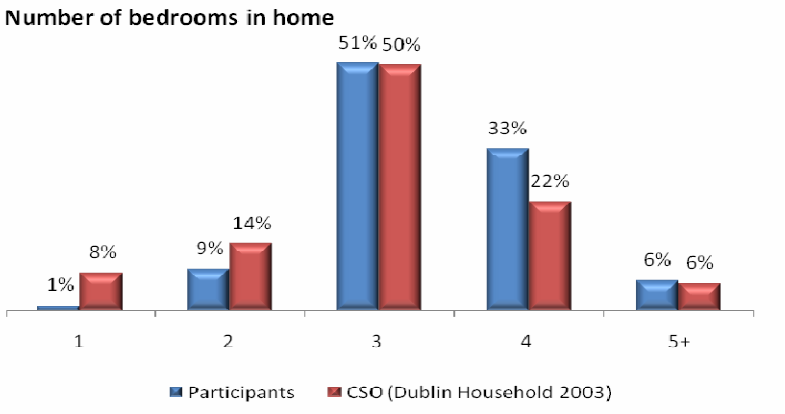


Figure Ax. 44: Distribution of house types by number of bedrooms

Figure Ax. 44 shows the distribution of bedroom count in the homes of respondents and as recorded for the Dublin area in the CSO 2003 household survey[13]. The lower level of one and two bedroom homes reflects the exclusion of rented properties with short tenancy (which will include a significant proportion of apartments, most likely to be one or two bedroom units). The higher proportion of four bedroom homes may also reflect the higher participation among the higher usage households.

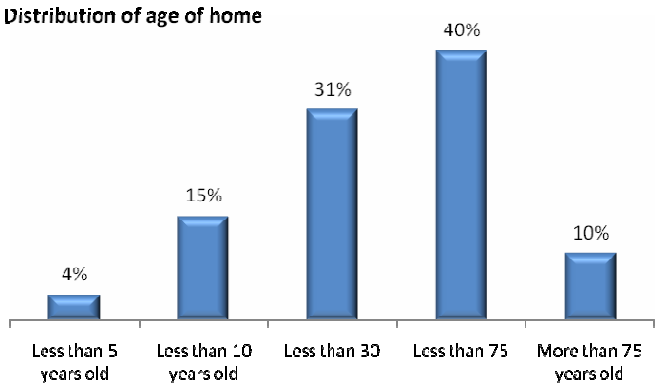


Figure Ax. 45: Distribution of house age

The distribution of the age of the property **(Figure Ax. 45)** shows a significant proportion of homes (50%) more than 30 years old.

A6.7 Profile of vulnerable groups

When considering the introduction of smart metering technology, it is necessary to assess the impact of such technology on vulnerable sections of society to determine if they are disproportionately affected. For instance, less affluent consumers may not be able to take advantage of the additional energy reduction information. In the case of the varying tariff applied to one experimental cell, less affluent consumers may not be able to modify usage in order to reduce the impact of increased prices during the more expensive periods of the year.

[13] Dublin figures are used as an approximation to the range of locations natural gas is available (of which the largest is Dublin).

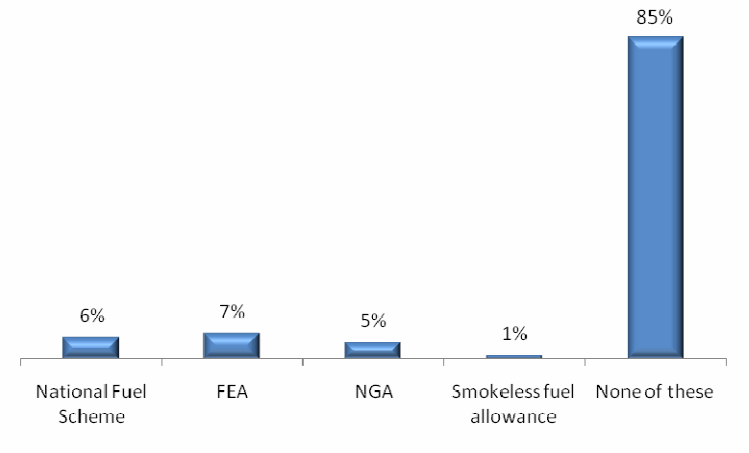


Figure Ax. 46: Proportion of participants receiving government energy related benefits

The Government of Ireland provides a range of energy related benefits which are paid on the basis of the recipients' age, financial position, location (in the case of the smokeless fuel allowance) and state of health. Most participants (85%) are not in receipt of any of these payments **(Figure Ax. 46)** with the remaining 15% in receipt of one of the other payments (National Fuel Scheme, Free Electricity Allowance, National Gas Allowance or the smokeless fuel allowance).

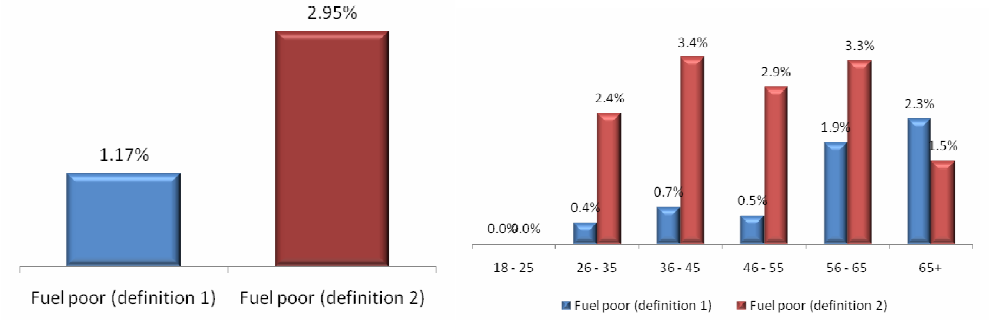


Figure Ax. 47: Proportion of participants self-classified as fuel poor (left) in the trial and the proportion in each age group (right)

Of particular concern are the members of society with insufficient financial resources to adequately heat their homes – these are known as fuel poor. The two definitions for fuel poor used in this research are:

- **Definition 1:** Resident states that the home is not kept adequately warm and the reason given for this is lack of finance to keep it as warm as they would like it to be
- **Definition 2:** Resident states that they had to go without heating during the last 12 months due to lack of money

Figure Ax. 47 shows the proportion of participants who state that they are fuel poor using each definition with a breakdown of this proportion by age. The two definitions show different levels at both overall level and by age cohort. The second definition does not vary

greatly by age up to the 65+ cohort which has a lower level reported (reflecting the availability of government energy allowances to elderly consumers). In contrast, the first definition is significantly higher among the participants over the age of 56.

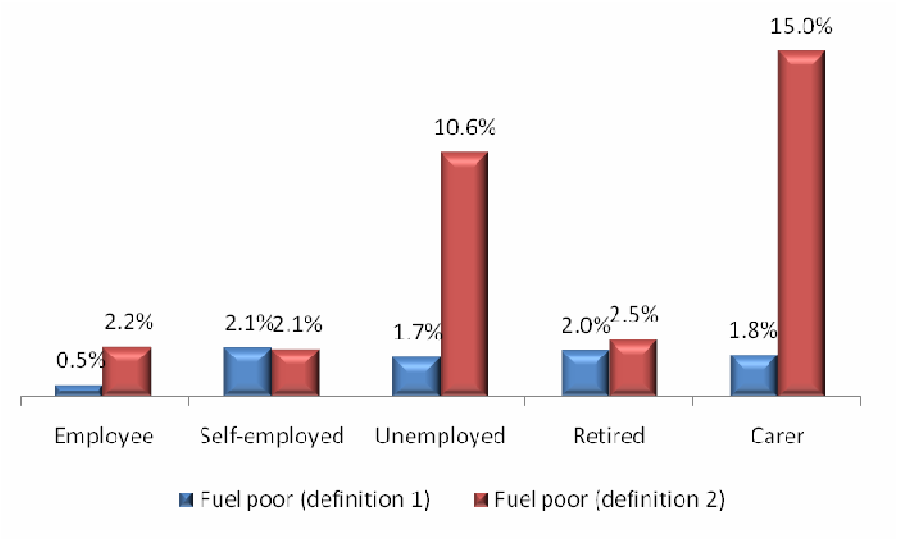


Figure Ax. 48: Proportion of participants self-classified as fuel poor by employment status

In the current economic climate with increased levels of long term unemployed, fuel poverty could also be related to employment status. **Figure Ax. 48** shows significant divergence in the reported rates between definitions 1 and 2. Focusing on definition 2, the higher proportion of fuel poor among the unemployed and among carers is clear. In conclusion, in the context of the gas smart meter trial it appears that definition 2 may provide a more appropriate basis for analysis than definition 1. However, both definitions are used in the detailed analysis of results so as to ensure consistency with the electricity smart meter trial

A6.8 Space heating controls and associated usage behaviours

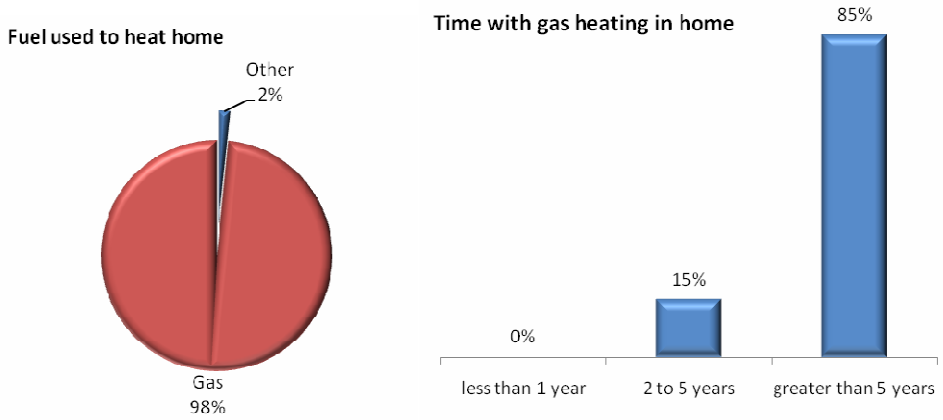


Figure Ax. 49: Reported prevalence of gas as the primary heating energy source (among gas consumers) and longevity of gas use for heating

As expected**,** almost all participants (98%) stated that they use natural gas to heat their home **Figure Ax. 49)**. This reflects the primary use of natural gas within the Irish market and the exclusion of gas consumers with usage below a threshold (1,000kWh per year). Most participants (85%) have used gas to heat their homes for more than 5 years.

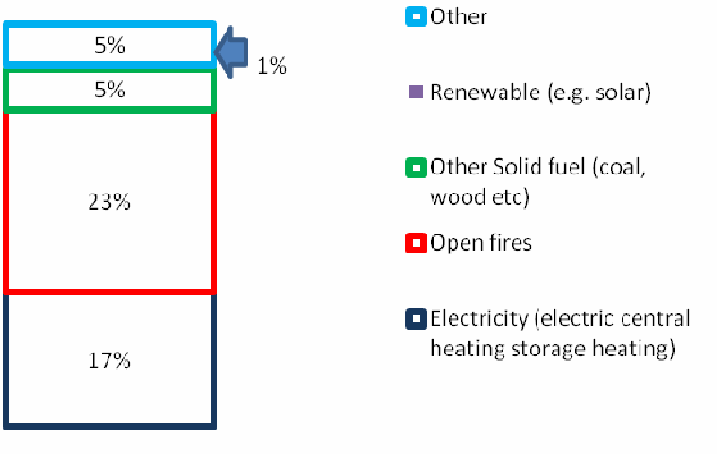


Figure Ax. 50: Percent of survey respondents, whose use other heat sources (base: those respondents using gas as their primary heating energy source)

While, gas is the primary heating energy source, most participants use other sources for space heating. The most common are open fires (23%) with other electricity (central or storage) heating used in 17% of homes (**Figure Ax. 50**). The prevalence of electric heating within the home was noted as it provides an opportunity for substitution of energy sources during the Trial as participants attempt to reduce gas usage.

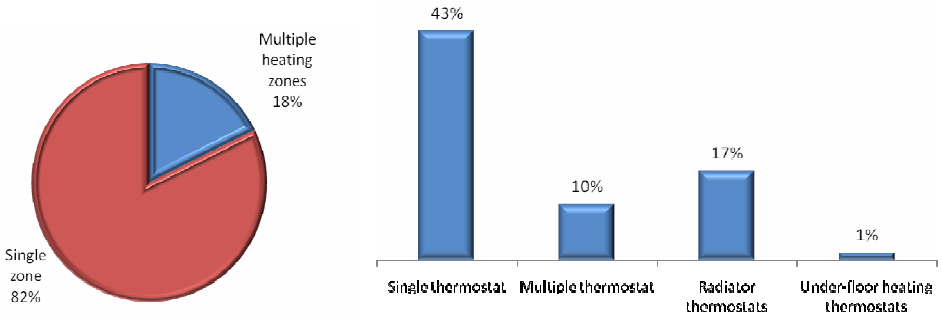


Figure Ax. 51: Reported prevalence of single or multi-zone heating and prevalence of different types of thermostats

Figure Ax. 51 shows the prevalence of multi-zone heating (18% of participants report their home as having multiple heating zones) and different types of thermostats with 63% of respondents reporting the presence of one or more thermostat and 43% reporting the presence of a single thermostat. It should be noted that some participants reported radiator level thermostats as well as thermostats at an overall or zone level (where multiple zones were

present). 74% of participants with thermostats reported actively managing the temperature in the home with these thermostats (by changing the setting to reduce or increase the temperature). It should be noted that varying the temperature setting on the thermostat is not necessarily a positive or negative behaviour – the outcome depends on the purpose of such changes. However, it does demonstrate a capability to actively manage the temperature in the home

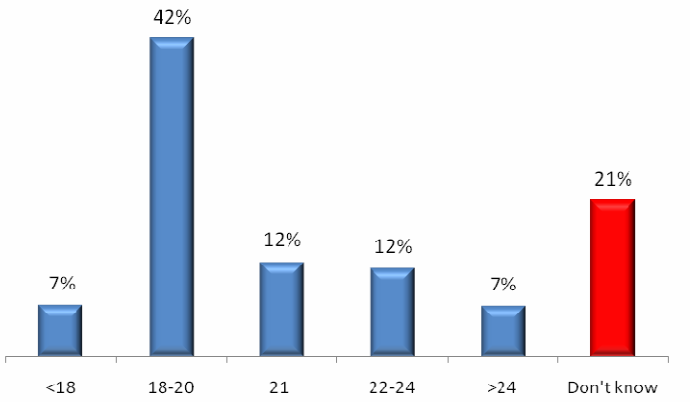


Figure Ax. 52: Typical temperature of the home – estimated by participants

Participants were asked to estimate the typical temperature of their home from a range of temperatures proposed **(Figure Ax. 52).** Most participants (79%) selected a temperature with the majority selecting the range of 18°C to 20°C.

Participants were also asked about their use of other heating control mechanisms:

- a booster switch or button which switches on their heating system for a limited period;
- a temperature setting on the heating boiler itself. Varying this setting would not generally be regarded as an effective way of managing home temperature.

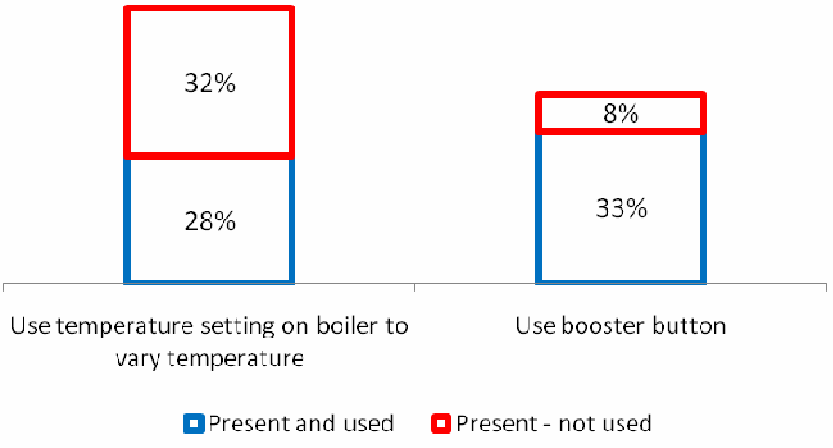


Figure Ax. 53: Reported use of other heat controls among participants

Figure Ax. 53 shows that 28% of participants state they have a temperature setting on the boiler which they use to vary the home temperature (a further 32% are aware of the setting but do not use it). As all boilers will have such a temperature setting, it is likely that the remaining 40% of respondents are unaware of this setting. 33% of respondents use a booster button to augment other heating controls (a further 8% state that there is a booster button but state that they do not use it).

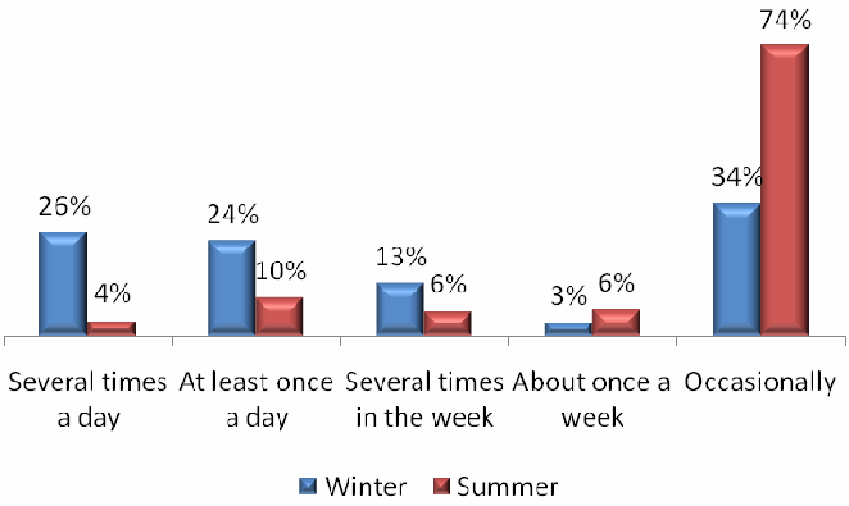


Figure Ax. 54: Reported use of booster among participants who reported using the booster button (33% of all participants)

The degree of use of the booster button is high among the 33% of the participants who have and report using this heating control: 26% report using the button several times a day with an additional 24% stating they use it at least once a day during the winter period **(Figure Ax. 54).** These rates are much lower during the summer period; however it is during the winter period that most natural gas is consumed. Therefore among 50% of the total participant base use of the booster button will have a significant impact on overall usage.

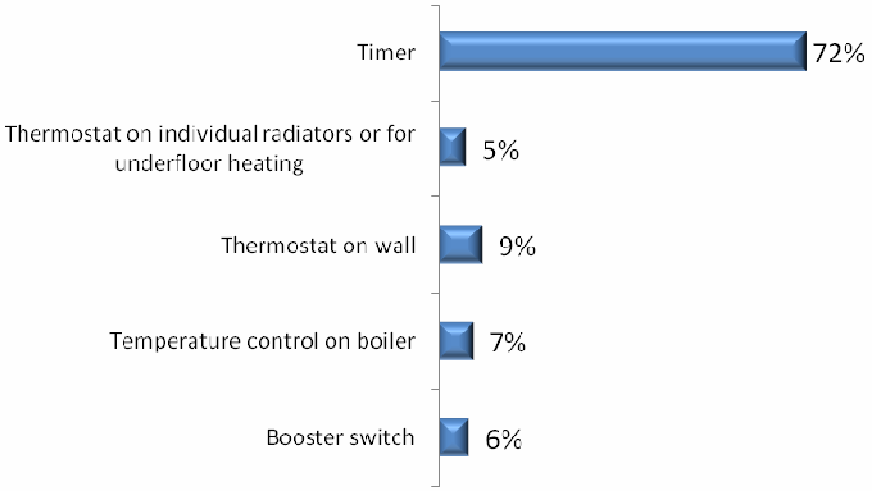


Figure Ax. 55: Most common mechanism used to control heating in home (among all participants)

The reliance on the booster button is contradicted by the participants' perception of the heating control used most commonly to control heating (**Figure Ax. 55**). The timer is identified by 72% with only 6% stating that the booster button is most commonly used (note that this is 6% of the entire set of participants and corresponds to 18% of those who report the presence and use of the booster button). This contradiction reflects a perception of the timer as the primary controller as it is the default control even if the booster is used more often and has, therefore, greater impact in terms of control of usage.

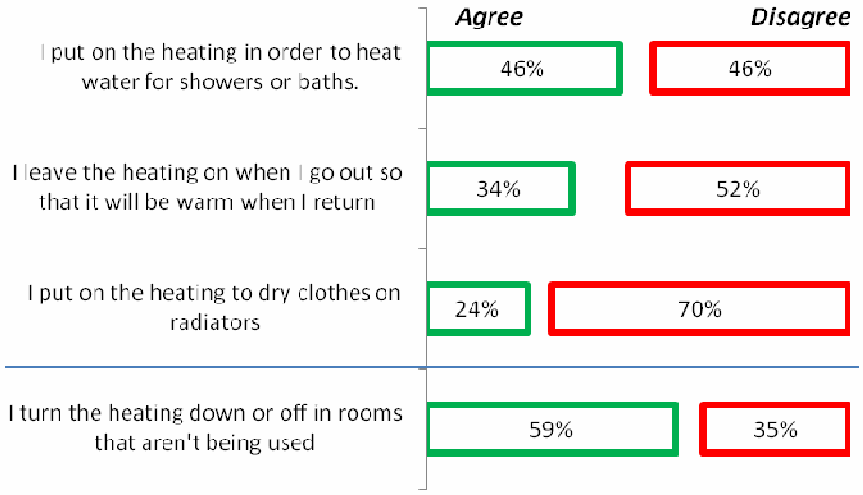


Figure Ax. 56: Reported prevalence of other heating control behaviours

As part of the qualitative research prior to the Trial, a number of negative consumer behaviours related to use of space heating were identified and quantified in the pre-trial survey. In addition, one positive behaviour (switching off radiators in a room not in use) was also quantified. The three negative consumer behaviours (top three items above the line in **Figure Ax. 56**) were all reported by a significant proportion of participants (e.g. 24% stated that they switched on the heating to dry clothes on radiators). However, a majority (59%) also reported the quantified positive behaviour (switching off radiators in a room not in use).

A6.9 Water heating controls and usage behaviours

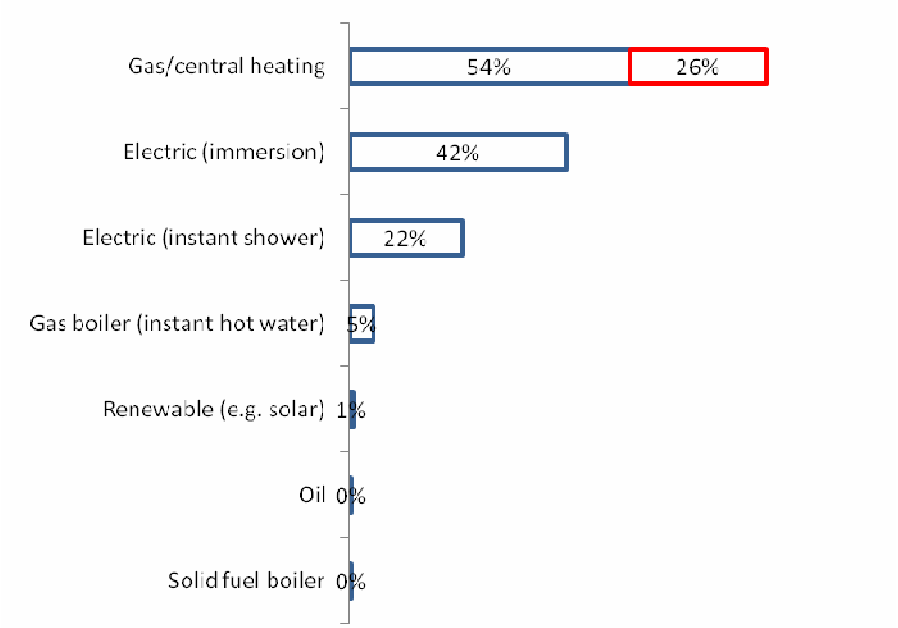


Figure Ax. 57: Approach to water heating in participant homes (note: 54% selected natural gas, with an additional 26% stating that it was the central heating system)

The majority of participants in the Trial (80%) stated that they used their natural gas fired central heating system to heat the water in their home. Electric immersions were also common with 42% stating that they used these and an additional 22% stated they used instant showers. 40% of respondents stated that they had a timer to control when their water heating switched on and off. Among those with immersion heaters, 48% stated that they used the sink setting with 39% stating they used the bath setting.

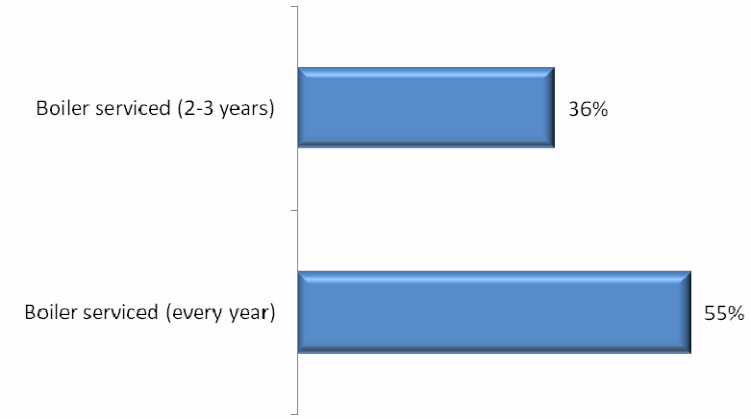


Figure Ax. 58: Reported prevalence of other heating control behaviours

Another dimension of engagement with energy reduction is the frequency with which the boiler is serviced. **Figure Ax. 58** shows that most participants (91%) had their boiler serviced at least every other year.

A6.10 Presence of energy efficiency improvements

The degree to which homes have efficiencies installed was also captured (**Figure Ax. 59**) with 90% of respondents reporting attic insulation, while 89% have a lagging jacket and 48% have external walls insulated.

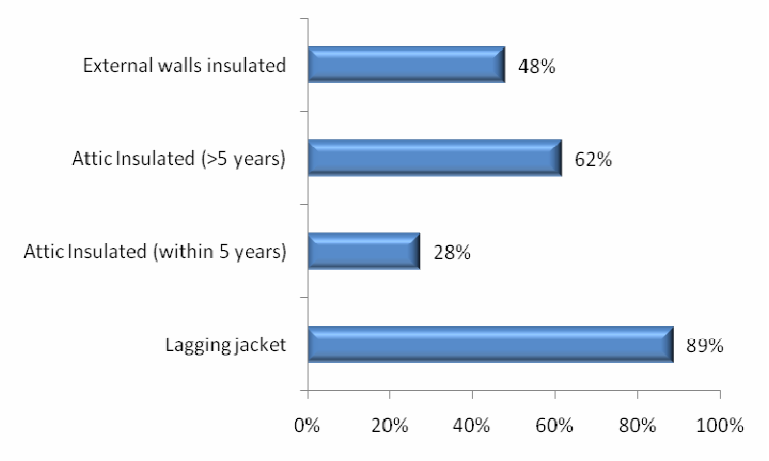


Figure Ax. 59: Reported presence of energy efficiency improvements

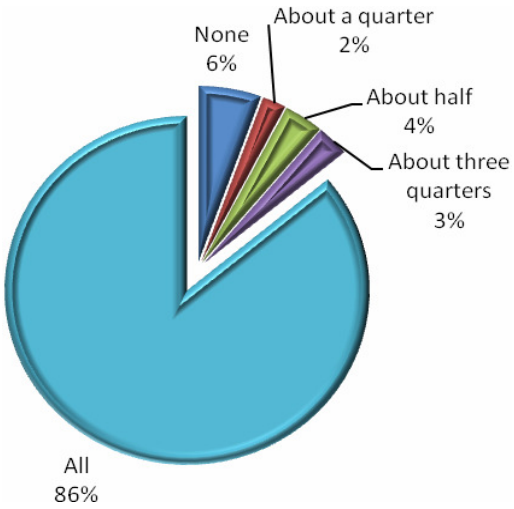


Figure Ax. 60: Reported presence and level of double glazing installed

Figure Ax. 60 shows the level of double glazing present with 94% reporting some level of double glazing present in the home and 86% stating that all windows are double glazed.

A6.11 Attitudes towards and experience of energy reduction

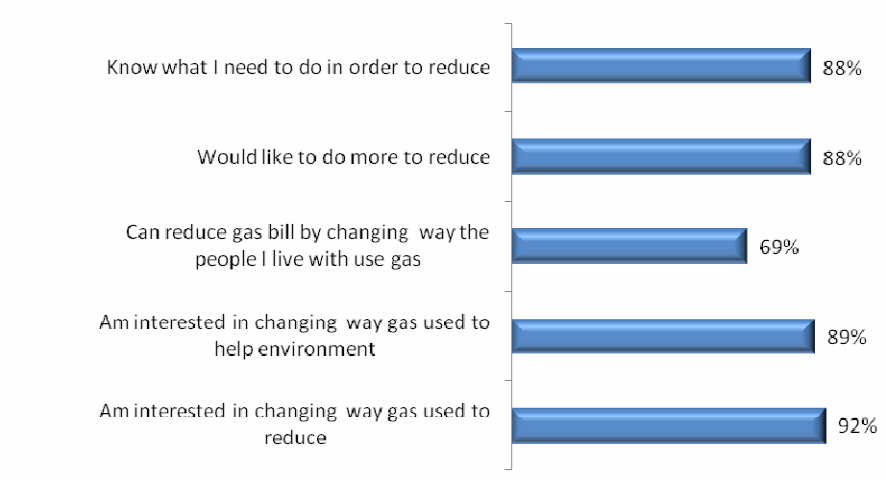


Figure Ax. 61: Reported engagement and empowerment with topic of energy reduction

Most participants believed that they were both empowered and engaged with the concept of energy reduction (**Figure Ax. 61**): 88% of participants believed that they knew what they needed to do to reduce and 88% stated that they would like to reduce the energy they used.

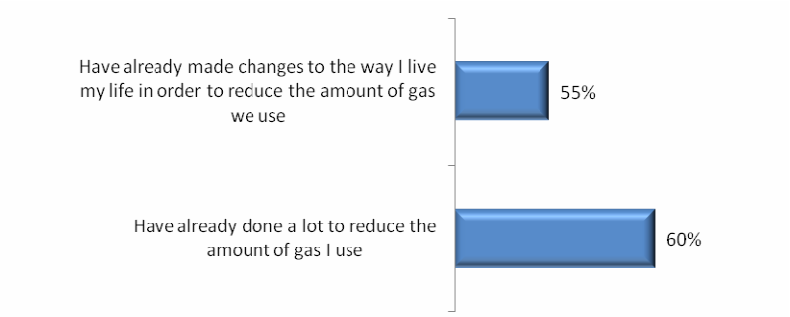


Figure Ax. 62: Reported experience of previous energy reduction activities

Not only did most participants state they would like to do more, many also believed they had already engaged in behaviour change **(Figure Ax. 62)**. Among those who had already changed behaviour, the average reduction experienced was 11%.

Reason for making changes or doing a lot to reduce the amount of gas used	%
It is too inconvenient to reduce our usage of gas	24%
I do not know enough about how much gas the radiators gas fires and cooker use in order to reduce my usage	57%
I am not be able to get the people I live with to reduce their gas usage	26%
I do not have enough time to reduce my gas usage	16%
I do not want to be told how much gas I can use	37%
Reducing my usage would not make enough of a difference to my bill	22%

Table Ax. 18: Reasons for not reducing usage (among participants who reported not making reductions)

Among those who had not made changes or done a lot in order to reduce the amount of gas they used, the reason most often given was lack of specific knowledge of consumption of different devices using gas (**Table Ax. 18**).

57% agreed that the reason for the lack of successful reduction was lack of specific knowledge of the consumption associated with radiators, fires, cookers etc. This proportion corresponds to 30% of the entire population stating lack of specific knowledge and contrasts with the 88% who claim that they know what to do in order to reduce usage. This suggests that the 88% is overstated and reflects lack of linkage between specific knowledge and ability to reduce usage.

A6.12 Motivation for participation in the Trial

Participants were asked to identify the reasons that captured their decision to participate in the Trial (with no limit on the number of reasons that could be selected).

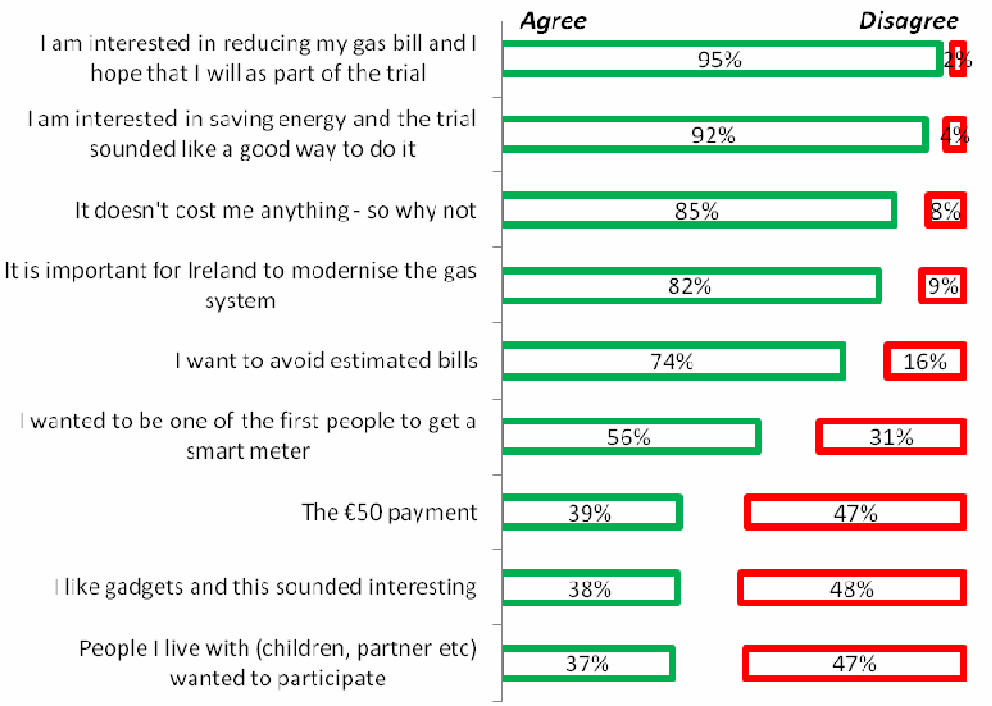


Figure Ax. 63: Reported motivations for participation in the trial

The level of agreement with each potential reason is shown in **Figure Ax. 63**. The most commonly chosen reasons are related to a desire to reduce energy usage (e.g. *"I am interested in reducing my gas bill and I hope that I will as part of the Trial"*). In contrast, the purely financial motivation of the payment of the incentive of €50 was selected as a reason by a much smaller proportion (39%). As participation was voluntary, it is not unsurprising that motivations around energy reduction were prevalent.

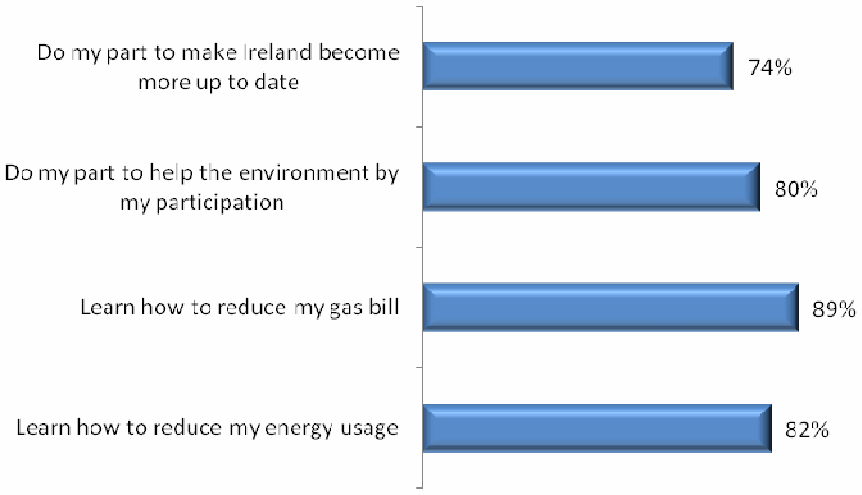


Figure Ax. 64: Reported expectations of benefits associated with participation in the trial

In addition to assessing the motivations, the survey also captured expected outcomes from participation in the trial. Participants were asked to select which outcomes they expected to achieve from participation in the trial (summarised in **Figure Ax. 64**) with 89% expecting to learn how to reduce their gas bill and 82% expecting to learn how to reduce their energy usage.

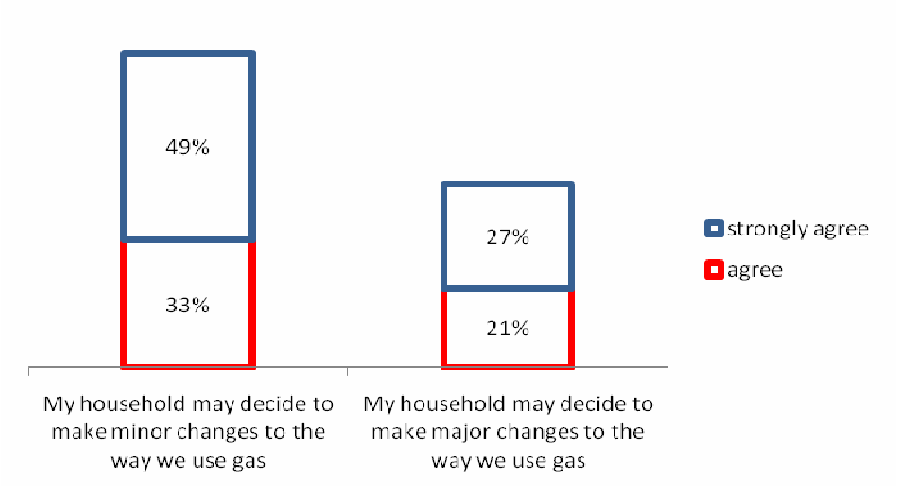


Figure Ax. 65: Reported expectations of behaviour changes associated with participation in the trial

Participants also appear ready to engage in behaviour change with 82% agreeing or strongly agreeing that their household may decide to make minor changes to the way they use gas as a consequence of their participation in the Trial. The likelihood of major changes being undertaken was regarded as much lower with 48% agreeing or strongly agreeing that their household may decide to make major changes to the way they use gas as a result of participation. These results are compared with the post-trial survey to determine the degree to which behaviour changes actually undertaken were deemed to be minor or major.

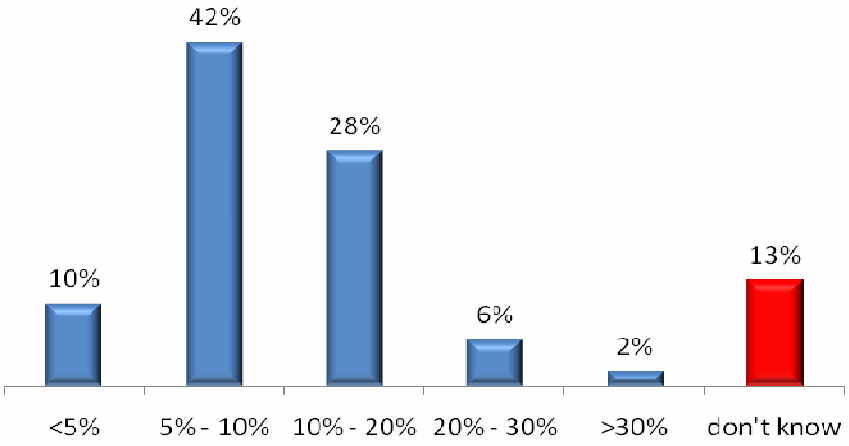


Figure Ax. 66: Expected reduction in gas bill among the 74% of participants who expected their bill to reduce through participation in the trial

With regard to achievement of actual reduction in the bill, 74% expected the size of their gas bill to reduce through participation in the Trial with 1% expecting an increase. Of those who

expected a decrease (**Figure Ax. 66**), the greatest proportion (42%) expected a reduction between 5% and 10% while only 10% expected a reduction of less than 5%. This is in line with initial expectations for the potential reduction achievable.

Appendix 7: The Residential Post-Trial Survey

A7.1 Introduction

A survey was conducted by The Research Perspective Ltd among trial participants who had remained in the Trial until the end date of 31st May 2011 (i.e. all remaining participants in control and test groups were included; attritors were not included). The objectives of the survey included:

- To gather perceptions of the impact of the Trial (perceived change in usage levels and patterns, perceived behavioural changes).
- To assess the level of recall and perceived impact of the DSM stimuli and the tariff applied to one test group; and recall and rating of the DSM stimuli at a feature and functional level. In the case of the tariff, the impact of the tariff on usage was assessed.
- To gather evidence that the Trial led to changes in usage patterns of heating controls (use of heating controls, overall use of heating etc) and prevalence of behaviours likely to positively and negatively impact on overall usage.
- To gather evidence that trial participation led to investment in energy efficiency.
- To determine whether participation in the Trial had any impact on the attitudes towards energy reduction and investment in energy efficiency measures. This was compared by including the same questions on engagement with the topic of energy reduction and behaviour change.

This chapter provides information on the methodological approach and summarises the findings of the post trial survey.

A7.2 Methodology

The survey was conducted using Computer Assisted Telephone Interviewing (CATI) in June and July 2011. Respondents had agreed to participate in the pre-trial and post-trial survey as part of their agreement to participate in the Customer Behaviour Trial. This greatly assisted in the response rates achieved and 1,217 completions (corresponding to 77% of the population of 1,575 participants remaining in the trial on 31st May 2011). Levels of participation in the post trial survey showed little variation between control and test groups and also within tariffs as shown in **Figure Ax. 67**.

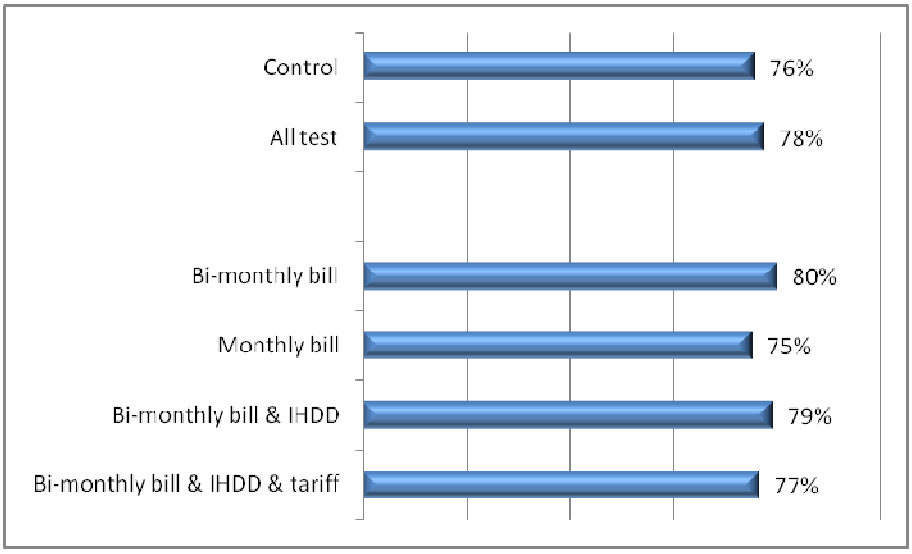


Figure Ax. 67: Overall level of participation in post trial survey among control and test groups

A7.3 Impact and assessment of DSM stimuli

The participants in the test groups were asked to assess their experience of each DSM stimulus. In some cases, the stimulus was made available to multiple test groups and in this case the results reflect the collective experience of all participants across the multiple test groups potentially exposed to each stimulus.

i) Bi-monthly and Monthly usage statements

All participants in the trial groups received an energy usage statement with each bill. This usage statement was a separate sheet included in the envelope with the bill. 86% of participants recalled receiving the statement. The finding that 14% did not recall the statement is not unexpected as the placement of the usage statement in the bill envelope had the associated risk of the participant interpreting it as an advertising insert and ignoring it. (The placement is justified by the advantage of ensuring the linkage with the bill showing the expenditure).

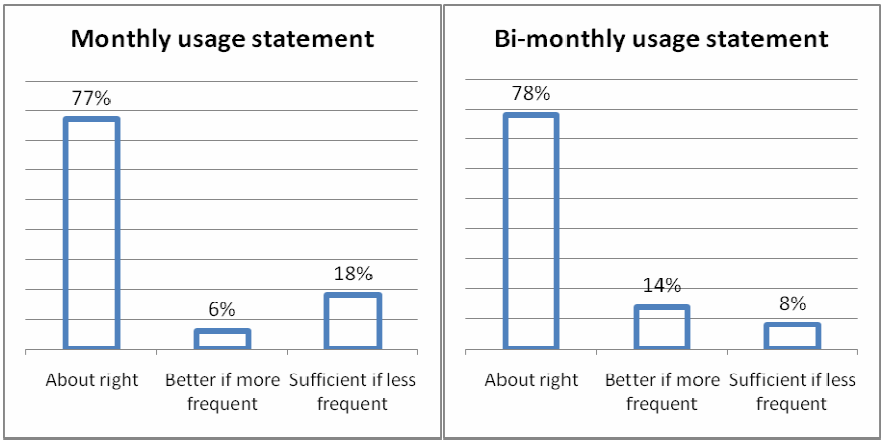


Figure Ax. 68: Consumer preference for frequency of energy usage statement

(those who received a monthly statement (left) and those who received a bi-monthly statement (right)

Figure Ax. 68 shows that most consumers were satisfied with the frequency of the energy usage statement whether that was monthly or bi-monthly. There is little demand for a more frequent energy usage statement (6% of consumers receiving a monthly statement would prefer a more frequent energy usage statement). Similarly, an energy usage statement less frequently than bi-monthly is not generally preferred (8% of consumers receiving a bi-monthly statement would prefer a less frequent statement).

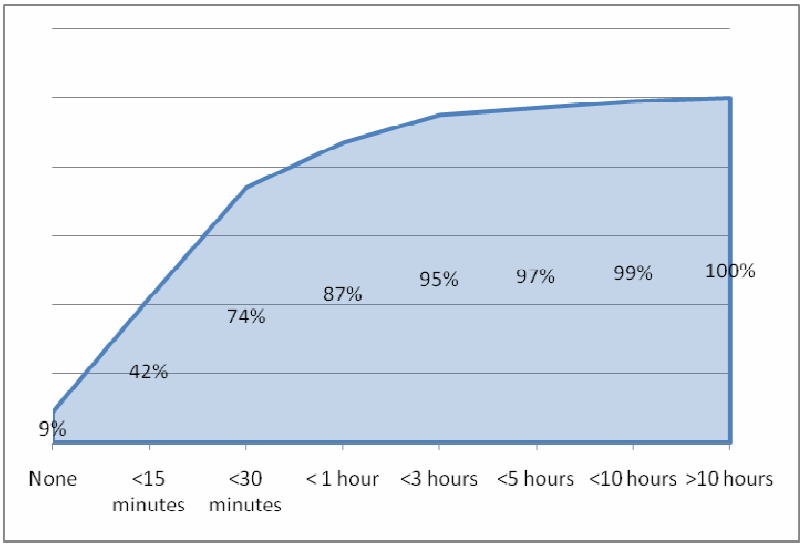


Figure Ax. 69: Cumulative time spent understanding the energy usage statement during the trial

On average, consumers spent a total of 45 minutes understanding the energy usage statement during the 12 months of the Trial. The cumulative time spent (**Figure Ax. 69**) shows that the majority of consumers spent 30 minutes or less with 9% spending no time at all.

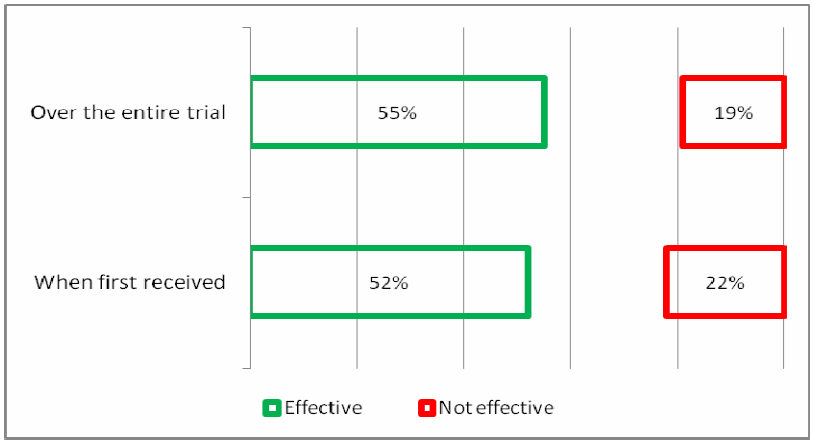


Figure Ax. 70: Rating of the effectiveness of energy usage statement initially and over the entire trial period

The energy usage statement was rated as effective by a majority of participants (**Figure Ax. 70**) both initially (52% rated it as effective when first received) and over the entire Trial (55% rated it as effective over the entire Trial). However, when asked directly whether they perceived the statement becoming less effective over time 39% agreed that this was the case (**Figure Ax. 71**) with 20% disagreeing. It is, therefore reasonable to assume that there was some diminution of impact over the Trial period. Qualitative research undertaken as part of the National Smart Meter Trial suggests that this can be best addressed by varying elements of the statement such as those relating to energy advice or comparing recipients' usage against comparable households.

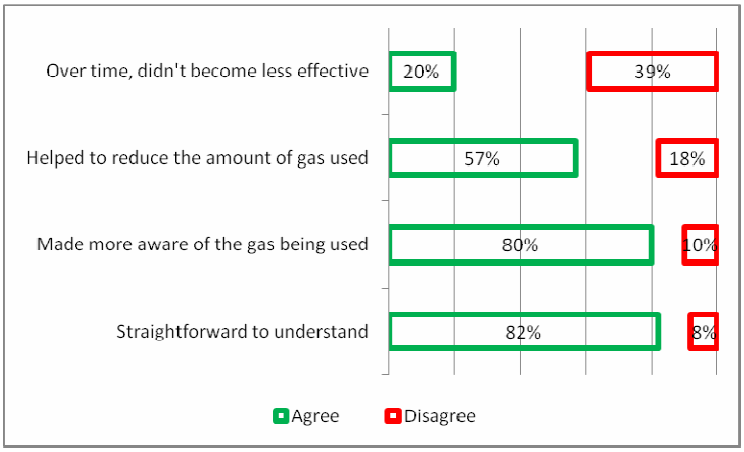


Figure Ax. 71: Rating of the impact and attributes of the energy usage statement

Overall, 82% of consumers agreed that the energy usage statement was straight forward and easy to understand (**Figure Ax. 71**). The effectiveness of the energy usage statement was reasonable with 57% agreeing that it helped them to reduce the amount of gas used and 80% agreeing that it made them more aware of the gas being used.

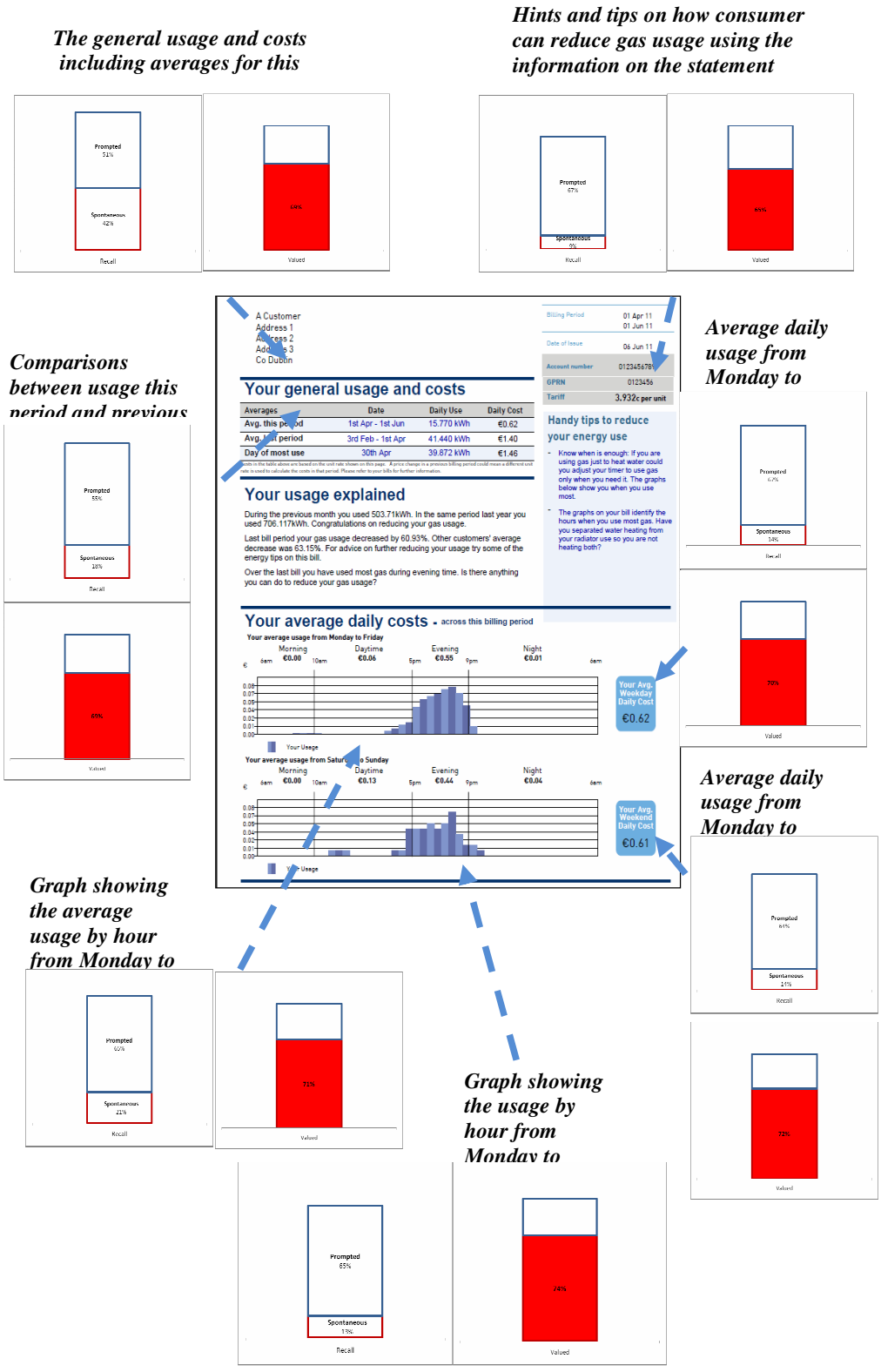


Figure Ax. 72: Recall and rating of the Energy Usage Statement

Figure Ax. 72 shows the recall and rating of the effectiveness of each element of the energy usage statement. In addition, 34% of participants in the trial were not able to recall any element of the statement unprompted while 5% were not able to recall any element even with prompting.

The level of unprompted recall of items on the statement are highest for the general usage and costs including the averages for this period and daily usage (42% recalled this item without prompting) with the graph of Monday to Friday usage being recalled by 21%. Some key elements were rarely recalled such as the hints and tips (9% recalled these without prompting).

All items were rated as of value by over 65% of participants who recalled receiving the statement and recalled the specific item. The most highly rated item was the graph showing usage by hour from Monday to Friday in euros (rated as useful by 74% of those who recalled the item). However it should be stressed that these ratings are only among those who recalled the element. As a percentage of the entire population of participants (i.e. including participants who didn't recall receiving the statement or didn't recall the elements), the general usage and costs including the averages for this period and daily usage item was recalled most often.

ii) In-home Display Device

The participants who received the In Home Display Device (IHDD) spent an average of 62.5 minutes understanding the IHDD across the entire period of the Trial. **Figure Ax. 73** shows the cumulative amount of time spent by participants. This shows that a small group of participants (8%) spent more than three hours understanding the device, while 63% spent less than 30 minutes.

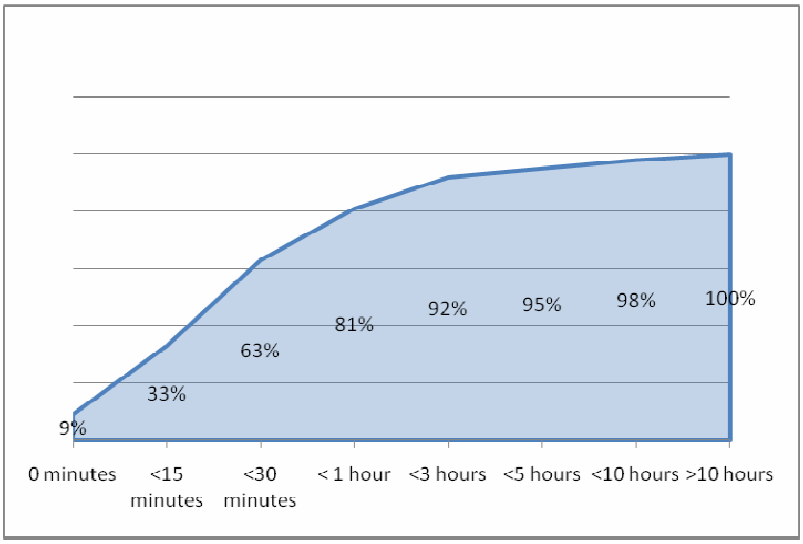


Figure Ax. 73: Cumulative time spent understanding the IHD device during the trial

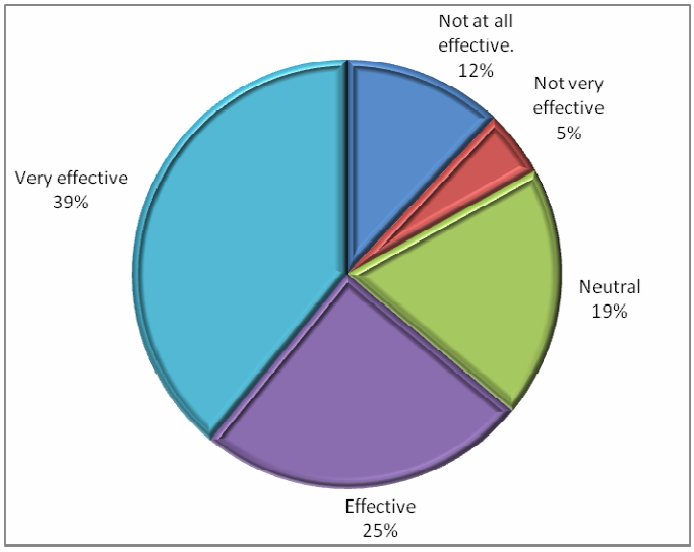


Figure Ax. 74: Effectiveness of the IHDD in reducing usage over the entire Trial

64% of participants who received an IHDD rated it as effective in helping them reduce their gas usage with 39% rating it as very effective. In contrast, 17% rated it as not very or not at all effective (**Figure Ax. 74**).

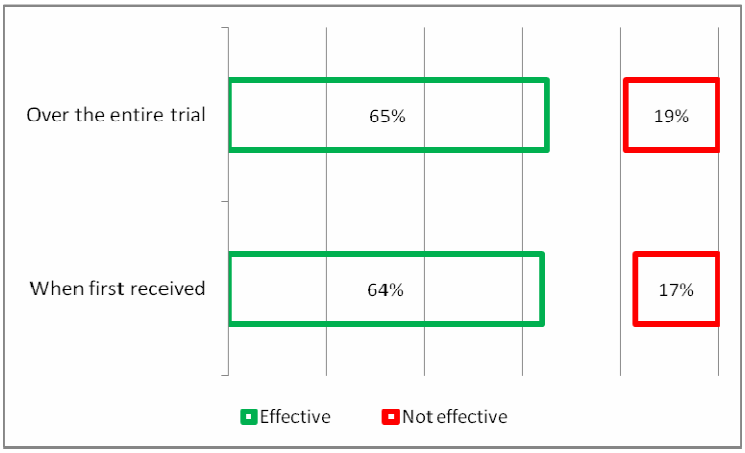


Figure Ax. 75: Rating of the effectiveness of IHDD initially and over the entire trial period

As with the energy usage statement, the assessments of effectiveness at the start of the trial and over the entire trial period were similar (**Figure Ax. 75**). However similar to the energy usage statement, there is evidence that the value declined over time with only 38% of participants believing that the IHDD did not become less effective over time (**Figure Ax. 76**).

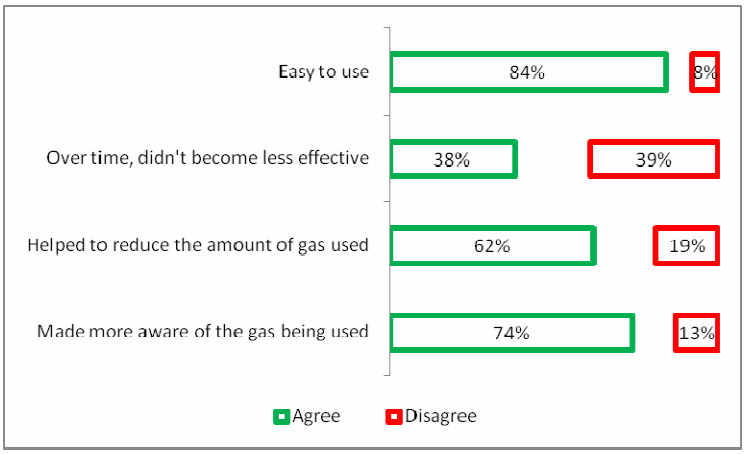


Figure Ax. 76: Participants' assessment of the IHDD

Most participants who received an IHDD felt it was easy to use (84%) with a majority believing it helped them reduce the amount of gas used (62%) and made them more aware of the gas they used (74%).

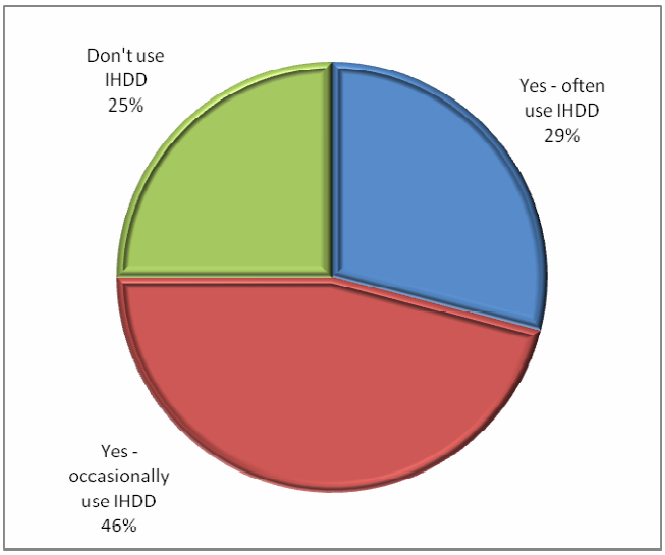


Figure Ax. 77: Proportion of participants who received an IHDD still using it

75% of participants who received an IHDD still use it (**Figure Ax. 77**) with 29% stating that they still used it often.

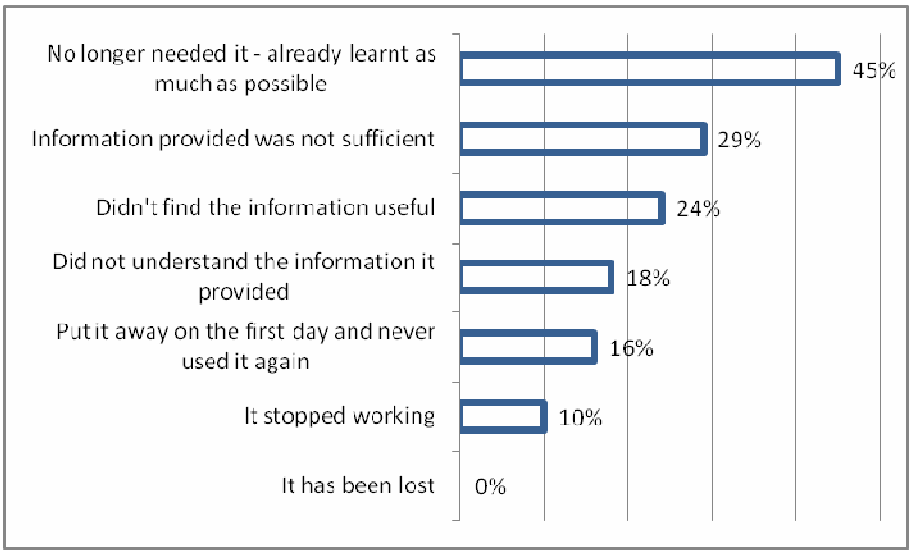
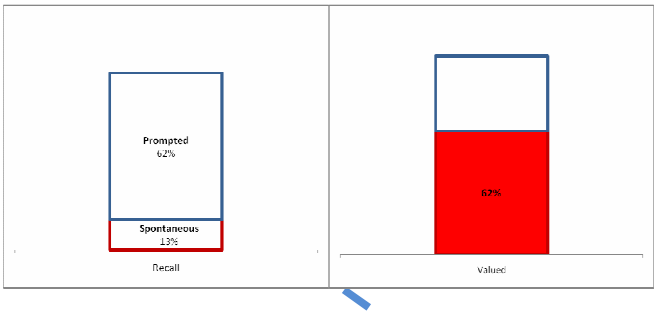


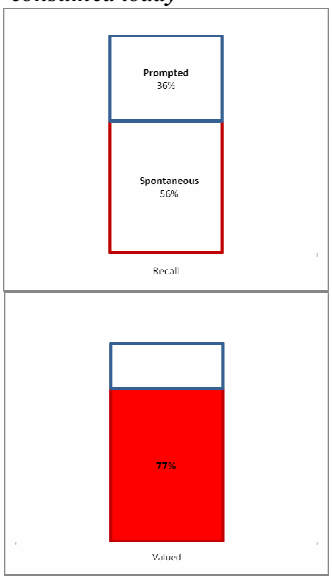
Figure Ax. 78: Reasons for no longer using the IHDD

Reasons given for no longer using the IHDD (**Figure Ax. 78**) were most commonly associated with lack of continued value (45% agree this is a reason for not using the IHDD any longer) or that the information was not sufficient (29%) or not useful (24%). Only a small proportion stated that they did not engage at all with the device. (16% stated that they 'put it away on the first day and never used it again').

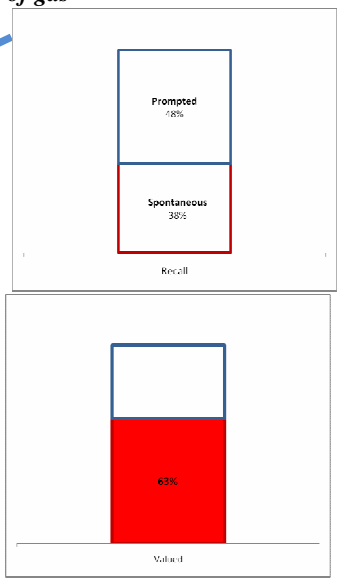
The current temperature



The cost of gas being consumed today



Graph showing current usage of gas



Recall of other features	Awareness		Valued (among aware)
	Unprompted	Prompted	
Your total cost over the last seven days	30%	52%	84%
Your total cost over the last 28 days	22%	51%	81%
Your total usage shown as a graph over the last seven days	20%	53%	70%
Your carbon emissions	13%	42%	59%
Your current meter reading	6%	51%	66%
The price of the gas at different times	39%	36%	84%

Figure Ax.79: Recall of elements of the IHDD and rating of elements by those recalling each element

Figure Ax. 79 summarises the participants' recall and assessment of the IHDD. 68% stated that they used the IHDD information accessible beyond the default main screen. 18% did not recall any feature spontaneously and 7% did not recall any of the features with prompting.

During the Trial, participants were sent eight text messages readable through the IHDD. Reflecting the infrequency of these messages, only 15% recall receiving these texts (**Figure Ax. 80**) and 14% read some or all of the texts. If it is assumed that the IHDDs received and displayed these messages this suggests significant challenges to this form of dynamic communication through the IHDD.

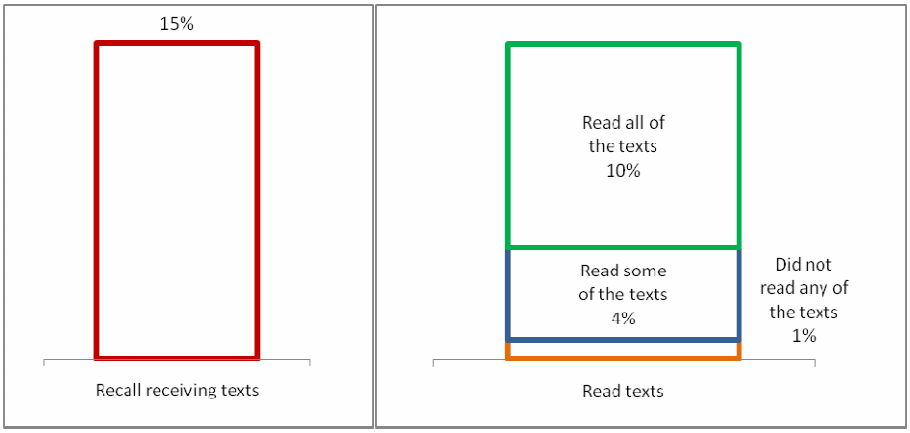


Figure Ax. 80: Participant recall of IHDD text messages and reported actions

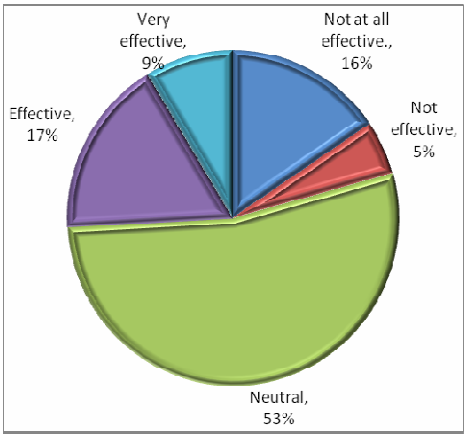


Figure Ax. 81: Participants' rating of the effectiveness of IHDD text messages in helping reduce gas usage
(among participants who recalled receiving the messages)

Among the participants who recalled receiving the text messages, 26% rated them as effective in reducing their gas usage (**Figure Ax. 81**) with 21% rating these as not effective. Translating these figures into the total participant population, this means that 4% recalled receipt of texts and rated them as effective.

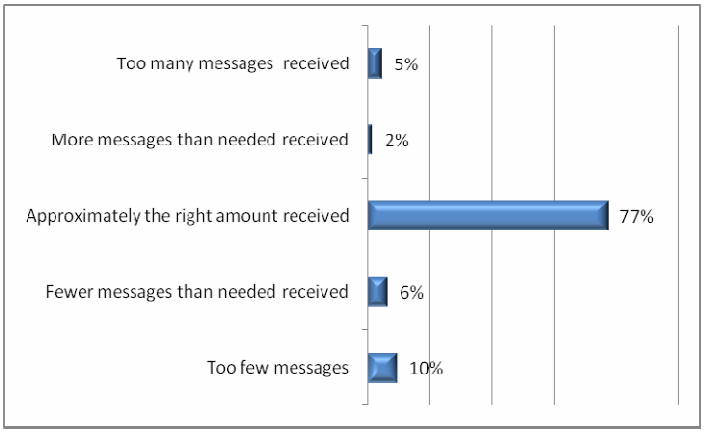


Figure Ax. 82: Participants' rating of the frequency of IHDD text messages sent
(among participants recalling receiving the messages)

Figure Ax. 82 shows the rating of the frequency of text messages by participants who recall receiving these messages. A majority (77%) state that the frequency was correct and only 5% stated that too many messages were sent.

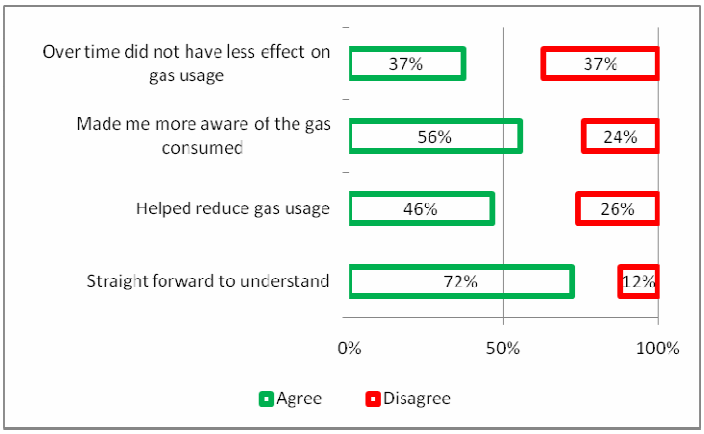


Figure Ax. 83: Participants' assessment of IHDD text messages sent during the trial
(among participants who recalled receiving the messages)

Among participants who recalled receiving the text messages, 67% stated that they were easy to follow with 43% stating that they helped reduction in gas usage and 51% stating that they made the recipient more aware of gas consumption (**Figure Ax. 83**). In conclusion, text messages appear to be an effective mechanism for delivering energy reduction related information. However, this effectiveness is limited to the proportion of the population that recalled receiving these messages.

iii) Seasonally varying tariff

The tariff tested varied for each two month period to reflect higher wholesale cost of gas at different times of year. Of the trial participants in this experimental cell, 57% were aware that the tariff varied during the Trial period. This is a surprisingly low figure given the potential

impact of the variable gas tariff on the bill size. However, approximately the same percentage also stated they understood how the cost varied at different times of year (**Figure Ax. 84**).

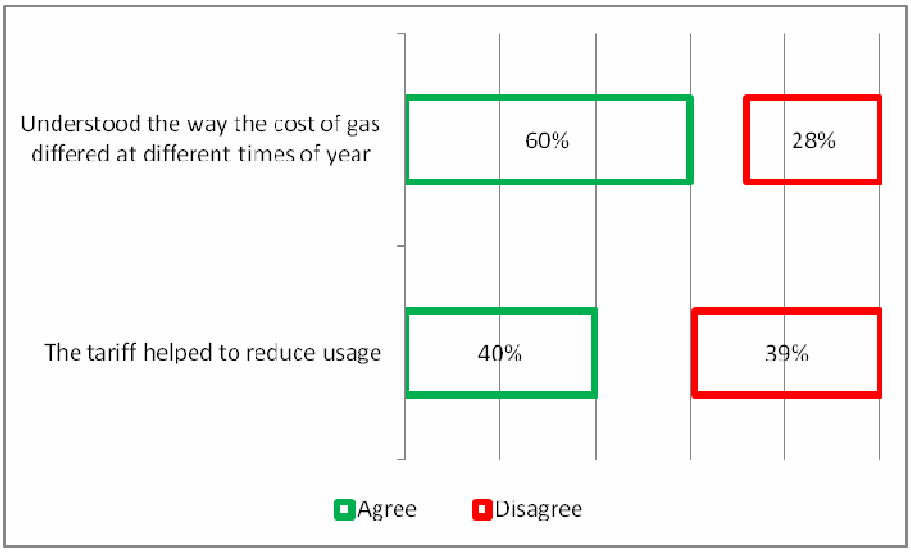


Figure Ax. 84: Participants' assessment of the impact of the variable tariff

The tariff was perceived to support usage reduction by 40% of participants (**Figure Ax. 84**) which corresponds to a high proportion of those aware of the tariff. .

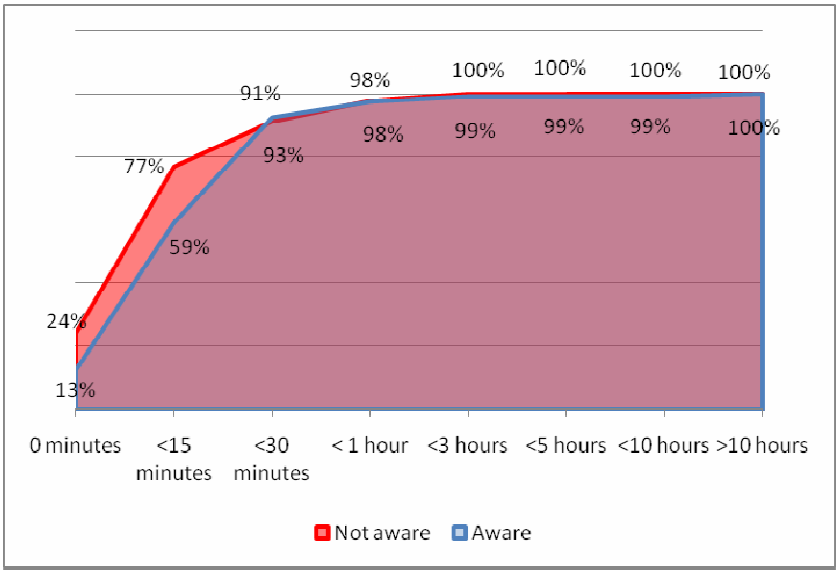


Figure Ax. 85: Cumulative amount of time spent on understanding the tariff

(among those aware of seasonal tariff (values below line) and those unaware of seasonal tariff (values above line))

The participants in the tariff group spent an average of 14.4 minutes understanding the tariff structure across the entire Trial. However, when considering only those participants who stated that they were aware of the changed tariff structure, this average becomes 20.25

minutes. **Figure Ax. 85** shows the cumulative amount of time spent understanding the tariff by participants in the tariff test group who were aware of the seasonal variation in the tariff and the participants in the same group who were not aware. It is clear that participants aware of the seasonal tariff did spend additional time understanding the tariff with 41% spending more than 15 minutes across the Trial period (compared to 23% among those unaware of the time varying aspect of the tariff).

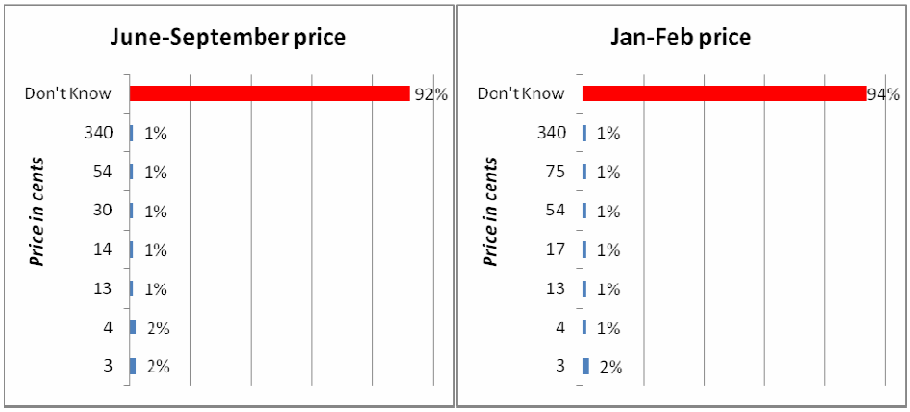


Figure Ax. 86: Awareness of price charged per kWh of gas consumed by tariff group from June to September (left) and January to February (right)

Figure Ax. 86 shows that a large majority of participants in the test group with the variable tariff were not able to state the price during the June to September period (92% were not able to provide any estimate of the unit price) or the January to February period (94% were not able to provide any estimate of the unit price). In addition, **Figure Ax. 86** shows that among the small group of participants who provided their recall of the price most were incorrect with estimates between 3 cent and €3.40.

A7.4 Perceived impact of the Trial

Most participants in the test groups reported making some degree of change in their approach to using gas in their home (**Figure Ax. 87**). 13% of all test participants stated that they made no change while 15% made very significant changes.

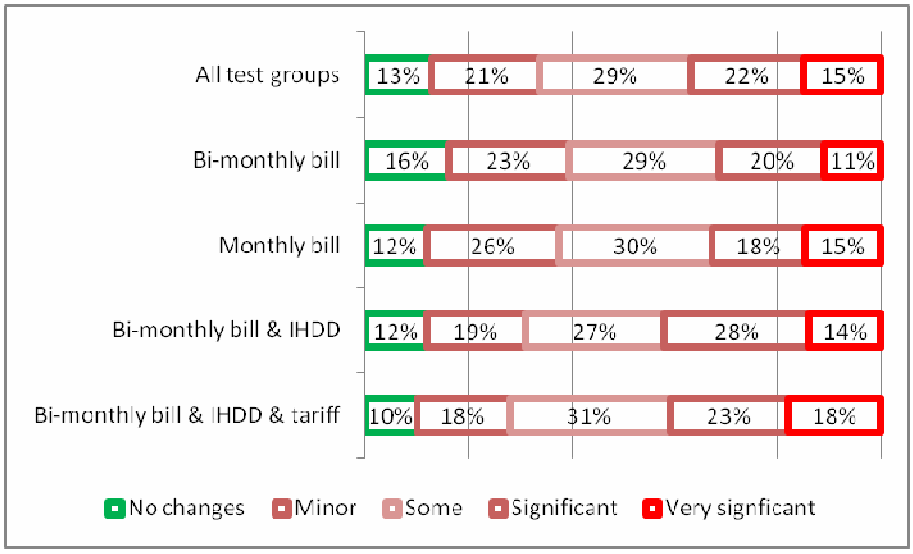


Figure Ax. 87: Degree of reported change in way gas was used in the home during the trial

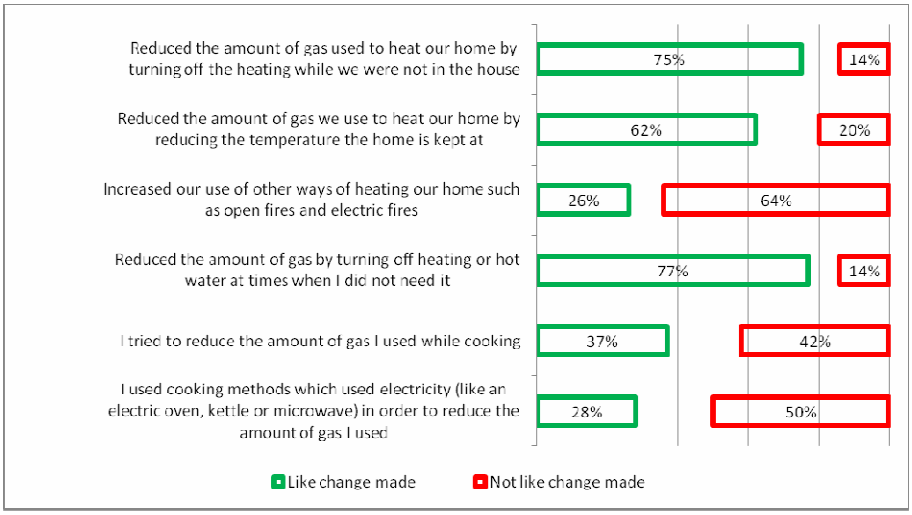


Figure Ax. 88: Reported specific behaviour changes among participants reporting changes in approach to gas usage

The specific behaviour changes reported are summarised in **Figure Ax. 88**. 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%). It can be concluded, therefore, that participation in the Trial encouraged appropriate behaviour changes.

Reported changes in home temperature	Reduced temperature	No Change	Increased temperature	Average reduction in temperature (°C)
Bi-monthly bill	41%	47%	12%	0.95 °C
Monthly bill	29%	54%	16%	0.49 °C
Bi-monthly bill + IHD	33%	52%	15%	0.86 °C
Bi-monthly bill + IHD + tariff	46%	43%	11%	0.93 °C
Control	36%	47%	18%	0.59 °C

Table Ax. 19: Reported change in home temperature during trial period and approximate average reduction in home temperature

The home temperature reported in the pre-trial and post-trial survey was compared for each respondent and analysed. This analysis showed that on average both test group and control group participants reported a reduction in home temperature. However, the reductions in home temperature reported by test group participants were on average greater by 0.23 °C than those reported by the control group. This was not the case for all stimuli with reductions made by participants who received only the monthly bill actually less than that reported by the control group (although the difference is too small to be considered significant).

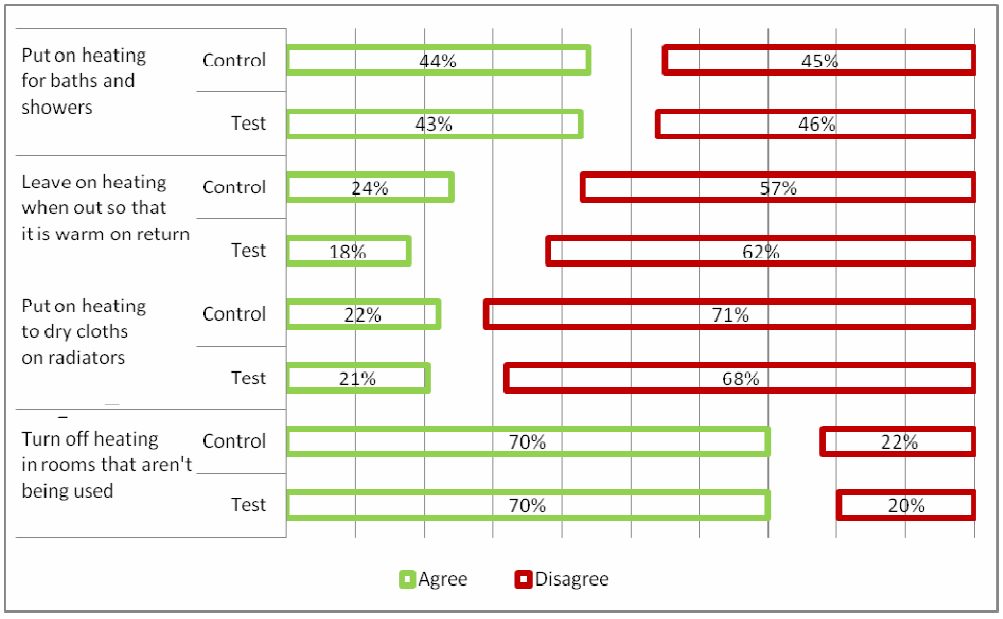


Figure Ax. 89: Comparison of reported behaviours between test and control groups

The prevalence of reported behaviours likely to lead to inefficient consumption of gas is similar among both test and control groups (**Figure Ax. 89**). Over 40% of both groups reported putting on the heating to heat water for baths and showers and over 20% of both groups reported putting on the heating in order to dry clothes on radiators. However, the proportion of test group participants who reported that they leave the heating on while out is

lower (18%) compared to the control group (24%). Finally, there was no change in the proportion of both 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).

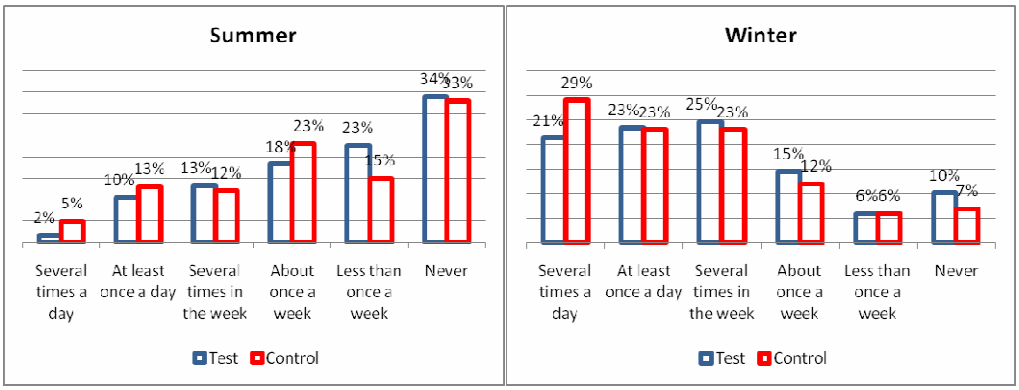


Figure Ax. 90: Reported use of the booster button during the summer (left) and winter (right) periods by both test and control groups

Booster button usage appears to be lower among the test than the control group during both summer and winter periods. For instance, 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 reported using the booster button several times a day during the winter compared to 29% of the control group during the same period.

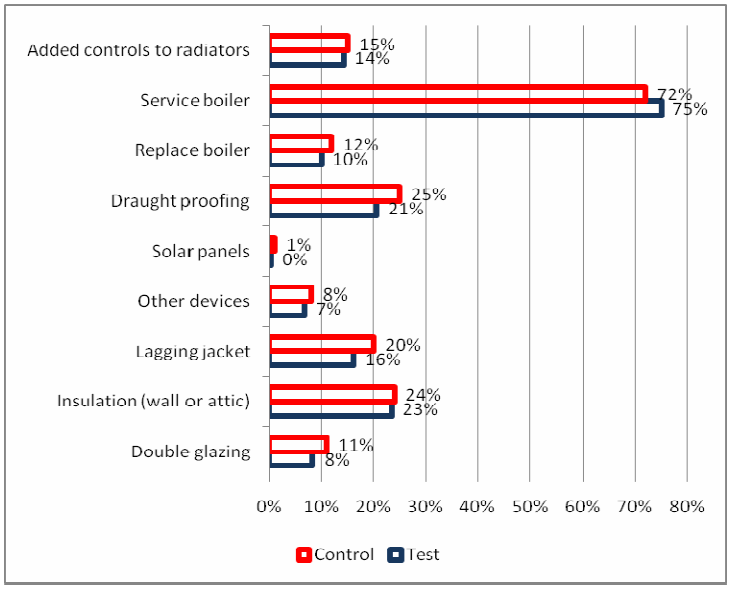


Figure Ax. 91: Comparison of level of investment in energy efficiency measures in control and test groups over the period of the trial

Figure Ax. 91 compares the level of investment during the trial period between test and control groups. This shows that, in general, there was a small decline in investment in energy efficiencies among the test groups when compared to the control. The exception to this was in the area of boiler servicing where 75% of test group participants reported this activity compared to 72% of the control group. While the degree of difference is small, it may be suggested that participation in the Trial appears to replace other investments for a small proportion of test group participants.

However, test group participants who did make investments in improving the energy efficiency of their home often reported that participation did impact on their decision to invest (**Figure Ax. 92**).

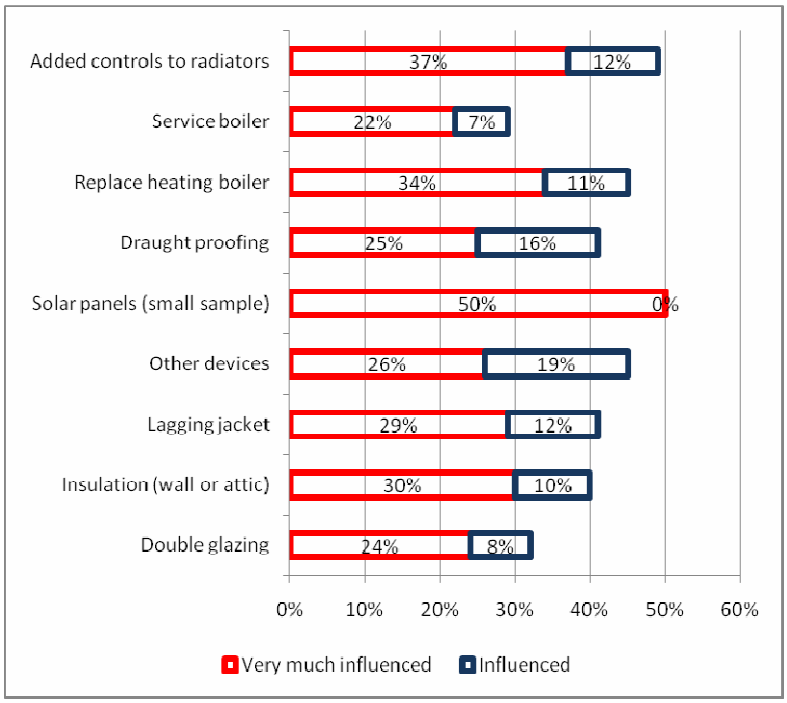


Figure Ax. 92: Influence of trial participation on decision to invest in energy efficiency improvements among test group participants reporting individual investments

The apparently similar level of investment between test group participants and control group when considered in combination with the ascription of impact of trial participation suggests that this attribution of impact is not significant.

A7.5 Impact of trial on attitudes and behaviours

Comparison between the perceived degree of empowerment and interest in reducing gas usage (**Figure Ax. 93**) shows no significant difference between participants in the test groups and control group. This suggests that participation in the Trial has no impact on the level of interest. In particular, the level of empowerment (as measured by the statement *"I can reduce*

my gas bill by changing the way the people I live with use gas") showed no significant difference between the control group (64% of these agreed) and the test group (66% of these agreed), thus suggesting that participation in the Trial has not increased the level of empowerment.

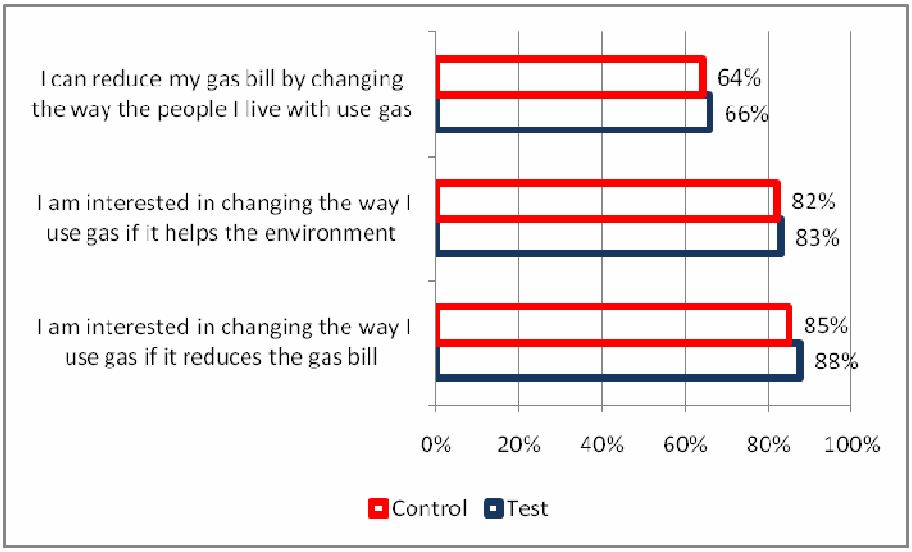


Figure Ax. 93: Comparison of empowerment and interest in gas usage reduction between test and control groups

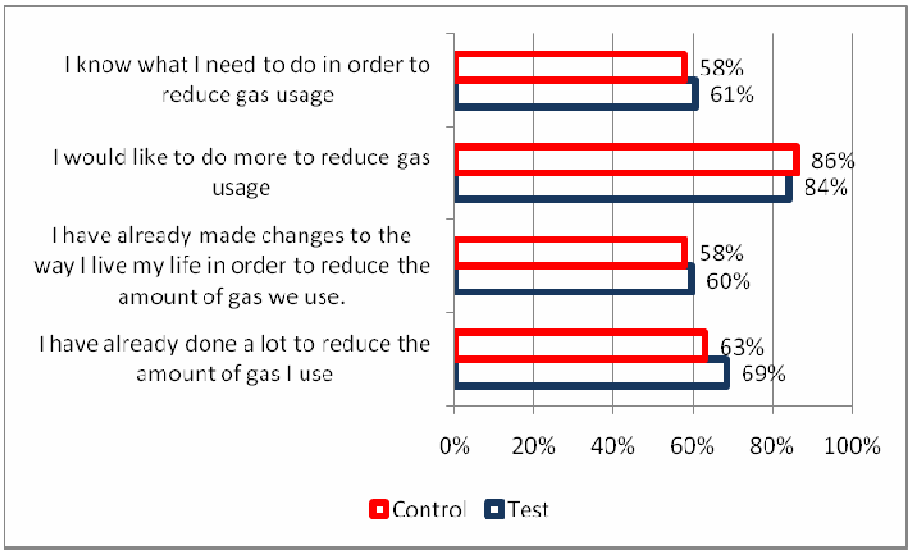


Figure Ax. 94: Comparison of engagement with behaviour change between test and control groups

Similarly, the level of engagement (**Figure Ax. 94**) has not changed among the participants in the test groups when compared to the control group. It is notable that the level of knowledge did not change significantly with 61% of the test group stating that they know what they need to do in order to reduce gas usage compared to 58% of 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 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 believe that they have already made changes to 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 Ax. 20: Reasons for not engaging in gas usage reduction

Among those who did not report making changes to their life to reduce usage or having already done a lot to reduce usage, reasons for lack of change are similar (**Table Ax. 20**) 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"*. This suggests a minor positive impact in terms of empowering gas usage reduction.

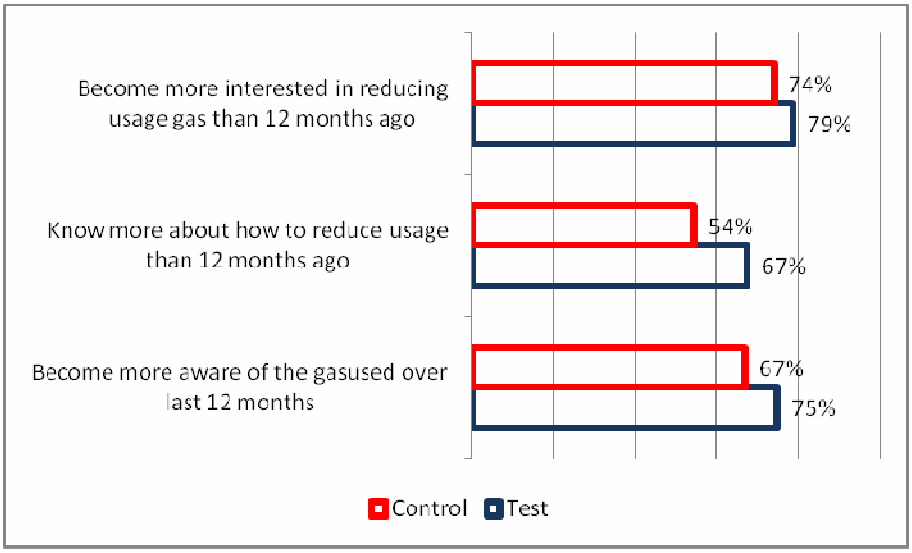


Figure Ax. 95: Comparison of perceived changes in empowerment and awareness with behaviour change between test and control groups

Finally, the perception of changes in engagement and empowerment shows higher scores among participants in the test groups when compared to the control group. In particular,

perception of increased knowledge was reported by 67% of the test groups compared to 54% of the control group. In addition, a higher proportion of the test groups stated that they had become more aware of the gas they used over the last 12 months (75% of the test group compared to 67% of the control group").

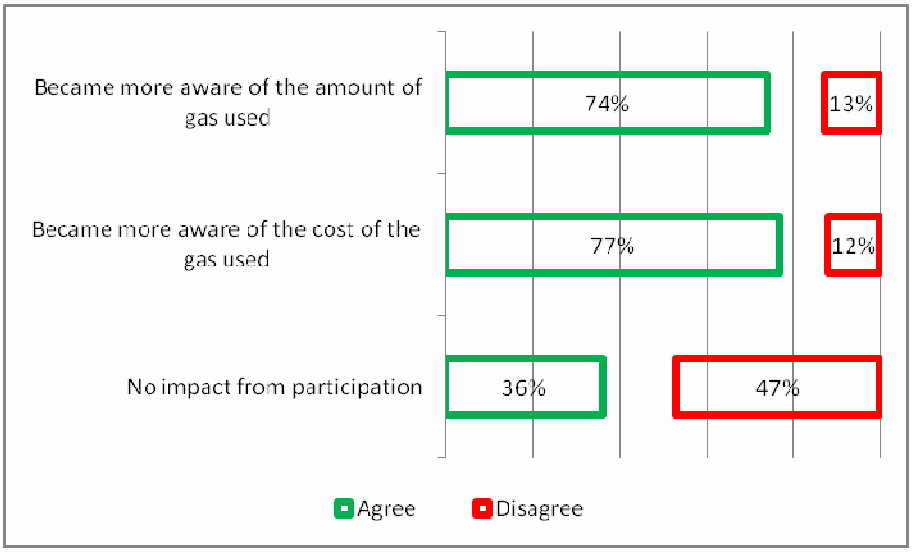


Figure Ax. 96: Perceived impact of participation in the trial among test group participants

While the 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 Ax. 96**).

A7.6 Perceived impact on usage and bill

A majority (62%) of test group participants perceived that they reduced their bill size through the period of the trial (**Figure Ax. 97**). When asked to estimate the amount of change in bill size, 29% of participants in the test groups believed that their gas bill reduced by between 5% and 10% (**Figure Ax. 98**).

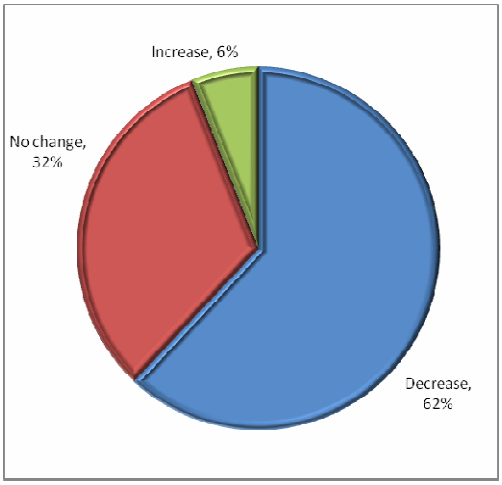


Figure Ax. 97: Change in total bill size perceived by test group participants

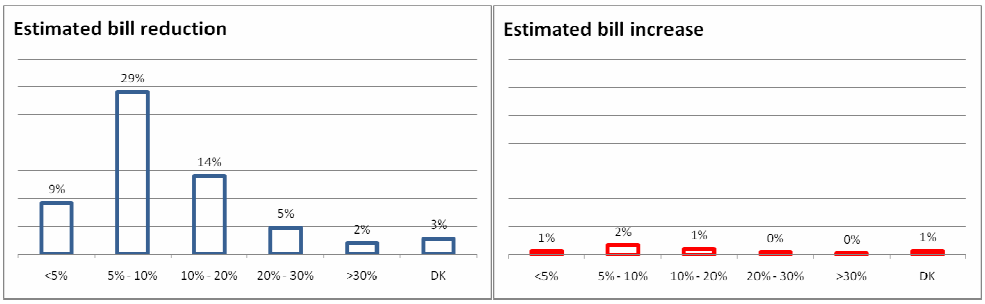


Figure Ax. 98: Estimated change in bill size among participants who perceived a bill reduction (left graph) and a bill increase (right graph)

Appendix 8: The SME pre-trial and post-trial surveys

A8.1 Introduction

Two surveys were conducted by The Research Perspective Ltd among all SME trial participants:

- A pre-trial survey of SME participants in January 2011 during the Trial. The survey achieved a response rate of 53% (29 respondents from a population of 55 acceptances). This varied greatly by sector with retail, leisure and healthcare/hotel achieving significantly lower response rates than the other three sectors. The objectives of the survey were similar to that of the residential pre-trial survey and included:
  - Business and usage profiling of the participants - who has opted to participate in the Trial
  - Motivation of the participants– why they joined
  - Reported behaviours related to the energy reduction – how they were likely to behave during the Trial
  - Engagement with the topic of energy reduction and behaviour change– how likely
- A post-trial survey of SME participants in August 2011. The survey achieved a response rate of 45% (25 respondents from a population of 55 acceptances). Of the respondents to the pre-trial survey 52% were also surveyed in the post-trial with the balance of the post-trial participants drawn from participants who had not participated in the pre-trial survey.

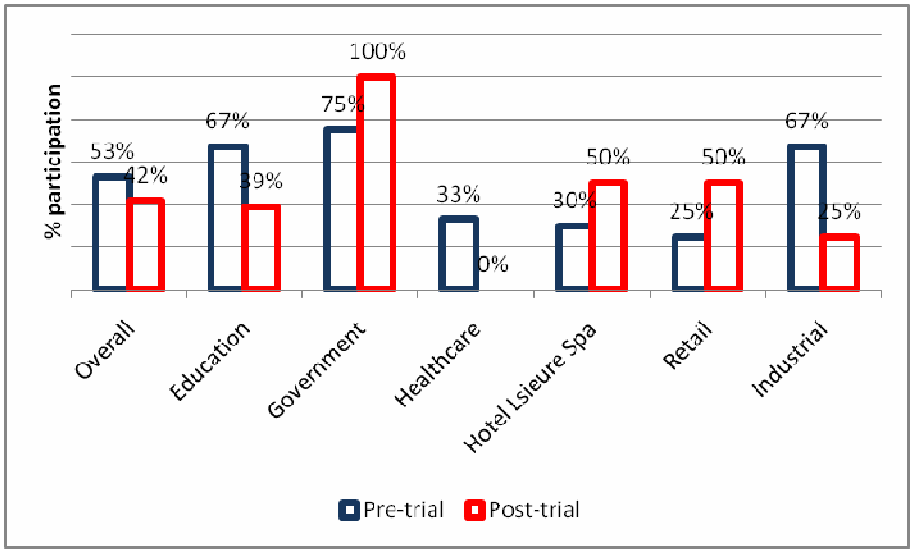


Figure Ax. 99: Response rates for the pre-trial and post-trial surveys overall and by sector

A8.2 Profile of participants

The participants are all SMEs (using the definition of SME as less than 250 employees). It should be noted that the participants included representation from the public as well as private sectors. Public sector participants included government departments or agencies, public healthcare organisations and educational establishments.

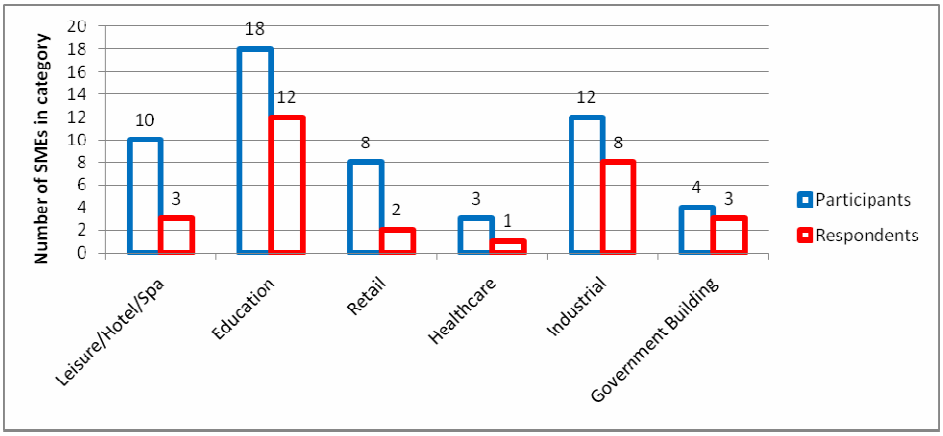


Figure Ax. 100: Sector level participation in the trial and pre-trial survey

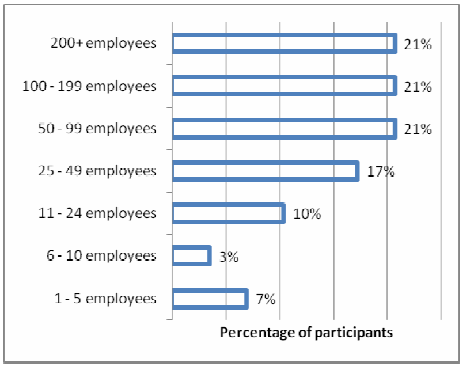


Figure Ax. 101: Breakdown of SME participants by number of employees

The number of employees is distributed across the full range of business size (**Figure Ax. 101**). While the national population of SMEs is predominated by micro-businesses with less than 10 employees, in the context of the National Smart Meter Gas Trial, it is reasonable to include a higher proportion of businesses with more employees as this will reflect the national situation in terms of volume of gas consumed.

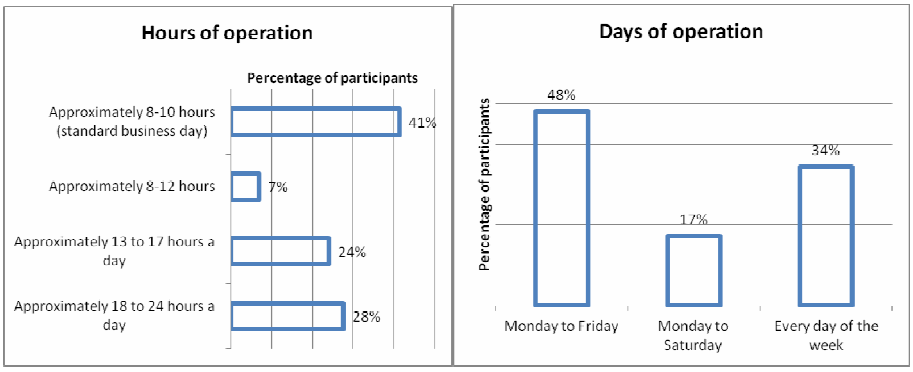


Figure Ax. 102: Hours and days of operation among SME participants

Almost half (48%) of participants operate their business Monday to Friday reflecting the proportion of government and educational organisations in the sample. A further 17% operated from Monday to Saturday which included organisations across all sectors (for instance educational establishments or government offices with limited Saturday opening) and 34% open seven days a week (including retail outlets, hotels and leisure businesses as well as industrial businesses). A similar proportion (41%) operates during the usual business day.

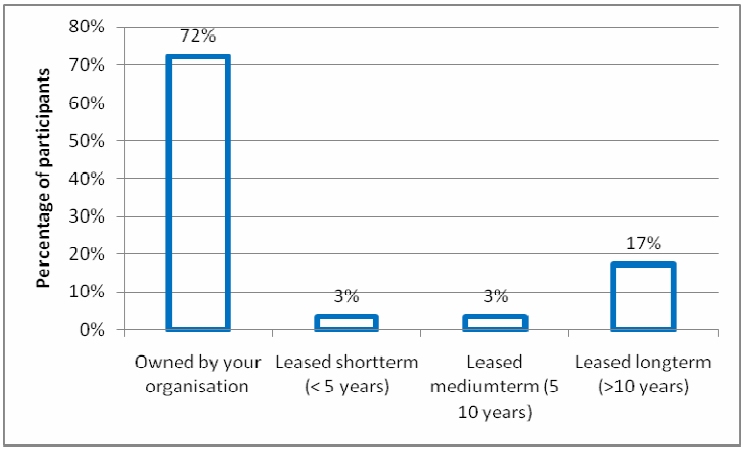


Figure Ax. 103: Tenure of participating organisations

Most organisations also own their current premises (72%) with most of the remaining participants on long terms leases (17%).

A8.3 Natural gas usage among participants

The significance of natural gas is measured in terms of the proportion of non-wage costs natural gas costs represents (**Figure Ax. 104**). For 47% of respondents it corresponds to less than 10% of these costs. Overall, the average contribution of natural gas to non-wage costs is 12%.

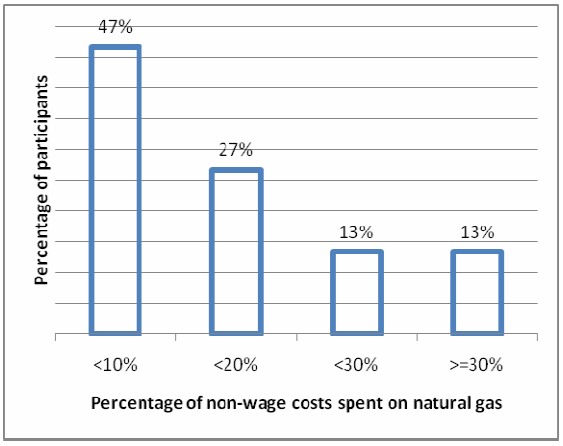


Figure Ax. 104: Proportion of non-wage costs spent on natural gas

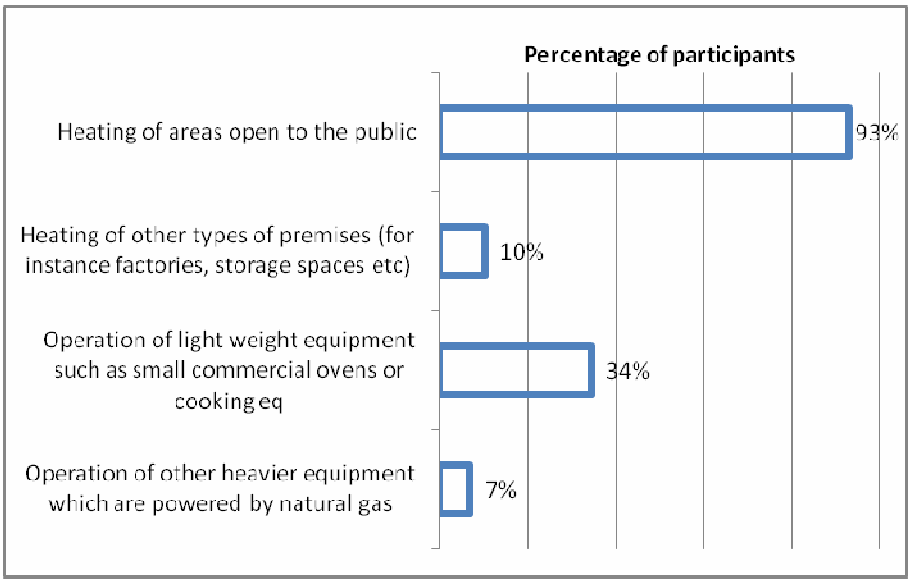


Figure Ax. 105: Uses of natural gas among SME participants

The primary use of natural gas is for space heating of areas with public access, with 34% of organisations also using gas for light weight equipment such as commercial ovens.

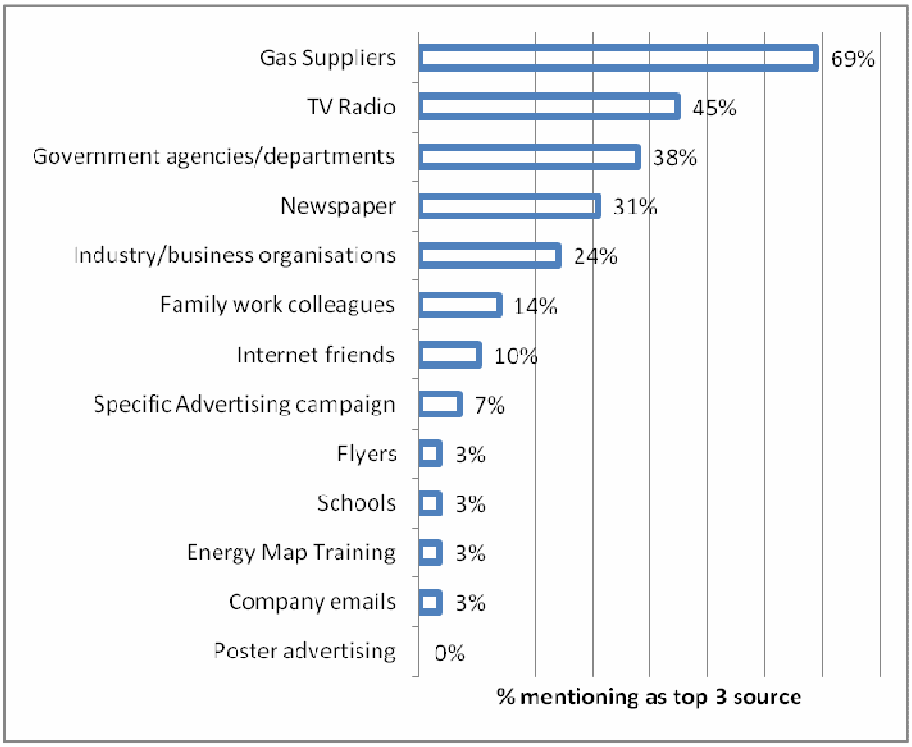


Figure Ax. 106: Sources of information about energy efficiency

Figure Ax. 106 shows the sources participants identified for energy efficiency information with the most common source being gas suppliers (69% identify this source) followed by TV/radio (45%) and government organisations (38%).

A8.4 Motivation for participating in the Trial

Recruitment and participation in the Trial was voluntary and required a commitment from both the organisation and the individual making the decision to participate. A large majority (86%) of participants stated that a motivation for the decision to participate was a wish to get more advice on how to reduce their natural gas usage. 76% agreed that their decision to participate was motivated by a wish to avail of the opportunity to reduce their organisations' impact on the environment. As participation was voluntary, it is unsurprising that the level of engagement with energy reduction was high amongst participants.

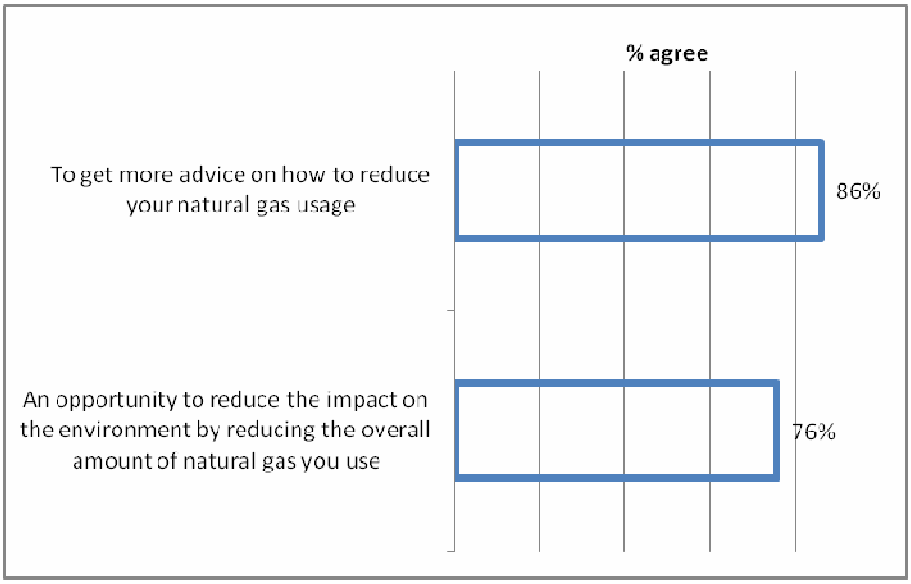


Figure Ax. 107: Reasons for participation in the SME trial

A8.5 Energy consumption control behaviours adopted

In the pre-trial survey, participants were asked about existing behaviours relating to control of energy usage such as prevalence of energy audits and tracking.

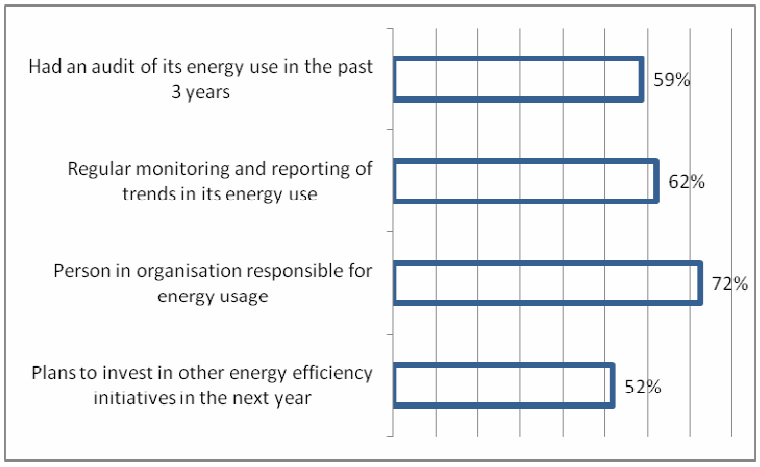


Figure Ax. 108: Prevalence of energy audits and responsibility

Figure Ax. 108 shows that a majority of organisations (59%) have undertaken an energy audit in the last three years and a slightly higher proportion (62%) state they undertake regular monitoring and reporting of energy use. There was a relationship between the level of annual usage and the undertaking of an energy audit. Most of the organisations with consumption greater than 1 million kWh stated that they had undertaken an energy audit. However, the reverse relationship was less clear with some of the SMEs with lower usage also undertaking an audit. Finally, it should also be noted that there was no clear connection between undertaking an audit and sector.

Of those organisations which undertook an energy audit, 45% used an external consultant exclusively with a further 3% using both external and internal expertise. With regard to the monitoring of energy usage, this is most often carried out monthly in line with the usual billing period (39% of participants who monitor and report trends do so monthly) or annually (28%). While not captured within the survey, it is reasonable to assume that the annual monitoring/reporting is aligned to annual budgeting processes.

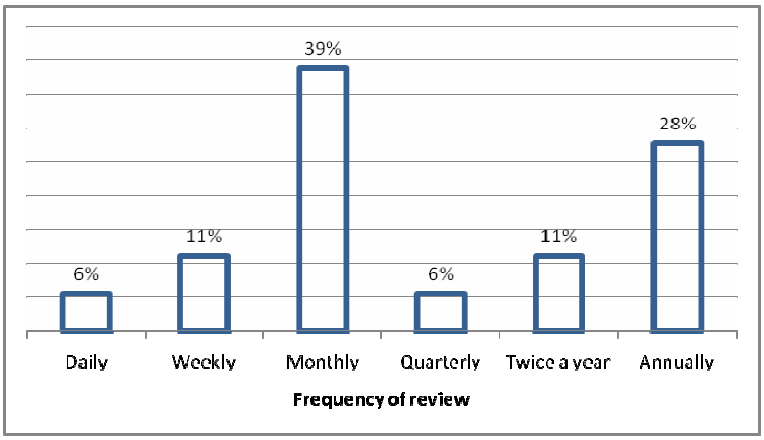


Figure Ax. 109: Frequency of monitoring/reporting of trends in energy usage (among the 62% of SMEs undertaking such monitoring)

72% of participants claimed to have a person in the organisation responsible for energy usage and 52% stated they planned to invest in other energy efficiency initiatives in the coming year.

A8.6 Attitudes towards and engagement with behaviour change among the participants

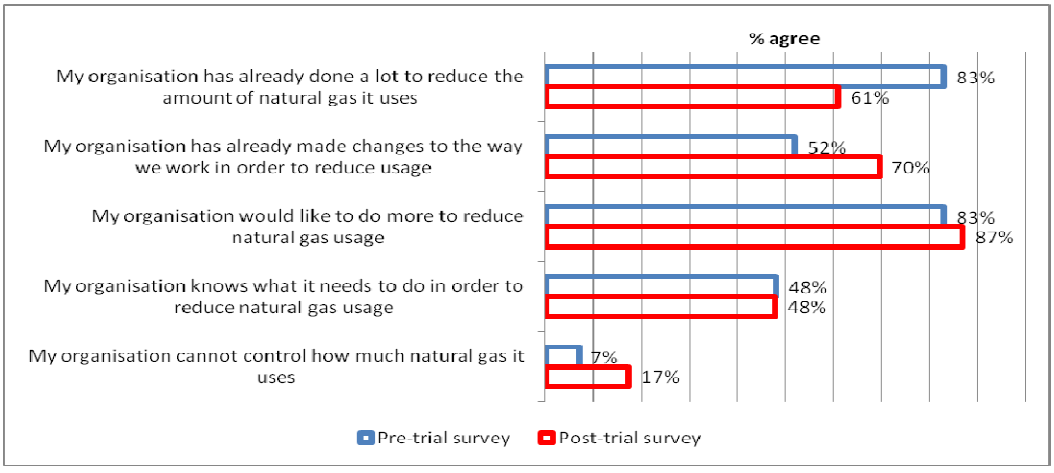


Figure Ax. 110: Engagement with energy reduction among SMEs

In the pre-trial survey conducted at the beginning of 2011, a majority of participating SMEs believed that they had already done a lot to reduce usage of natural gas (83%). However, a

lower proportion (52%) believed that the organisation had changed work practices to achieve reductions (**Figure Ax. 110**). Few participants believed that their organisation was not able to control the amount of gas they used (7%) with a large proportion (83%) or organisations interested in doing more to reduce usage.

Among the 83% of participants who reported doing a lot to reduce usage of natural gas, all could identify at least one energy reduction activity undertaken prior to the survey. The most common activities were structural (such as installing timers and thermostats (46% of participants) and insulating walls/roofs (25% of participants). Behavioural changes were undertaken by a minority (less than 10%) and these were primarily focused on reducing the amount of gas used. Among the organisations which implemented these changes, 79% stated that they had achieved reductions in their bills. The average saving claimed was 19% with individual organisations claiming savings between 3% and 50%.

The comparison of the responses to these questions in the pre-and post-trial surveys shows an increase in the percentage of SMEs stating that *"My organisation has already made changes to the way we work in order to reduce usage"* from 52% in the pre-trial survey to 70% in the post-trial survey. This reflects the impact of participation in the Trial, although it may also reflect some changes in the general population of SMEs (as the SME trial does not include a control group, it is not possible to definitively determine the degree to which this is the case).

The percentage of respondents who stated "*My organisation has already done a lot to reduce the amount of natural gas it uses*" declined from 83% in the pre-trial survey to 61% in the post-trial survey. An analysis of the responses of individuals who participated in both the pre- and post-trial survey found that this change is not a consequence of differences in respondent populations between the two surveys (i.e. this change in score did not occur because in some cases different organisations participated in the pre and post trial survey). In fact, the change in score was driven by a significant proportion of the subgroup of respondents (42% of those who responded to both pre and post trial survey) changing their response to this question between the pre- and post-trial surveys. Finally, it should also be noted that most other scores in Figure Ax110 are unchanged and therefore this result does not reflect lack of robustness in the survey results. Therefore, while it is not possible to determine the precise cause of this change in opinion from the survey results, it can be reasonably interpreted to reflect a change in perception of what "done a lot" means and hence to relate it as a positive outcome for the trial.

Most respondents to both pre- and post-trial surveys believed that their organisation could control the amount of natural gas used. Furthermore, 70% of respondents to the post-trial survey stated that they believed that further reductions in usage were possible within their organisation.

A8.7 Impact of the Trial on participating SMEs

The impact of the SME trial can be categorised into two areas:

- **Perceptions of changes in gas usage:** The design of the SME trial was not intended to assess change in usage as against a control group and benchmark period (as is the case with the Residential Trial).
- **Changes in attitudes and behaviours:** The post-trial survey measured changes in attitude as well as specific behaviours such as change in work practices/organisational structures and investments in energy efficiency.

Perceptions of changes in gas usage

48% of SMEs participating in the Trial stated that they decreased their consumption during the Trial (**Figure Ax. 111**). The estimate of reduction was 7.75% on average. While estimates ranged between less than 5% and more than 20%, most estimated the decrease as between 5% and 10%.

Amongst the 9% that stated that their usage had increased somewhat during the Trial, the average increase was 7.7% with all of these respondents estimating their increased usage between 5% and 10%.

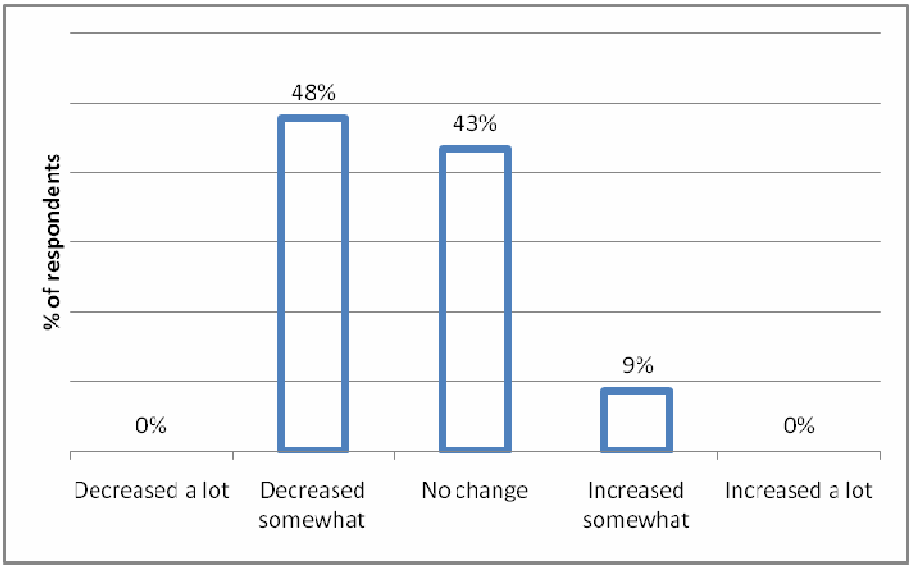


Figure Ax. 111: Reported increase or decrease in consumption among respondents to SME post-trial survey

Among the respondents who stated that their usage had reduced, 36% found it easy and 27% stated it was difficult to reduce usage.

Relating the change in usage to annual consumption as measured in the Trial shows reductions were reported in organisations with smaller consumption levels (**Figure Ax. 112**). The largest consumers of gas reported no change. Of the six participating SMEs with usage

more than one million kWh per annum, four reported no change in usage with one reporting a decrease and one reporting an increase in usage. Among those who reported a reduction in usage, the degree of difficulty associated with that reduction and the scale of the reduction were not related to the total usage.

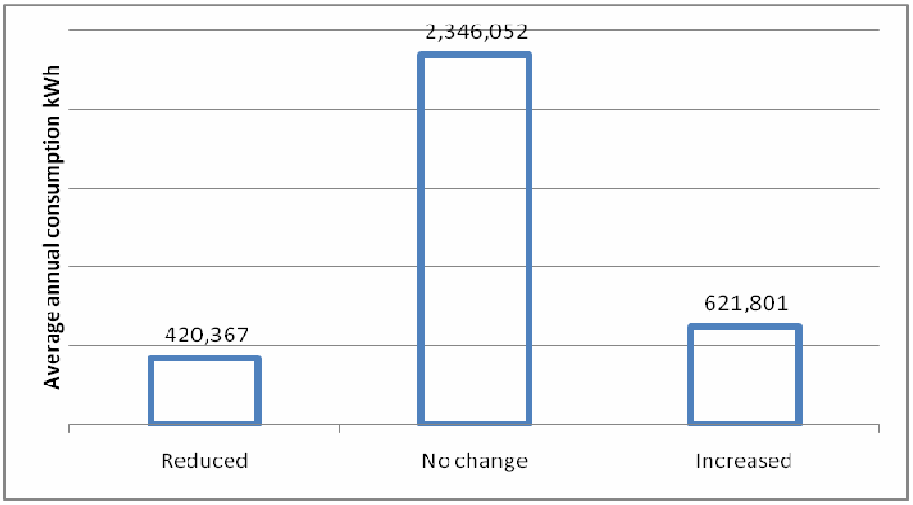


Figure Ax. 112: Average consumption among SMEs reporting reduced, unchanged or increased gas usage during the Trial

Changes in attitudes and behaviours

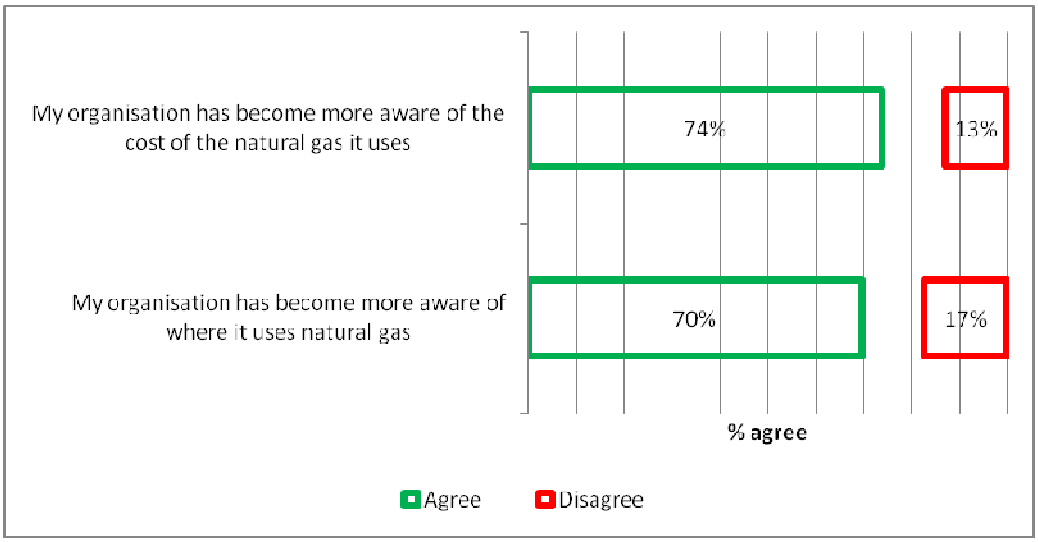


Figure Ax. 113: Impact of the Trial on awareness of natural gas usage among respondents to the SME post-trial survey

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%) and increased their organisation's awareness of where gas is used (70%) (**Figure Ax. 113**).

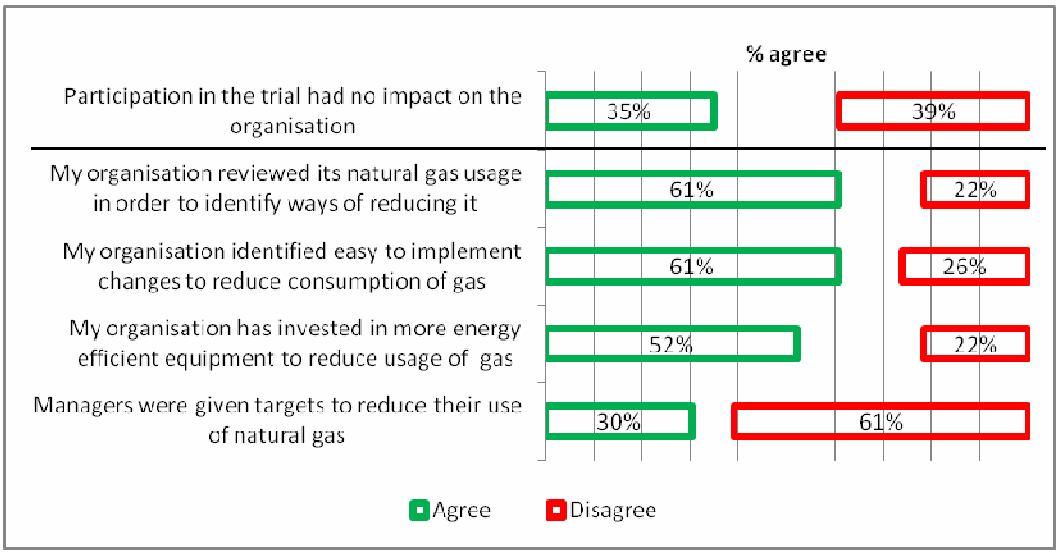


Figure Ax. 114: Impact of the Trial on SME behaviours

When asked about general approaches to reduction of gas usage, 35% stated that participation in the Trial had no impact on the organisation (**Figure Ax. 114**). There was no clear relationship between either level of usage or sector and perception of impact.

However, 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 such as reviewing usage to identify ways of reducing; identifying easy to implement changes; and investing in more energy efficient equipment to reduce usage of gas. In each case, there was no clear association between the behaviour and the sector to which the organisation belonged. This was also the case for investment in more energy efficient equipment.

Similarly, there was no clear association between annual gas usage and undertaking annual reviews of usage or the identification of easy to implement changes. There were also no differences between organisations which identified easy to make changes and those which did not in terms of engagement with other aspects of the Trial such as use of the web interface. However, there was some relationship between having undertaken an energy audit during the previous 12 months and having found easy to implement changes (the reverse was not true: Some organisations which had not undertaken an energy audit had identified easy to implement changes). This suggests that smart metering in conjunction with an energy audit increased the potential to identify easy to make changes. Finally, in 30% of the organisations participating in the post-trial survey managers had been given targets for gas reduction.

The respondents to the survey were asked about changes in behaviours. This included:

- **Frequency with which gas equipment is serviced:** 91% stated that the frequency with which they serviced this 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;

- **Carrying out of energy audits:** Of the post-trial respondents who had carried out an energy audit 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 post-trial respondents who had introduced monitoring and tracking of trends in energy use, 33% of these stated participation was a significant factor;
- **Appointment of a person responsible for energy usage checking, monitoring and feeding back:** Of the post-trial respondents where a person had been made responsible, 33% state participation in the Trial was a significant factor.

A8.8 Assessment of the Web Interface

All participants were given access to on online "web interface" which allowed current and historic usage information to be viewed. Participants were informed of the system at the start of the Trial and sent further reminders 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). Questions about the web interface were included in both pre- and post-trial surveys. This reflects the timing of the pre-trial survey in January 2011 after participants had access to the system. The results from these surveys were similar across most measures included in the pre- and post-trial survey. On this basis, the pre- and post-trial results are only explicitly referenced where significant differences exist.

Among those who were aware of the system 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.

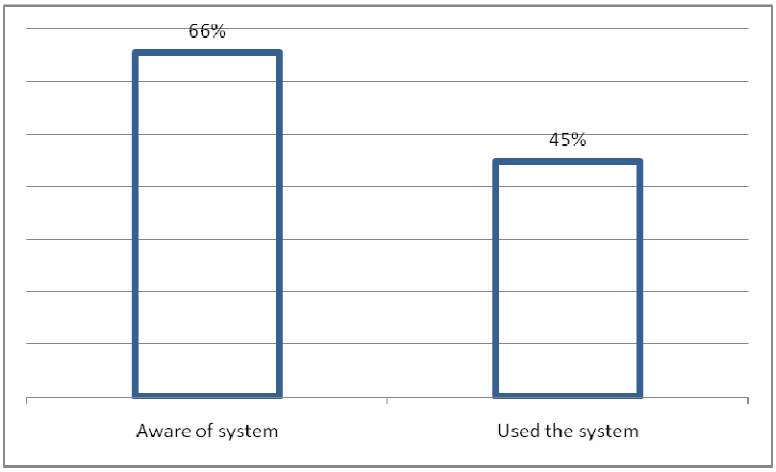


Figure Ax. 115: Awareness and use of online system among SME participants

Awareness and the use of the web interface was greater among those with lower usage levels (**Figure Ax. 116**). This shows that SMEs with higher usage levels were less likely to be aware of the system and, when aware of the system, were less likely to use the system than the smaller SMEs. If a single case with very high usage is excluded (the recalculated figure is shown as a red box in **Figure Ax. 116** below), a clear relationship emerges between the average annual usage and awareness and use of the web interface.

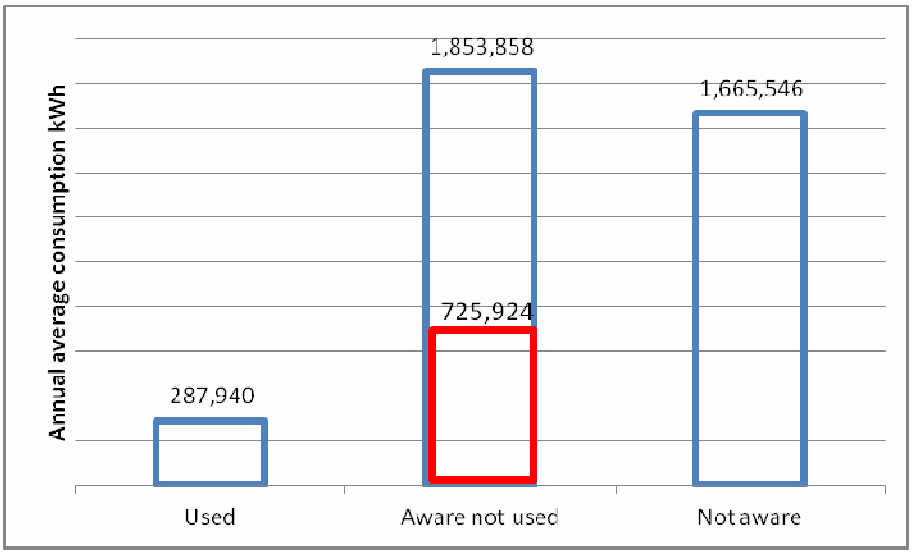


Figure Ax. 116: Average usage of SMEs who used/did not use the web interface

(central red box represents average calculated with single high consumption participant excluded)

In the case of the middle category (aware but didn't use), comments captured in the survey suggest that this may reflect perceived duplication in functionality between existing energy managements systems in place in these larger organisations and the web interface provided.

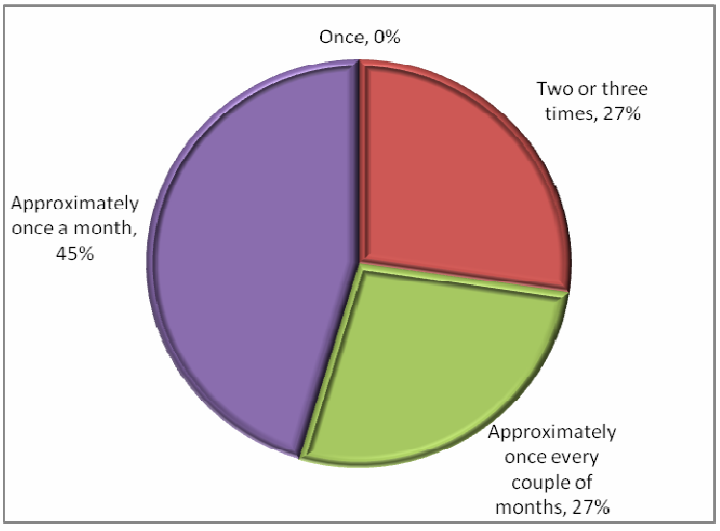


Figure Ax. 117: Frequency of use of web interface among 38% of SME participants who used the system

All of the 38% of participants who had used the web interface themselves claimed to have used the system twice or more with 45% claiming that they used the system approximately once a month (**Figure Ax. 118**). This frequency of use is in line with typical billing frequency.

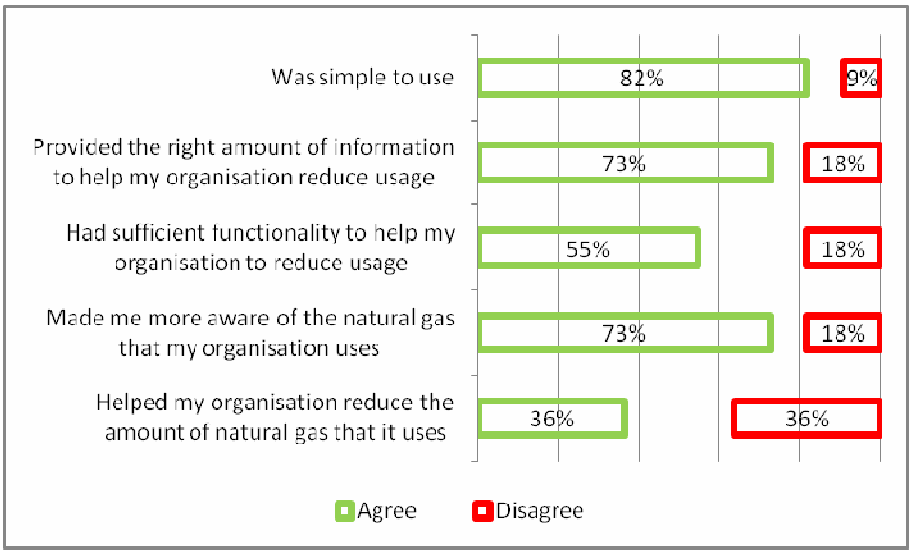


Figure Ax. 118: Assessment of web interface among SME participants who used the system

Among the SME participants who used the web interface, most found the system easy to use (82%); agreed it had the right information (73%); and made them more aware of the gas used (73%). However, only 36% stated that it helped their organisation reduce the amount of gas it used with 55% stating that it had sufficient functionality to help their organisation to reduce usage. Furthermore, most respondents in the post-trial survey found the information that they were looking for (71%) and did not find it took too long to find the information (14% said it took too long). This suggests a gap between the type of information provided by the system and the type of information and other support required to achieve usage reduction. In particular, it suggests that the web interface may need to be integrated within a broader range of supports (spanning information and consultancy) to achieve greater usage reduction.

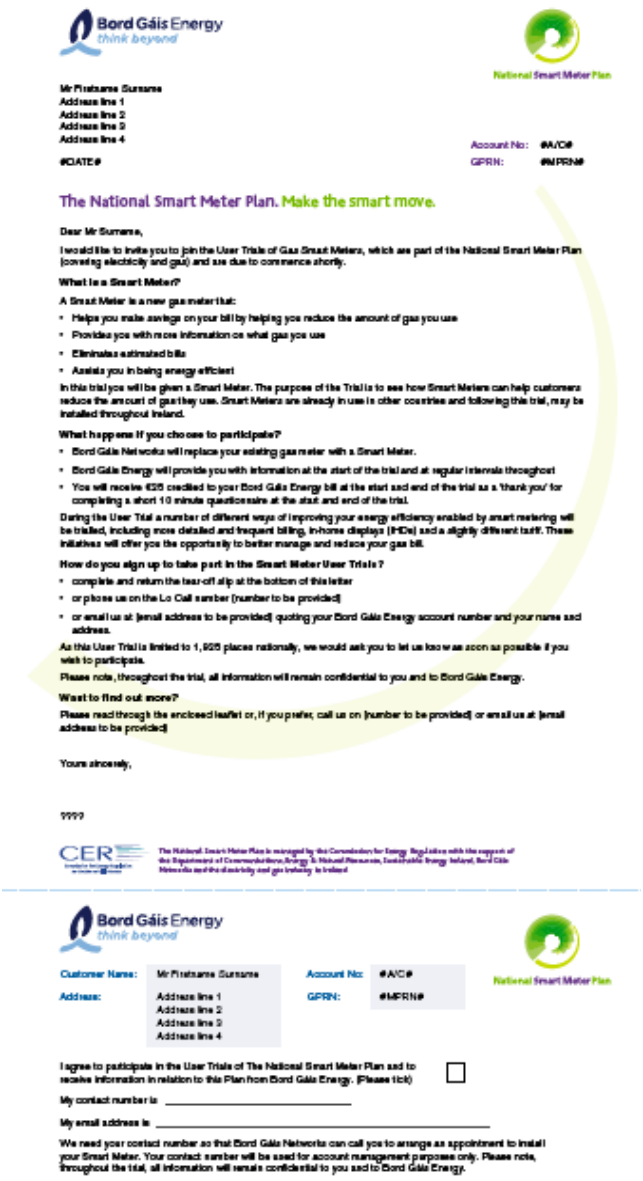
Appendix 9: Table of Communications

Communication	Issued
Invitation Letter, FAQ and telephone call	From August 2009
Letter acknowledging agreement to participate	From September 2009
Letter outlining what would happen next	December 2009
Letter and brochure to the gas monitor group advising of installation of the unit	5 May 2010
Letter to the Control Group	24 May 2010
Letter and brochure advising participants which test group they were being allocated to.	24 May 2010
Letters advising participants they would be contacted regarding pre- and post-trial surveys, as well as non-response and attrition surveys	From August 2009 onwards
Letter advising participants the Trial was ending and addressing issues, such as reversion to normal billing and thank-you payments.	May 2011
Final letter reconciling costs of gas during the Trial and credits due to participants on the variable tariff	June 2011

Table Ax. 21: Gas Customer Behaviour Trial – Main Communications, 2009 to 2011

Appendix 10: Sample Communications

Invitation Letter - Residential



Bord Gáis Energy
think beyond

National Smart Meter Plan

Mr Firstname Surname
Address line 1
Address line 2
Address line 3
Address line 4

#DATE#

Account No: #A/C#
GPRN: #MPRN#

The National Smart Meter Plan. Make the smart move.

Dear Mr Surname,

I would like to invite you to join the User Trials of Gas Smart Meters, which are part of the National Smart Meter Plan (covering electricity and gas) and are due to commence shortly.

What is a Smart Meter?

A Smart Meter is a new gas meter that:

- Helps you make savings on your bill by helping you reduce the amount of gas you use
- Provides you with more information on what gas you use
- Eliminates estimated bills
- Assists you in being energy efficient

In this trial you will be given a Smart Meter. The purpose of the Trial is to see how Smart Meters can help customers reduce the amount of gas they use. Smart Meters are already in use in other countries and following this trial, may be installed throughout Ireland.

What happens if you choose to participate?

- Bord Gáis Networks will replace your existing gas meter with a Smart Meter.
- Bord Gáis Energy will provide you with information at the start of the trial and at regular intervals throughout
- You will receive €25 credited to your Bord Gáis Energy bill at the start and end of the trial as a 'thank you' for completing a short 10 minute questionnaire at the start and end of the trial.

During the User Trial a number of different ways of improving your energy efficiency enabled by smart metering will be trialled, including more detailed and frequent billing, in-home displays (IHDs) and a slightly different tariff. These initiatives will offer you the opportunity to better manage and reduce your gas bill.

How do you sign up to take part in the Smart Meter User Trials?

- complete and return the tear-off slip at the bottom of this letter
- or phone us on the Lo Call number (number to be provided)
- or email us at [email address to be provided] quoting your Bord Gáis Energy account number and your name and address.

As this User Trial is limited to 1,925 places nationally, we would ask you to let us know as soon as possible if you wish to participate.

Please note, throughout the trial, all information will remain confidential to you and to Bord Gáis Energy.

Want to find out more?

Please read through the enclosed leaflet or, if you prefer, call us on [number to be provided] or email us at [email address to be provided]

Yours sincerely,

????

CER

The National Smart Meter Plan is managed by the Commission for Energy Regulation with the support of the Department of Communications, Energy & Natural Resources, SEAI/Public Energy Ireland, Bord Gáis Networks and the electricity and gas industry in Ireland

Bord Gáis Energy
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National Smart Meter Plan

Customer Name:	Mr Firstname Surname	Account No:	#A/C#
Address:	Address line 1 Address line 2 Address line 3 Address line 4	GPRN:	#MPRN#

I agree to participate in the User Trials of The National Smart Meter Plan and to receive information in relation to this Plan from Bord Gáis Energy. (Please tick) ☐

My contact number is _____

My email address is _____

We need your contact number so that Bord Gáis Networks can call you to arrange an appointment to install your Smart Meter. Your contact number will be used for account management purposes only. Please note, throughout the trial, all information will remain confidential to you and to Bord Gáis Energy.

Frequently Asked Questions Brochure

why?

Why are the User Trials being carried out?

The purpose of the User Trials is to understand how a number of energy efficiency initiatives enabled by Smart Metering can help customers reduce the amount of gas they use, thus helping the environment and helping Ireland meet its climate change targets.

The changes that customers make in the User Trial will also provide information on what could be expected if all customers have Smart Meters.

where?

Where have Smart Meters already been introduced?

Italy, Canada and Sweden are some of the initial countries that have already installed Smart Meters.

Where can I get more information about this User Trial?

Refer to the contact details on the letter accompanying this leaflet.

CER

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This leaflet and letter are printed on environmentally friendly stock which is produced from sustainable forests, 30% will broke and post consumer waste.

Smart Meters. Make the smart move.

what?

What are the National Smart Meter Plan User Trials?

The National Smart Meter Plan may ultimately see all premises in the country provided with a gas Smart Meter. This will enable customers to reduce their gas bills by cutting back on the unnecessary use of gas.

Prior to any national installation of Smart Meters, a User Trial is being undertaken. The purpose of this User Trial is to understand how the use of Smart Meters can reduce the amount of gas customers use.

Participants from across the country will be randomly selected and invited to participate in this User Trial.

What is a Smart Meter?

Smart Meters are the next generation of gas meters. They monitor and record how much gas you use and when you use it. They can then communicate this data automatically to your gas supply company.

Is my usage information secure and will it remain confidential?

Under the Data Protection Act 2003 your information will be kept confidential.

What am I signing up to?

By agreeing to take part in the Smart Meter User Trial, you agree to the following:

- Taking part in the trial until completion in May 2011
- Having your existing gas meter replaced with a Smart Meter
- Having a wireless communications unit installed within your home to enable remote reading of your new Smart Meter
- Trialing energy saving initiatives which may include a different tariff
- Answering a simple questionnaire at the beginning and end of the User Trial
- All those who participate in the User Trials will be randomly allocated to different test groups.

You will receive a "thank you" payment at the end of the User Trial.

What is the questionnaire?

There will be a short and simple questionnaire at the beginning and end of the User Trial period.

What is the Thank You Payment?

During the Trial you will receive two thank-you payments of €25 each (€50 in total). You will receive the first payment when you have completed a questionnaire later this year and the second payment when you have completed a questionnaire early in 2011 (ie. once the Trial has ended). These two questionnaires are important in understanding your experience during the course of the Trial.

who?

Who is sponsoring the National Smart Meter Plan?

The National Smart Meter Plan is managed by the Commission for Energy Regulation (CER) with the support of the Department of Communications, Energy & Natural Resources, Sustainable Energy Ireland, Bord Gáis Networks and the gas and electricity industry in Ireland.

The CER is an independent agency that regulates natural gas and electricity utilities in the public interest. SEI is the national agency responsible for promoting sustainable energy in Ireland.

Who is participating?

Participants will be invited from all parts of the country. The goal is to reflect the diversity of customers who use gas in different ways.

how?

How do Smart Meters differ from the existing Meters?

Our old-style meters can only measure the total amount of gas used over an entire billing period because they have to be read manually. This often results in estimated bills.

Smart Meters can capture gas usage at regular intervals throughout the day and communicate this information from the customer's premises to the supplier via an in-home wireless communications unit. Smart Meters can be read remotely which will bring an end to estimated billing.

Will I need to pay for any equipment?

No, the Smart Meter will be installed free of charge by a Bord Gáis Networks Technician and there will be no additional charges associated with the Smart Meter installation.

How long does it take to fit the meter?

Once the Technician has access to the meter position they will need to switch off supply of electricity and gas to your home for 1-2 hours approximately to allow the meter to be replaced and the wireless communications unit to be fitted. Supply will be restored once the Smart Meter has been installed successfully.

The timing of the installation will be discussed and agreed with you prior to installation.

Where will the meter be positioned?

The Smart Meter will be positioned in the same location as your existing gas meter.

Installation of the Smart Meter is dependent on your gas metering meeting applicable standards. A wireless communications unit will also be installed within your home at your fuseboard or in your electricity meter box.

Acknowledgement Letter – SMEs

A
B
C
D
E

05/03/2010

The National Smart Meter Plan

Dear,

Thank you for agreeing to participate in the Gas User Trials of the National Smart Meter Plan. We will be writing to you over the coming months to provide you with more details on the User Trail and the web-service which will be available to you as part of the Trial. This service will provide you with detailed information on your gas consumption in order to support you in understanding and managing your gas usage.

To enable your participation in the trial, smart communications equipment will be fitted to your existing gas meter. There are a number of points we would like you to note:

- The installation of smart communications equipment will be carried out by a Networks Technician from Bord Gáis Networks.
- As a first step a Networks Technician from Bord Gáis Networks will conduct a site visit to ensure the suitability of your metering.
- If your meter is confirmed as suitable for the smart meter equipment, Bord Gáis Networks will arrange an appointment when this work will be carried out.
- There will be no disruption to your gas supply during this installation.
- The smart communications equipment works on wireless communications (ie., similar to your mobile phone) and is battery operated. It will collect gas consumption data at hourly intervals and relay this data to the Bord Gáis Networks data centre on a daily basis. This data will then be used to provide you with daily information on your gas usage and gas costs.

Once again, I would like to thank you for your participation. Your input and feedback from using the web-interface during the User Trial will provide us with valuable information for decisions around the national roll-out of these meters. We will provide you with further information on this shortly, but in the meantime if you have any queries, please contact us on 1850 495 500 or email us at smart@bordgais.ie.

Yours Sincerely

Padraig Fleming
Pricing and Regulation Manager

Letter to participants re what will happen next

Bord Gáis Energy

National Smart Meter Plan

Joe Sample
Sample House no.
Sample Road
Dublin Sample
Ireland

MPRN No.
A/c No.

18th December 2009

Dear XXXX,

Thank you again for agreeing to take part in the User Trials of The National Smart Meter Plan. Your gas Smart Meter is now installed and is operating normally. The purpose of this letter is to provide you with more information on the Smart Meter User Trial and some next steps.

The Smart Meter User Trial starts on 1st December 2009 and runs to 31st May 2011. It is divided into two parts:

Normal Use Period	1st December 2009 to 31st May 2010
Active User Trial Period	1st June 2010 to 31st May 2011

Normal Use Period: 1st December 2009 to 31st May 2010 - What you have to do

The period from 1st December 2009 to 31st May 2010 is called the "normal use period". During this time we would like you to continue using your gas as normal. This is necessary so that that we can establish your normal gas use before we ask you to trial smart meter related initiatives. It also means that at that at the end of the trial we will be able to see the "before and after" effect of the various initiatives associated with smart meters.

Bill Timing Changes

There is one change you will notice during the "Normal Use period". From the beginning of December the timing of when you receive your bill may change. This is because we need all those in the User Trials to receive their bill at the same time so that we can clearly see what changes in gas use have occurred as a result of smart meters and the associated initiatives.

If you pay by direct debit, your payment date will also change. If you pay by budget direct debit, the timing of your payment will stay the same.

This change happens from 1st December 2009. We will issue you with a bill up to end of November 2009, so that from 1st December 2009 all participants in the trial will be billed on the same date.

Pre-Trial Survey

Also during this time we would like your help in completing a survey on how you and members of your household use gas in your home (for example, for cooking, heating, hot water, and so on).

This telephone survey will be carried out in April of next year and we will write to you nearer the time to remind you. Once the survey is complete we will credit €25 to your BGE bill. (We will repeat this survey at the end of the trial in June 2011 and you will receive a further €25 for taking part.)

These surveys are an integral part of feedback in relation to the User Trials of the Smart Meter Plan and your participation would be very much appreciated. As you know, throughout the trial, all information will remain confidential to you and to Bord Gáis Energy.

Bord Gáis Energy

National Smart Meter Plan

Active User Trial Period: 1st June 2010 to 31st May 2011 - What you have to do

The Active User Period will run from 1st June 2010 to 31st May 2011. From this time different groups of customers will be asked to test various energy efficiency initiatives, such as a more detailed billing, a different tariff, an in-home display monitoring gas consumption or a monthly bill. Some customers may be asked to participate in a group, where they just continue using gas as normal. We will write to you after the survey has been completed to tell you which group you are in and to explain what we would like you to do. We will also outline next steps.

If you have any queries on any of the above please contact us on [supplier number] or email us at [supplier number].

Yours sincerely

XX
General Manager
Bord Gáis Energy

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The National Smart Meter Plan is managed by the Commission for Energy Regulation with the support of the Department of Communications, Energy & Natural Resources, Sustainable Energy Ireland, ESB Networks and the electricity and gas industry in Ireland.

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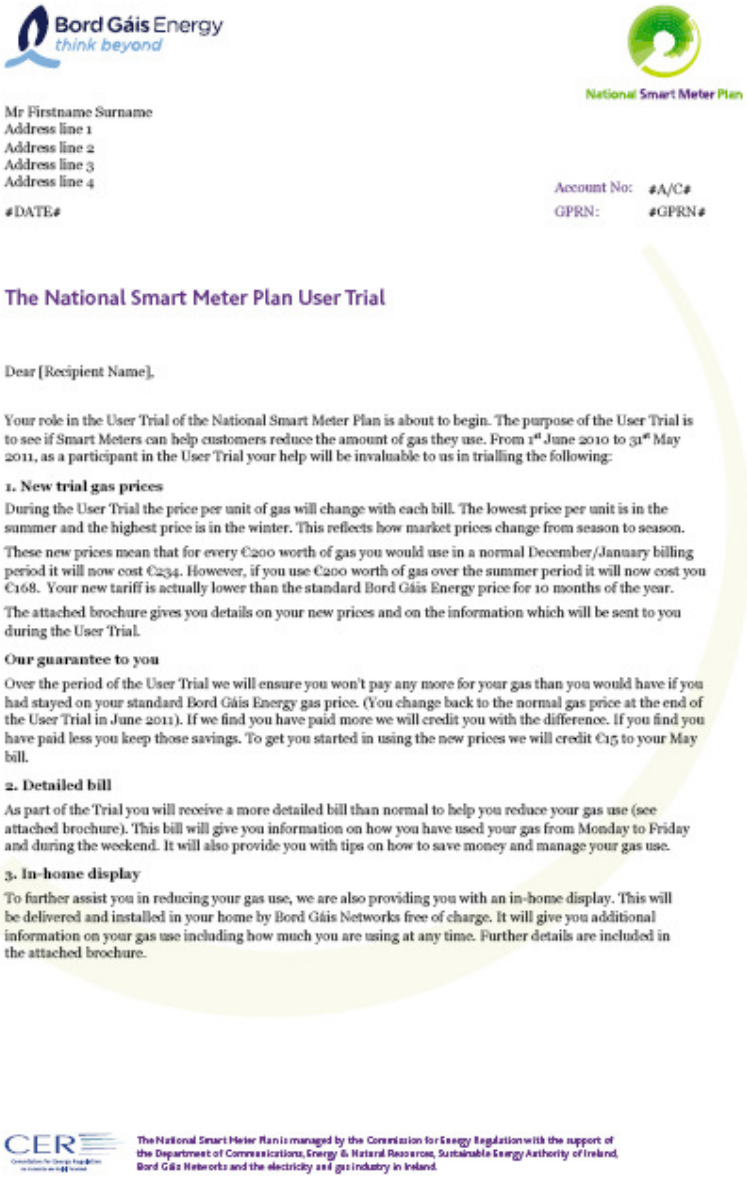
Letter to IHDD and variable tariff Stimulus Group (*content of this letter varied slightly for the other stimulus groups*)



Bord Gáis Energy
think beyond

National Smart Meter Plan

Mr Firstname Surname
Address line 1
Address line 2
Address line 3
Address line 4

#DATE#

Account No: #A/C#
GPRN: #GPRN#

The National Smart Meter Plan User Trial

Dear [Recipient Name],

Your role in the User Trial of the National Smart Meter Plan is about to begin. The purpose of the User Trial is to see if Smart Meters can help customers reduce the amount of gas they use. From 1st June 2010 to 31st May 2011, as a participant in the User Trial your help will be invaluable to us in trialling the following:

1. New trial gas prices

During the User Trial the price per unit of gas will change with each bill. The lowest price per unit is in the summer and the highest price is in the winter. This reflects how market prices change from season to season.

These new prices mean that for every €200 worth of gas you would use in a normal December/January billing period it will now cost €234. However, if you use €200 worth of gas over the summer period it will now cost you €168. Your new tariff is actually lower than the standard Bord Gáis Energy price for 10 months of the year.

The attached brochure gives you details on your new prices and on the information which will be sent to you during the User Trial.

Our guarantee to you

Over the period of the User Trial we will ensure you won't pay any more for your gas than you would have if you had stayed on your standard Bord Gáis Energy gas price. (You change back to the normal gas price at the end of the User Trial in June 2011). If we find you have paid more we will credit you with the difference. If you find you have paid less you keep those savings. To get you started in using the new prices we will credit €15 to your May bill.

2. Detailed bill

As part of the Trial you will receive a more detailed bill than normal to help you reduce your gas use (see attached brochure). This bill will give you information on how you have used your gas from Monday to Friday and during the weekend. It will also provide you with tips on how to save money and manage your gas use.

3. In-home display

To further assist you in reducing your gas use, we are also providing you with an in-home display. This will be delivered and installed in your home by Bord Gáis Networks free of charge. It will give you additional information on your gas use including how much you are using at any time. Further details are included in the attached brochure.

CER

The National Smart Meter Plan is managed by the Commission for Energy Regulation with the support of the Department of Communications, Energy & Natural Resources, Sustainable Energy Authority of Ireland, Bord Gáis Networks and the electricity and gas industry in Ireland.

What happens next?

- You will receive your in-home display between 24th May and 31st May 2010.
- From 1st June your gas will be charged at the new trial gas price.
- You will receive your first detailed bill using these new prices early in August.

What do you have to do now?

The enclosed guide contains further information on your new prices, your bill and your in-home display. From 1st June we would like you to use this additional information to assist you in reducing your gas use and being more energy aware.

Would you like more information?

We would like to thank you again for your participation in the Smart Meter User Trial and wish you every success in managing your gas use over the next twelve months. If you have any queries on any of the above, please contact us on 1850 495 500.

Yours sincerely

Sample Bord Gáis Energy Bill

your natural gas bill

Bord Gáis Energy
think beyond

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

METER NO	METER READINGS		CONVERSION		GAS USED	GPRN	AC BAND
A6B01234567891	1496	1450	46 m³	11.3051	520	0123456	B
A6B01234567891	1535	1496	39 m³	11.3338	442	0123456	B

A: Amended reading / C: Reading taken by customer / E: Estimated reading

	AMOUNT €
Previous Balance	€40.25
11 Apr 11 Payment Received – Thank You	€20.00CR
26 Apr 11 Payment Received – Thank You	€20.00CR
02 May 11 Payment Received – Thank You	€20.00CR
09 May 11 Payment Received – Thank You	€50.00CR
23 May 11 Payment Received – Thank You	€20.00CR
30 May 11 Payment Received – Thank You	€10.00CR
Total Payments	€140.00CR
Domestic Standard Rate (2 Apr 11 to 1 Jun 11)	
Standing Charge 0.164 for 61 days	€10.00
Unit Rate 0.03932 for 962 kWh	€37.83
Carbon Tax 0.00277 for 962 kWh	€2.66
Total Excluding V.A.T.	€50.49
V.A.T. @ 13.5%	€6.82
Total Including VAT	€57.31

General enquiries 1850 632 632

CREDIT BALANCE INCLUDED	PLEASE PAY BY	TOTAL €
NONE	No Amount Due	€42.44CR

Bord Gáis Eireann
Registered office: Barrington Plaza Cork
VAT Number: IE 9Y66102O

Page 1 of 2

Bord Gáis Energy

AIB Bank 40-47 Westmoreland Street, Dublin 2
Account number: 1700707 Sort code: 93-27-64 BIC: AIBKIE2D
IBAN: IE95 AIBK 9327 6417 0070 7E

BANK GIRO CREDIT TRANSFER

CASH €
CHQS €
TOTAL CASH €
CHQS NO.
TOTAL CHQS €

Customer account no.
0123456789

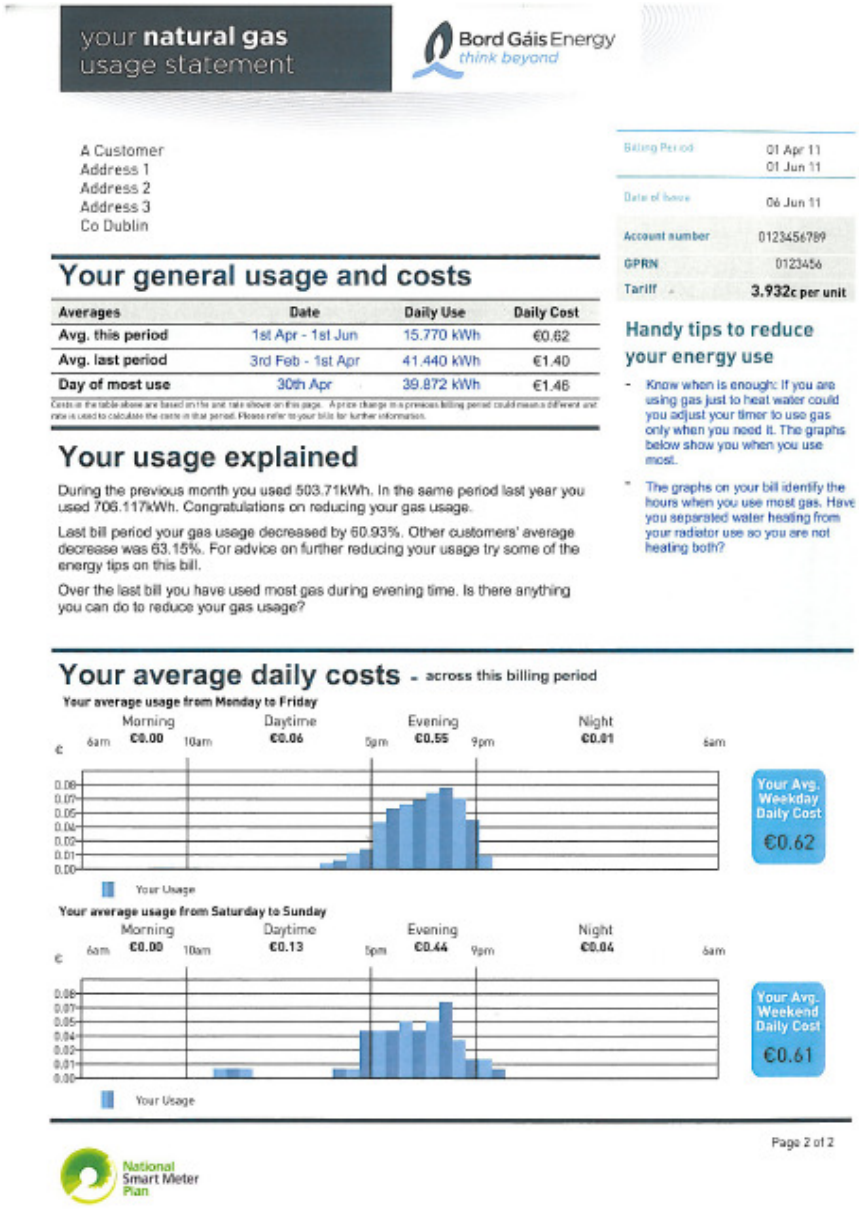
A Customer

TOTAL €

PLEASE DO NOT MARK BELOW THIS LINE

06114 101234567899 0000001 931039

Sample Bord Gáis Energy Residential Energy Usage Statement



your **natural gas** usage statement

Bord Gáis Energy *think beyond*

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

Your Avg. Weekday Daily Cost €0.62

Your average usage from Saturday to Sunday

Your Avg. Weekend Daily Cost €0.61

Page 2 of 2

National Smart Meter Plan

Sample Brochure

Your Guide to the Smart Meter User Trial

Smart Meters are the next generation of gas meters. They monitor and record how much gas you use and when you use it. They can communicate this data automatically to your gas supplier. The National Smart Meter Plan User Trial is being undertaken to understand how the use of Smart Meters can help in reducing the amount of gas customers use.

New trial gas prices

During the User Trial the price per unit of gas will change with each bill. The lowest price per unit is in the summer and the highest price is in the winter. This reflects how market prices change from season to season.

These new prices mean that for every €200 worth of gas you would use in a normal December/January billing period it will now cost €234. However, if you use €200 worth of gas over the summer period it will now cost you €165. Your new tariff is actually lower than the standard Bord Gáis Energy price for 10 months of the year.

What are the new prices?

The gas price per unit from 1st June 2010 to 31st May 2011 is set out below. These rates may be subject to change in line with Bord Gáis Energy price changes.

	June July	Aug Sept	Oct Nov	Dec Jan	Feb March	Apr May
Unit Rate excl. VAT*	3.3c	3.3c	3.8c	4.6c	3.9c	3.4c

Unit Rate until 31st May 2010 is 3.032c.

*The unit rate does not include standing charge, carbon tax or VAT.

Understanding your smart bill

During the User Trial of the National Smart Meter Plan you will receive a more detailed bill than your current one. This new bill and the information it provides will help you to identify when you are using the most gas and what you could do to reduce your use.

Meter readings

Because Smart Meters collect your usage regularly throughout the day and can be read remotely, all of the bills you receive during the User Trial will be based on actual use. This removes the need for estimated readings.

Standing charge, carbon tax and VAT

The standing charge, carbon tax and VAT remain unchanged from your previous bills.

Your bill

There are two pages in your new bill: the first page is the same as your existing gas bill.

The second page will provide you with extra information on how you are using gas from day to day and gives you tips on how you can reduce your gas usage. You can also see how you are doing compared to others in the User Trial.

Your in-home display

Your in-home display can help you in being energy aware by giving you information about your gas use and how much it is costing you.

Using the screens you can see the following information at a glance:

See how much you have used

The in-home display allows you see your costs and usage for the last week (7 days), four weeks (28 days) and recent months. You can also see your current meter reading and unit price, as well as your level of CO_2 emissions. These screens are updated with new information every half hour.

Extract from User Guide to In-Home Display Device

Extract from SME Webservice brochure

What kind of information is available online?

You can easily access a range of information on your gas account online, including:

- How much your gas has cost over the last seven days, the last month and the last year
- How much gas you have used over the last seven days, last month and last year
- How your gas use and costs change over time

Usage graphs displayed in kWh

Usage graphs displayed in €