INT 1. ECOWATT Trail in Brittany – Using Energy Responsibly

Description:
EcoWatt is a scheme set up by EDF Energy. Brittany only generates 8% of the electricity that it uses, the rest being transmitted from power plants some distance away elsewhere in France. Approximately 28% of homes in Brittany are heated by electricity. During winter peak periods there is an increased risk of power cuts. Based on a voluntary approach this scheme aims to raise awareness of issues surrounding balancing the power system, and encourage consumers to alter their energy use during periods of peak demand.

Initially 9,400 customers signed up to the scheme however evidence suggests that reaction to the nine alerts issues over the winter 2008/9 was more widespread than just these participants. The following year 18,500 customers had registered via the internet. Eleven alerts were issued. By March 2012, 50,000 households had enrolled in the scheme with an estimated reduction in consumption during events of between 2 and 3%.

Customers involved:
Domestic, businesses and community organizations are involved in this scheme.

Technologies deployed:
The internet, SMS messaging, mobile phone apps, widget, RSS feeds and email are deployed to inform participants who have signed up to the scheme about alerts.

Customer offerings:
No rewards are offered however the threat is that without action blackouts are possible. Inhabitants of Brittany do not want a new nuclear power station built on the peninsula.

Customer engagement approach:
Knowledge of the scheme has spread via channels such as the internet, word of mouth, social media and news reports.

Smart metering:
Smart Meters have not been installed as part of this initiative.

Tariff:
No tariff was used for this program

Remote / Automatic Control of Appliances:
No remote or automatic appliance control was used for this program

Information and Data:
No information or data sharing was used in this trial
Advice / Customer Engagement:

Information about the scheme is available via the internet. A dedicated web-site provides the facility for participants to sign up to be sent notifications of any alerts. This web site provides energy saving advice.

Results:

Demand reduced by between 1 – 1.5%, the equivalent of a city of 60,000 inhabitants, increasing to between 2 - 3% during winter 2011/12.

Key lessons learnt (to date):

- Brittany has a strong sense of community which has helped motivate participation;
- The program explained the reasons why Brittany was particularly at risk of black outs and asked for assistance via this scheme to overcome the issue;
- There was also strong opposition in Brittany to building a nuclear power station to overcome these problems.

Major barriers encountered (to date):

- Different attitude towards electricity and the electricity industry in other countries would make this scheme difficult to replicate.

References:

Further information on this project can be found at:

http://www.ecowatt-bretagne.fr/
http://www.lagazettedescommunes.com/105716/bretagne-ecowatt-a-ecrire-jusqua-3-de-la-demande-electrique-lors-des-pics-indique-rte/
INT 2. SDG&E Reduce Your Use Day

Description:
The “Reduce Your Use” scheme was introduced to motivate householders in the San Diego area to reduce their electricity consumption at times of peak consumption (between 11am and 6pm). These periods are typically on the hottest days of the summer when the Air Conditioning load is high. The scheme has been necessitated by the closure of a nuclear power station. Householders sign up to the scheme, which has no penalties attached. For every kilowatt hour saved a credit is assigned to the household’s next bill. Alerts are issued the day preceding the event. Historical electricity consumption data is used to calculate if any saving has been achieved.

Customers involved:
Households and businesses can sign up to this scheme

Technologies deployed:
Internet, Smart Meters, emails and SMS messaging

Customer offerings:
There are no penalties involved with this scheme. Customers who successfully use less electricity during the Reduce Your Use periods receive a credit against their next bill.

Customer engagement approach:
No information is available on this.

Smart metering:
Smart Meters have already been installed in this area. Historical data from them is used to calculate an amount that householders must consume less than in order to earn rewards. This information is available to householders via their internet account.

Tariff:
There are no tariffs associated with this scheme however householders can save $.75 or $1.25 per kWh saved (the higher sum is for those who have enabling technology).

Remote / Automatic Control of Appliances:
Customers who already have home automation received a larger rebate per kWh reduction in energy use however having technology is not a requirement for involvement.

Information and Data:
Participants are able to access information about the amount of energy they have saved via their online account.
Advice / Customer Engagement:
Advice on effective ways to save energy is available on the schemes web site.

Results:
In one locality 78% of SDE&G customers earned money back against their next bill resulting in a total rebate in the area of $205,000.
On average householders saved $2.50 per event and $20 over the year.

Key lessons learnt (to date):

Major barriers encountered (to date):

References:
Further information on this project can be found at:

http://www.sdge.com/save-money/reduce-your-use/reduce-your-use-rewards


http://carlsbad.patch.com/articles/carlsbad-residents-sdge-bills-reduce-your-use

INT 3.  PG&E SmartRate

Description:

PG&E operate three time-based tariffs (two open to new enrolment as of May 2012), as follows:

- **SmartRate™**: an overlay on other available tariffs which has a high price during the peak period on event days, referred to as SmartDays, and slightly lower prices at all other times during the summer. Prices vary by time of day only on SmartDays. Enrolment was halted for a period during the well-publicised legal case involving PG&E’s roll-out of Smart Meters, but was allowed to continue from November 2011.
- **Rate E7**: a two period, static ToU rate with a peak period from 12 PM to 6PM. This rate is now closed to new enrolment; and
- **Rate E6**: a three period ToU rate, typically joined by customers with solar PV installations. The rates are as follows:
  - Summer Weekdays: Peak period 1 to 7PM, partial peak 10AM to 1PM and 7 to 9PM. Off-peak prices at all other times.
  - Summer Weekends: Partial peak 5 to 8PM. Off-peak prices at all other times.
  - Winter Weekdays: Partial peak 5 to 8PM. Off-peak prices at all other times.
  - Winter Weekends: Off-peak prices at all times.

These are part of the array of tariffs offered by PG&E and are not part of a trial. E7 was first offered in 1986 and was targeted at customers with air conditioning. Enrolment continued until 1996, when a new meter type was required (at a cost of $200) to join the tariff.

SmartRate can be used in conjunction with SmartAC- a program in which customers receive a payment from PG&E in return for allowing PG&E to remotely turn down their air conditioner at times of high system load (either through direct control of the air conditioning unit, or via the thermostat). Further details are available via Case Study INT11.

Results from the scheme appear to be published yearly, and the 2011 results are described within this template.

Customers involved:

SmartRate had 23,000 customers enrolled in 2011; approximately 4,800 of these were also enrolled in the SmartAC program. Around 50% of SmartRate customers are ‘low income’ customers (CARE (California Alternate Rates for Energy- a program through which low-income homes receive lower rates than non-CARE customers)), compared to 25% of the general PG&E population. Customers enrolled on the SmartRate program are more likely to be located in hotter regions than the general population. Customers choose to opt-in to the SmartRate tariff and are given bill protection for the first year.

73,700 and 14,100 customers are enrolled on E7 and E6 respectively. Evaluation has been carried out for E7 customers without their own generation only. E7 customers differ from the general population: they generally have higher consumption, a smaller share of customers is on low incomes (CARE) and a higher share is in ‘all-electric’ households. Customers choose to opt-in to the E7 tariff. It is therefore not possible to say that the price responsiveness of the E7 customers could be extrapolated to the general population. The attrition (drop-out) rate for E7 customers is 3.8% per year.

89% of E6 customers are net metered (i.e. have their own generation) compared to 1% of the general PG&E population. 4% are CARE customers (compared to 28% of the general population). Customers on both E6 and E7 are much less likely to have Smart Meters installed than those on the flat rate tariff.
Technologies deployed:

Some customers within the SmartRate program have air-conditioning, and some of these consumers also participate in the SmartAC program. The load impact of SmartDays has been analysed against the probability that the household has air conditioning (for those customers who are not also enrolled on the SmartAC program). The average impact for customers with a greater than 75% probability of owning an air conditioning unit is 0.28kW, compared to 0.07kW for those with only a 0 to 25% probability. Although the response from customers who are unlikely to own air conditioning is low, it does demonstrate that a response can be provided in the absence of this technology.

Customer offerings:

See ‘Tariff’ for details of tariffs offered to customers.

Customer engagement approach:

Customers opt-in to the program, but marketing for the program has previously focused on specific geographic regions. They are offered bill protection for the first year.

The published information does not indicate to what extent the program was used to try and create any enthusiasm around Smart Meters/ the ‘Smart Grid’.

Smart metering:

Customers who are part of the SmartRate program must have a Smart Meter installed. Although not specified within the PG&E website it is assumed that the Smart Meter is used to enable hourly billing and therefore accurate payment during Smart Days.

Tariff:

SmartRate™

- A critical peak pricing tariff which is an overlay to the customers otherwise applicable tariff (OAT). The SmartRate consists of an incremental charge that applies during peak periods on SmartDays (a maximum of 15 days per year) and a per kilowatt hour credit that applies for all hours from June to September. The additional peak period charge on SmartDays is $0.60/kWh (around 8 times the Tier 1 E1 rate on normal days). The credit is around $0.03/kWh, with an additional credit of $0.01/kWh to Tier 3 and high usage residential customers.
- Customers are notified a day ahead of a SmartDay based on the weather forecast by a method of their choosing (email, phone etc). Customers can chose to receive no notification. Roughly 15% of customers either chose not to be notified or provided information which was initially incorrect or became outdated. The impact of these notifications is described in ‘Advice/ Customer Engagement’ (below).
- Customers are only exposed to ToU pricing on SmartDays (apart from a very small (25 in 2011) number of customers who OAT is ToU).
- Customers are given ‘bill protection’ for the first year. This was designed to “address the risk aversion that pilot programs and market research have shown to be a significant barrier to enrolling customers onto dynamic rates”.
- The retention rate for customers on the SmartRate program is relatively high (2.3% drop-out due to de-enrollment in 2011). Non-CARE customers de-enroll at a much higher rate than CARE customers.
**E7 and E6**

Tariff information is summarised in the ‘Description’ (above) and shown graphically below.

- Customers choose to opt-in to the tariffs (although E7 is now closed to new applicants)

**Remote / Automatic Control of Appliances:**

Remote/ automatic control of appliances only applies when the SmartRate program is combined with the SmartAC program, which is described under Case Study 16.

**Information and Data Sharing:**

Not applicable for this initiative.

**Advice / Customer Engagement:**

Customers receive notifications of each SmartDay by up to four means (email addresses, phone numbers). Some customers elect not to be notified of SmartDays, or provided invalid information. Analysis of the impact of SmartDays has shown that customers who receive no notification have an average impact of 0.02kW (compared to an average of 0.25kW). Perhaps more surprisingly, the impact increases with increasingly number of notifications (0.13kW for one notification, 0.49kW for four notifications). This shows the value of customer advice in conjunction with tariff information. It may be that customers who are most keen to receive notifications (and therefore provide multiple phone numbers and email addresses) are those who are more likely to actively engage in the program anyway.
Results:

SmartRate Program

- Average load reduction per event per household in 2011 was 0.24kW (similar to 2010 results) and the aggregate load reduction per event was 5.6MW. The results were highly variable across ‘Local Capacity Areas’ (a transmission constrained load pocket designated by the California Independent System Operator (CAISO)). These differences can be attributed to differences in climate/ geography between the areas.
- The average load reduction for CARE customers in 2011 was 39% as large as for non-CARE customers. This is despite a tendency for non-CARE customers to be located in cooler areas, and for CARE customers to be more likely to have air conditioning which has been shown to be a good enabling technology to take part in the SmartRate program.
- Event notification is highly correlated with load reductions, even among customers notified more than once.
- Air conditioning ownership is a strong driver of demand response.
- Customers that are enrolled in both SmartRate and SmartAC provide significantly greater demand response than those who are SmartRate alone.
- The vast majority of customers who sign up for SmartRate stay on the program.
- Between June and September 2011, 79% of SmartRate customers saved money compared with their otherwise applicable tariff.
- ‘High Responders’ (i.e. those providing the greatest response) are typically non-CARE customers, located in hot areas with air conditioning and high monthly usage.
- The size of the impact does not appear to change substantially depending on the number of summers a customer has participated in the program for.

E7 Static Time of Use Tariff

- During the peak price period in July from 12PM to 6PM customers use an average of 14.3% less electricity compared to the reference load.
- Customers are observed to decrease load during the peak period in the hottest month, with load increasing again (to levels similar to the reference group) immediately following the peak period (6 to 10 PM).
- During the summer (when there is the greatest difference in prices for E7 customers) the average load reduction was 0.27kW, these demand reductions coincide almost exactly with the peak pricing period (12 to 6PM). During winter, customers provided smaller, statistically insignificant demand reductions when prices are lower. On average E7 customers demand was 0.08kW lower than that of the control group during winter peak period hours. The average weekday load reduction across the whole year was 0.11kW (9.1%).
- Over the course of the year, 96% of customers on E7 had a lower average bill than they would have done with the same consumption profile on the E1 tariff (standard flat rate tariff), with an average saving of 11.6%.

Key lessons learnt (to date):

- Critical Peak Pricing and static ToU tariffs with residential customers can provide load reduction during peak periods.
- Enabling technology (particularly large single loads such as air conditioning) contributes substantially to the size of response provided.
- Customers are willing to sign up to such a scheme and drop-out rates are relatively low.
- However, not all customers on the program provided a response, some sign up but do not opt to receive notifications of events and therefore provided little demand response.
- Specific information regarding customer experiences is not provided but the low drop-out rate would suggest that customers are generally happy.
Major barriers encountered (to date):

- Barriers specifically related to this scheme are not described within the reference document. However, they have provided bill protection for customers on the SmartRate program to overcome the perceived barrier of customers’ concern regarding the risk of paying more under the program.

References:

2011 Load Impact Evaluation of PG&E’s Company’s Residential Time Based Pricing Programs. Available from:
Accessed 24/10/2012
INT 4. Florida Power and Light Residential Load Control Pilot Project

Description:
This pilot was established to evaluate the technical and economic benefits of a two-way communicating programmable thermostat technology to enhance Florida Power and Light’s (FPL) existing switch-based direct load control program, On Call. The technology provided FPL with enhanced capability to monitor and control heating and cooling during system-critical periods. Participants had remote internet access to thermostats for programming to save energy and to monitor the temperature of their homes, and to override FPL curtailments.

Customers involved:
The pilot involved 400 residential customers. All the customers involved in the trial were from Broward County in south Florida. They lived in detached properties, inhabited by one family and had central air conditioning and heating appliances.

Technologies deployed:
The pilot deployed programmable thermostats that could also be controlled by FLP. Householders could control their heating technology and monitor the temperature of their home remotely via the internet. The internet function could also be used to override any FLP curtailments.

Customer offerings:
There were no commercial offering involved in this trial.

Customer engagement approach:
Two methods of recruiting participants in the trial were used in order to compare the appeal of this new product with the existing ‘On Call’ technology.

A group of 1000 existing On Call participants were given the opportunity to switch to the new technology in lieu of the credits that they would receive for taking part in the existing scheme. 2.2% of these customers switched.

The remainder of the trial participants were recruited from a direct mail shot to householders who would have been eligible to join the On Call scheme. They were offered either the new technology, or the existing On Call credit scheme. There was a 16% greater increase in response rate to the mail shot when the new technology was offered. 59% of respondents chose the On Call scheme and 41% chose the new thermostat scheme. On-going support was available from a free-phone line, the number of which was on the thermostat and the program web site.

Statistical analysis suggests that the new technology was statistically more appealing than the existing On Call scheme.

Smart metering:
Smart meters were not installed as part of this trial. Air conditioner energy consumption data was gathered and transmitted by the thermostat.

Tariff:
This trial did not require any trial intervention.
Remote / Automatic Control of Appliances:

FPL was able monitor and control heating and cooling during system critical period. Householders retained an override function, giving them the ability to override any curtailment.

One participant who left the trial blamed curtailments for their decision.

The override rate by event type is shown in the table below.

<table>
<thead>
<tr>
<th>Event type</th>
<th>Number of events in average</th>
<th>Average cumulative override rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>All events: 8 summer and 1 winter</td>
<td>9</td>
<td>0.96%</td>
</tr>
<tr>
<td>Typical summer peak days, 50% cycle</td>
<td>4</td>
<td>1.07%</td>
</tr>
<tr>
<td>Peak hour overrides for typical summer peak days, 50% cycle</td>
<td>4</td>
<td>0.18%</td>
</tr>
<tr>
<td>Winter, 50% cycle</td>
<td>1</td>
<td>2.28%</td>
</tr>
</tbody>
</table>

Information and Data Sharing:

This trial did not involve sharing data.

Advice / Customer Engagement:

Participants were encouraged to program their thermostats. They were provided with information on three occasions telling them how this could be done.

1) by brochure at the time that the thermostat was installed;
2) by email following installation
3) by email in Spring 2008.

Fifty six percent of trial participants programmed their thermostats.

Results:

- Customer satisfaction with the new thermostat is shown in the table below:

<table>
<thead>
<tr>
<th></th>
<th>June 2008 (before events)</th>
<th>June 200 (after 9 events)</th>
<th>Test of statistical difference (t-test, 90% confidence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall satisfaction with thermostat program, “Very satisfied”</td>
<td>71%</td>
<td>68%</td>
<td>No difference</td>
</tr>
<tr>
<td></td>
<td>59 responses</td>
<td>60 responses</td>
<td></td>
</tr>
<tr>
<td>Would “definitely” recommend program to a friend</td>
<td>79%</td>
<td>73%</td>
<td>No difference</td>
</tr>
<tr>
<td></td>
<td>63 responses</td>
<td>62 responses</td>
<td></td>
</tr>
</tbody>
</table>
- Impact reduction customer overrides averaged less than 1%;
- Thermostat summer peak hour reductions, net of overrides, averages 0.93kW per participant at the meter;
- Thermostat winter peak hour reduction, net of overrides, averaged 0.91kW per participant at the meter;
- 4.75% of participants dropped out of the trial;

**Key lessons learnt (to date):**

- Thermostat-based load control requires much more customer support than the ‘On Call’ program;
- The thermostat technology was more attractive to potential customers than the ‘On Call’ system

**Major barriers encountered (to date):**

- The new technology failed the post-trial statistical cost effectiveness test.
- Programmers uses 12% more annual cooling energy than none programmers;

**References:**

More information about the trial can be found at:

INT 5. Electricity Customer Behaviour Trial

Description:
This Customer Behaviour Trial (CBT) is part of the Irish National Smart Meter Plan which is a commitment in the Irish Government’s Energy Policy Framework. The objective of the CBT was to discover the potential for Smart Meter technology in conjunction with Time-of-Use tariffs to change consumer behaviour in terms of a reduction of peak load and overall electricity use.

Customers involved:
5,375 domestic customers initially recruited via a phased ‘opt-in’ model, representative of the national profile. 723 SME were enrolled onto the trial. Participation was limited to:

- Customers of Electricity Ireland (this was the only electricity supplier in Ireland at the start of the trial, however supply competition was opened up during the trial. Any participant switching from Electricity Ireland during the trial was deemed to have dropped out of the trial);
- Consumers had to have been at their current address for over a year. This restriction was put in place to remove those most likely to move during the Trial period, and therefore reduce attrition;
- Consumers who had opted out of sales and marketing contact from Electricity Ireland;
- Consumers who used Night Save rate electricity and had therefore already modified their electricity consumption;
- Consumers classified as in payment arrears or liable to being disconnected.

Technologies deployed:
Smart Meters were installed in all participant households. From the 1st July to 31st December 2009 data was collected on a half hourly period and used for benchmarking. The test period lasted from 1st January to 31st December 2010. Some participants also tested an electricity monitor. The purpose of the technology aspect of this trial was to:

- To learn about providing supporting systems, testing and deployment of smart meters;
- To assess the performance of different Smart Meter systems and communication technologies, and especially their performance in the context of the Irish environment;
- To identify risks and issues that should be considered in the context of a full Smart Meter roll out.

The number and combinations of customer installations were as follows:

- Metering system with GPRS communications – 5,800 single phase and 500 three phase meter;
- Metering system with PLC communication – 1,100 single phase meters for customers in Limerick and Ennis (mix of urban and village locations);
- Metering system with 2.4GHz Wireless mesh – 1,591 meters in Cork City and 690 in rural County Cork.

Customer offerings:
The CBT also wanted to discover if there was a “Tipping Point” when the price of electricity would significantly alter usage.

A control group was billed against their normal electricity supplier tariff and saw no changes to their bills. They received none of the DSM stimuli and were requested to continue using their electricity as normal.

The Time of Use tariffs were designed:
- To be neutral in comparison with a standard Electric Ireland tariff ensuring that the ‘average’ participant who did not alter their consumption pattern would not be penalised;
- The base Time of Use tariff reflects the costs of transmitting, distributing, generating and supplying as per standard tariffs;
- The time of use system bands were based on system demand peaks;
- Tariffs would be based on cost inputs used in the 2009/10 regulated tariffs.

All participants testing time-of-use tariffs were guaranteed that they were guaranteed that they would not pay more for their electricity than if they had been on a normal Electricity Ireland tariff. All participants received a balancing credit at the end of each benchmarking period. Those who had incurred costs above this average were recompensed on a case by case basis.

A small Prepayment User trial was also undertaken to test whether a Smart Meter could be used as a Prepayment Meter. This trial has sixty participants, mainly staff members from Electricity Ireland.

Customer engagement approach:

5,375 participants were recruited following a voluntary ‘opt-in’ model using a tear off slip. The average response rate was 30%. In order for the participants to be representative of the national population, a phased recruitment process was implemented. Once recruitment was completed the consumers who had volunteered was compared to those who had not responded in order to check and confirm for national representivity.

Smart metering:

The smart meter was used to collect half hourly data for billing. Three communication systems were trialled: power-line carrier, wireless LAN and point to point wireless. The following observations were made.

- Currently PLC could deliver monthly readings however there was issues with reliable daily data collection and on-demand tasks. Outside ideal network conditions the reliability deteriorated.
- The GPRS system worked well with good availability however scaling the system to large numbers may be an issue. This would be useful as a short term solution for a small number of meters however there may be issues with it in the long term;
- The 2.4GHz mesh system worked in urban areas however performance was disappointing in rural areas. This was largely because of European Regulatory limitations on the signal power at this licence exempt frequency.

Management of access to install indoor meters was a key deployment issue, but it benefited from time spent developing a plug and play meter design. Technical difficulties were encountered in 3% installations. Time and resources to deal with these issues must be factored into any future roll out.

Tariff:

Once recruited, participants were allocated to a test group, or the control group. Allocation was based on achieving an even profile in each experimental cell across demographic, behavioural and attitudinal perspectives. Data from the benchmarking period and the pre-trial survey was used to achieve this.
Table 1: Domestic Time of Use Tariff

<table>
<thead>
<tr>
<th>Tariff</th>
<th>Night (23.00-08.00)</th>
<th>Day (08.00-17.00)</th>
<th>Peak (17.00-19.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12.00</td>
<td>14.00</td>
<td>20.00</td>
</tr>
<tr>
<td>B</td>
<td>11.00</td>
<td>13.50</td>
<td>26.00</td>
</tr>
<tr>
<td>C</td>
<td>10.00</td>
<td>13.00</td>
<td>32.00</td>
</tr>
<tr>
<td>D</td>
<td>9.00</td>
<td>12.50</td>
<td>38.00</td>
</tr>
</tbody>
</table>

Table 2: Domestic Time of Use Tariff (Weekend tariff)

<table>
<thead>
<tr>
<th>Day</th>
<th>Night (23.00-08.00)</th>
<th>Day (08.00-17.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday to Friday</td>
<td>10.00</td>
<td>14.00</td>
</tr>
<tr>
<td>Saturday &amp; Sunday</td>
<td>10.00</td>
<td>10.00</td>
</tr>
</tbody>
</table>

Table 3: SME Time of Use Tariff

<table>
<thead>
<tr>
<th>Electric Ireland</th>
<th>Night (23.00-08.00)</th>
<th>Day (08.00-17.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tariff A</td>
<td>14.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Tariff B</td>
<td>7.50</td>
<td>16.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bord Gáis Energy</th>
<th>Night (23.00-08.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro Cents per kWh</td>
<td>Tariff applied varied by individual participant</td>
</tr>
</tbody>
</table>

Table 4: Residential Matrix allocation as of 13 November 2009

<table>
<thead>
<tr>
<th>Tariff</th>
<th>Bi-monthly bill and energy usage statement</th>
<th>Monthly bill, and energy usage statement</th>
<th>Bi-monthly bill, energy usage statement and electricity Monitor</th>
<th>Bi-monthly bill, energy use statement plus Overall Load Reduction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>342</td>
<td>342</td>
<td>342</td>
<td>342</td>
<td>1,368</td>
</tr>
<tr>
<td>B</td>
<td>127</td>
<td>129</td>
<td>127</td>
<td>128</td>
<td>511</td>
</tr>
<tr>
<td>C</td>
<td>342</td>
<td>342</td>
<td>343</td>
<td>343</td>
<td>1,370</td>
</tr>
<tr>
<td>D</td>
<td>127</td>
<td>129</td>
<td>126</td>
<td>127</td>
<td>509</td>
</tr>
<tr>
<td>Weekend</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Control Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,170</td>
</tr>
<tr>
<td></td>
<td>938</td>
<td>942</td>
<td>938</td>
<td>940</td>
<td>5,028</td>
</tr>
</tbody>
</table>

Participants also received a fridge magnet and sticker. The fridge magnet displayed the time bands and costs, customized for each tariff group.
Remote / Automatic Control of Appliances:
The trial did not include any elements of remote or automated control of householders appliances.

Information and Data Sharing:
There was no information sharing element to this trial.

Advice / Customer Engagement:
A decision was made that cooking and oven use would be excluded from any communication about energy reduction or peak shifting in order to avoid any sensitivity about prescribing when people should cook meals.

Both the Test and Control groups were exposed to national energy efficiency campaigns that were being run by various organisations at the time.

All the Test groups received a Fridge magnet, tailored to their time-of-use tariff, showing the different time bands

Results (Domestic):
- Time of Use tariffs and DSM stimuli are found to reduce overall electricity usage by 2.5% and peak usage by 8.8%;
- The combination of bi-monthly bills, energy usage statement and electricity monitor is found to be the most effective combination of stimuli, reducing peak usage by 11.3%;
- Overall energy reduction is linked to the level of usage – high consumers tended to deliver the greatest reduction in usage;
- Analysis suggests the shifting of load from peak to post-peak and in general to night usage from peak;
- No single tariff group in combination with DSM stimuli was more effective than others;
- The peak and overall load reductions detected for all the stimuli proved to be statistically significant apart from the overall load reduction for the bi-monthly billing and detailed energy statement stimulus, although the peak load reduction achieved for this stimulus was statistically significant;
- The data from the trial proved no evidence of a Tipping point – peak usage was estimated to be highly inelastic relative to price.

Results (SME):
- Time of Use tariffs and DSM reduced overall usage by 0.3% and peak usage by 2.2%. Neither result was statistically significant;
- There was no tariff, DSM stimulus or tariff and DSM stimulus group that reduced overall electricity use or peak usage by a statistically significant amount;

Key lessons learnt (to date) (domestic):
- Participant adapted their usage to the tariffs. 82% participants made some changes to the way that they use electricity with 74% stating that their household made major changes;
- The fridge magnet and stickers were found to be useful by participants, achieving 80% recall and 75% found the fridge magnet useful;
- The electricity monitor was deemed an effective support to achieving peak and overall electricity reduction;
- The trial succeeded in making participants more aware of their energy usage;
Key lessons learnt (to date) (SME):

- Tariffs were regarded as effective supporting overall energy usage and reduced peak usage. 71% stated that peak cost forced them to attempt to reduce the usage at this time;
- Participants had a higher level of regular monitoring of their electricity usage with an increased likelihood of trying to identify ways to reduce usage;
- The electricity monitor was found to be an effective tool to reducing overall and peak electricity use;
- Among those participants who achieved an overall load reduction, the reduction was 8.51% on average, and amongst those who achieved a peak load reduction, the peak reduction was 10.25% on average.

Major barriers encountered (to date) (domestic):

- Linking behaviour change to bill reduction proved a barrier to peak load reduction. This may be difficult to address because of exaggerated saving expectations;
- The Overall Load Reduction incentive was not well remembered;
- Participants were reluctant to shift usage to night time because of safety concerns and convenience;
- The Trial did not provoke any secondary benefits such as increased awareness of general energy efficiency or investment in energy efficiency products for the home;

Major barriers encountered (to date) (SME):

- The main barrier to reduction was the perception that it was not possible to move usage to other times
- The web-site information was poorly-used;

References

Further information on this project can be found at:

INT 6. PG&E SmartAC Program

Description:

PG&E operate the SmartAC program with residential and small/medium customers. The program involves the installation of programmable communicating thermostats (PCTs) and/or switches in customers’ homes with central air conditioning (CAC) units. When a SmartAC event is called, the control devices limit the duty cycles of CAC units or adjust thermostat temperature settings, reducing demand.

SmartAC events can be called in emergency situations between May 1st and October 31st for six hours or less, to a total of 100 hours per year. The results discussed below are for summer 2011. During this period the system was only used for test purposes. The program has run from 2008 onwards.

Customers involved:

In 2011 the program involved 146,000 residential and 6,200 small/medium business customers. This equated to 161,484 controlled devices in residential properties and 11,533 devices in business premises.

Technologies deployed:

The results for 2011 focus on the control of air conditioning units either directly through switches, or via a thermostat. The program website suggests that customers with heat pumps would also be eligible to join the program.

The program uses two switches working directly with air conditioning units, LCR5000 and LCR5200 via the use of two different algorithms:

- 50% simple cycling: the device has its duty cycle limited to run no more than 50% of the time.
- 50% TrueCycle 2: limited to run no more than 50% of a baseline value, and so is limited to ensure the unit uses only 50% of the load they would have done otherwise.

It also uses UtilityProPCTs under simple and TrueCycle cycling and ExpressStat PCTs with simple cycling only, or by adjusting the temperature set point. For residential customers this temperature adjustment is 2 degrees in the first hour, and 1 degree in each of the following two event hours. For business customers the temperature adjustment is 1 degree in each of the first three event hours. The majority of technology was controlled under the TrueCycle2 algorithm.

In residential properties, 84% of controlled devices were switches for air-conditioning, and 16% were programmable thermostats. In business properties, 90% of controlled devices were thermostats and only 10% were switches for air-conditioning units.

Customer offerings:

The installation of equipment to participate in the SmartAC program is provided free of charge and customers are provided with free technical support. Customers are able to opt-out of participating in an event either via the internet or telephone.

A financial reward is not offered for participating in SmartAC only (i.e. when not used with the SmartRate program described under Case Study 6).

The benefits of participating in the program are summarised for prospective program members via the PG&E website as follows:

- Free technical support of customers’ air conditioning systems during their participation in the scheme. Technicians will repair any problems relating to the SmartAC device.
The benefit for the community is highlighted, “You reduce the likelihood of power outages and help the environment—all without sacrificing comfort or control.”

The benefits for the environment are also summarised, “By generating less electricity from fossil fuel plants during peak periods, fewer greenhouse gases are produced and that means cleaner air for all of us.”

Customer engagement approach:
Details of the recruitment methodology are not given within the literature reviewed. Information regarding the program is provided on the PG&E website. It is not known whether direct marketing of the scheme to customers (e.g. via mailshots) has taken place.

Smart metering:
The eligibility criteria for joining the scheme does not include a requirement to have a Smart Meter installed. As the technology does not rely on communications via the Smart Meter and does not require billing information it would appear that the scheme could operate effectively without Smart Meters.

Smart Meter data has been used for residential customers to allow analysis of data from the 2011 program. For business properties this approach was not possible and so data from the CAC data logger was utilised.

Tariff:
Some customers on the SmartAC program also take part in the SmartRate program. An analysis has been undertaken of the benefits of ‘dual enrolment’. The results are summarised in ‘Results’ below.

Remote / Automatic Control of Appliances:
- The program involves the automatic control of air conditioning units and thermostats.
- Customers are able to opt-out of participating in any particular event and are provided with free technical support.
- Residential standard cycling strategy in 2011 was 50% TrueCycle2 for switches or UtilityProPCTs and 50% simple cycling for customers with ExpressStat PCTs. This led to an increased size of response relative to a more simple switching strategy in 2010.
- Small/Medium business standard cycling strategy in 2011 was 33% for TrueCycle 2 switches and PCTs. These control strategies were improved between 2010 and 2011 and this resulted in an increase in load reduction of 70% and 120% for residential and business customers respectively.

Information and Data Sharing:
Not applicable.

Advice / Customer Engagement:
Not applicable.

Results:
- Residential Customers have an estimated impact of 0.50kW per event (compared to a reference load of 2.30kW)- a load reduction of 22%.
- Controlling residential air conditioning units directly (via CAC switches) provided nearly twice the impact of controlling thermostats, with average residential impacts per device of 0.32kW and 0.54kW for thermostats and CAC switches respectively.
- Residential customers with higher reference consumption of electricity were shown to provide a greater impact than those with lower reference consumption. The average per customer per event impact for customers in the top 10% of consumption is 0.85kW, compared to 0.19kW for customers in the bottom 10% of consumption.
- For residential customers who are enrolled in both SmartAC and SmartRate the control devices are activated for both event types. Analysis of the impacts for dually enrolled customers and those on SmartRate or SmartAC only is shown below:
  - Average Impact for SmartAC only customers: 0.58kW
  - Average Impact for SmartRate only customers: 0.33kW
  - Average Impact for Dually-Enrolled customers: 0.68kW
- 1,000 residential customers who took part in a two hour test event did not experience statistically significant more discomfort than a control group of customers who did not take part in an event. This result was replicated for small/medium business customers.
- The mean impact for a residential customer for five and two hours events were 0.65kW and 0.61kW respectively. This demonstrates that the size of response is not adversely affected if a longer event is necessary. The ‘snapback’ demand following the end of an event is also roughly the same (0.28kW for five hours, 0.26kW for two hours).
- Small/Medium Business customers have an estimated impact of 0.29kW per event (compared to a reference load of 1.71kW) - a load reduction of 17%. The size of impact was not influenced by the type of technology (controlled air-conditioning or thermostat).

**Key lessons learnt (to date):**

- Analysis of the data shows that residential multi-device properties appear to provide no more load impact per premise than single-device properties. Installing multiple devices per premises increases costs (due to additional equipment and installation time) without any further benefit. Conversely, business multi-device properties appear to provide roughly the same amount of impact per device as single device properties and are therefore most cost efficient as they only require one visit by a technician to install equipment and provide maintenance. It is suggested that the difference between residential and business customers is due to the higher likelihood that business customers operate multiple air conditioning units at once time.
- Customer satisfaction with SmartAC program is generally high - customers who were asked to rate “how satisfied they were with the program overall” on a scale of 1 to 10 (1 being “Very Dissatisfied” and 10 being “Very Satisfied”). The mean scores among residential and business customers were 8.0 and 7.7 respectively.
- The following recommendations were made as a result of the 2011 review of the program:
  - Concentrating recruitment of customers to those with particularly high summer energy usage (estimated to increase per customer load reduction by 50%)
  - Further improvements in device communications.

**Major barriers encountered (to date):**

Some technical communications issued were experienced in contacting the switches to ensure a response for each test event. This has been improved via the use of a new algorithm which attempts to contact the device every half hour, rather than once only.

No barriers in relation to customer experiences/engagement are identified within the literature reviewed.
References:


INT 7.  ETSA Direct Load Control

Description:
ETSA (now SA Power Network, Distribution Network Operator in South Australia) have implemented a number of phases of trials of Direct Load Control. The main driver of this trial is to reduce peak electricity demand, particularly that from air conditioning units. The trials have taken place in three main phases (Phase 1 completed March 2006, Phase 2 during Summer 06/07 and 07/08 and a third phase in Summer 09/10), with different numbers of customers' geographies involved at each stage. The aim of the project was to investigate both the technology and customer acceptance.

The results of each stage of the trials are described below. It is not clear whether any trials are currently ongoing, although the SA Power Networks website currently states: "We are now committed to implementing our invaluable trial learning’s".

Customers involved:
The customers involved in each stage of the trials are shown below:

- Phase I (completed in March 2006): Sample size of 20 residential customers. The customers were selected from a pool of 50 in the Adelaide metropolitan area that represented a cross section of the community in terms of house type, age of house, occupants’ lifestyle, size and type of air conditioner etc.
- Phase II (completed in Summer 06/07 and 07/08): Marketing to approximately 12,000 residential and commercial premises. This resulted in 4,000 contacts from which 2,392 air conditioning units were suitable for the trial in approximately 1,570 residential and commercial locations. The total number of units used in the trial was therefore 2,392. This phase was split into two sub-phases:
  - Phase II(a): Focusing on ‘Type 1’ air conditioners from a total pool of 1,108 units.
  - Phase II(b): Focusing on ‘Type 2 and 3’ air conditioners from a total pool of 1,158 units.
- Phase III (completed Summer 09/10): 1,100 potential participants. The mix between residential and commercial premises is not stated in the literature.

Technologies deployed:
Automatic switching of air conditioning (either split or ducted refrigerated systems). The literature describes the use of a Demand Response Enabling Device (DRED or Peakbreaker) connected to the air conditioning unit in order to facilitate direct load control, via the use of an FM radio signal. Newer air conditioning units required an additional interface card.

Customer offerings:
Phase I: Customers identified based on ensuring that the sample was representative of the metropolitan area of Adelaide. The available literature does not indicate whether customers were offered any particular incentive (financial or otherwise) to participate in the trial.

Phase II: This phase was preceded by a marketing and community engagement program, “Beat the Peak” focused in an area with a significant penetration of air conditioners which are supplied by two substations which are likely to be constrained within a small number of years. Customers were offered a AUS$100 incentive to take part.

Phase III: This trial was specifically marketed to customers in a different location to Phase II. The incentive offered to customers to take part is not stated within the literature reviewed.
Customer engagement approach:

Customers were targeted according to geography in Phase II and III of the trial. The engagement approach used for Phase I is not clear. Customers in Phase II and III voluntarily opted-in to the trial. In the case of Phase II a specific marketing campaign was used to attract customers. This resulted in 47 and 16 features in local and national media respectively, with only one including negative commentary. No media disputed the demand side message, or raised issues with the use of the demand side to resolve the problem as against use of the supply side. For Phase II a direct marketing campaign in the local area was also employed via the use of direct mailshots, bus shelter advertising, large posters in shops and on the back of the local community bus and articles placed in local council newsletters. Customers were provided with a self-addressed envelope to indicate their interest via the direct mail shot, could call one of three designated call centre operators, contact a dedicated email address or contact ETSA via a registration form on their website. All customers who expressed an interest received a personal letter from ETSA thanking them for registering and were followed up with a phone call. Some of the key lessons learnt from this customer engagement are summarised in ‘Results’ (below).

The customer engagement approach used in Phase III (direct marketing, media campaign etc) is not clear from the literature reviewed.

Smart metering:

Each phase used interval meter data to determine the size of response (stored in either 15 or 30 minute intervals depending on the size of connection). Data was received using both remote connections and on site reading. It is not clear if the ‘interval meter’ referred to in the documentation was a ‘Smart Meter’ or whether it was fitted specifically for the purposes of the trial.

Tariff:

Not applicable.

Remote / Automatic Control of Appliances:

The trial investigated the use of direct load control of a variety of types of air conditioning units, in various phases. An additional switching/ interface device was installed to facilitate this direct load control. The complexity of the installation of the direct load control equipment varied according to the type of air conditioning unit, this also effected the time taken by the installer to install the equipment. One design of air conditioner required a more intrusive installation which would take longer. Approximately 6% of customers dropped out when this was explained to them.

A variety of lengths of interruptions were trialed, from as little as 8 minutes in each 30 minute period to a maximum of 25 minutes in a 60 minute period.

The literature reviewed does not state whether customers were provided with a manual override function to opt-out of any particular interruption.

Information and Data Sharing:

Not applicable.

Advice / Customer Engagement:

Not applicable.
Results:

- The use of direct load control showed a measurable decrease in demand when activated. The average reduction for the Glenelg and Mawson Lakes areas were 0.45kW and 1.34kW respectively (compared to average air conditioning ratings of 3.08kW and 5.07kW), as part of the Phase III trial. This difference is thought to be due to the geography of the regions involved.
- There was also high variability in the size of response within each geographical region.
- The Phase I trial showed a demand reduction of 17%.
- Phase I also demonstrated that it was possible to interrupt air conditioning loads without customers experiencing a reduction in comfort levels.
- The second phase of the trial (following the ‘Beat the Peak’ marketing campaign) observed a change in community attitude including a new openness to thinking about how to manage peak demand. This change in attitude extended beyond trial participants. This also demonstrated that it is possible for customers to change their view that the supply side should be entirely responsible for the balance of supply and demand. The avoidance of jargon and divorcing the discussion from pricing was believed to be important in describing to customers the difference between paying for electricity supply and paying for electricity transmission/distribution.
- The early outputs from the trial indicated that it is feasible to sustain interruptions of 15 minutes in a 30 minute period without leading to any customer complaints regarding comfort levels.
- There was a higher drop-out rates of customers when the installation required access to the home rather than a ‘garden installation’.
- When a more intrusive installation was required, customers were much more trusting when the installation was to be carried out by a representative from the manufacturer of their air conditioning system rather than a third party.

Key lessons learnt (to date):

- The marketing used prior to Phase II “demonstrated that the community values direct and simple communications that avoids technical, market and political emphasis and is prepared to respond with a strong ethos of contribution and involvement in “doing their bit” as long as they understand where the value lies in their contribution. The every little bit helps message is one the community feels comfortable with.”
- Where customers have volunteered to take part in a trial, and require a visit by an installation technician in order to set-up the equipment involved it should be noted that “homeowners need to be given a significant level of control over the installation time. Installers cannot expect volunteers to act like customers and to be available in a schedule that suits the installer rather than the volunteer”.

Major barriers encountered (to date):

- Customers were more likely to drop-out when an installer required access to the inside of their home (as opposed to a ‘garden installation’).
- Customers were also more likely to drop-out if they perceived a risk for damage to either their equipment (their air conditioning unit) or the fabric of their building.
References:


IT 1. Impact of a mandatory ToU rate among residential customers in Italy

Description:
RSE is currently monitoring a selected panel of customers in Italy in order to analyse the effects of the introduction of a mandatory Time of Use electricity rate in Italy starting from July 2010.

The panel is composed of 28,000 household customers, randomly selected among the whole Italian population, and it contains their monthly consumptions during both peak and off-peak hours.

Data acquisition has started in July 2009, i.e. from one year prior to the introduction of the ToU tariff, and it will likely continue beyond 2013.

Customers involved:
About 28,000 residential customers, all subject to the universal supply regime in Italy.

Technologies deployed:
The only technology deployed in the project is the smart meter used to measure customers’ electricity consumptions.

Customer offerings:
All the customers are subject to the universal supply regime in Italy and therefore have to comply with the rules established by the Italian Authority for Electricity and Gas (AEEG); however, they are allowed to switch to the “free market” and therefore choose another DSO without any penalties whenever they want.

Customer engagement approach:
Customers were randomly selected among all the customers subject to the universal supply regime in Italy: the four major Italian DSO’s were asked to extract 1 out of every 1,000 their customers, after ordering them alphabetically.

Smart metering:
Smart meters were exclusively used to collect customers’ monthly consumptions during both peak and off-peak hours.

Tariff
The customers have been subject to the following tariffs:
- July 1st 2009 \(\rightarrow\) June 30th 1st 2010: flat tariff
- July 1st 2010 \(\rightarrow\) December 31st 2012: transitional ToU tariff
- January 1st 2012 \(\rightarrow\) now: final ToU tariff

The switch from flat to ToU tariff was mandatory for all customers subject to the universal supply regime. No complaints were filed during the monitored period by any of the customers involved.

Remote / Automatic Control of Appliances
There were not any remote or automatic control of appliances/end-use loads inside customers’ homes.
Information and Data Sharing

All the results were shown during both national and international conferences, always in an aggregate form, in order to protect customers' privacy. Consumers organization were informed but they were not directly involved in the process of data acquisition and analysis. The main difficulty encountered was elaborate an automated procedure to elaborate the huge amount of data which were transmitted monthly to RSE. Customers were unaware that their consumption were being recorded and transmitted to RSE by their DSO, in order to prevent Hawthorne effect. The results have been used by the Italian Authority for Electricity and Gas (AEEG) to test the effectiveness of the entry into force of a mandatory ToU tariff and elaborate new strategies to improve its weak points.

Advice / Customer Engagement

Customers were unaware of their participation in the test case and the information they received before the entry into force of a mandatory ToU tariff was the same of all the residential customers in Italy; such information included both advertising campaigns and a systematic splitting of their consumption between peak and off-peak hours in their bills prior to the entry into force of the tariff itself.

Results:

The change in the behaviour of the Italian users has not been negligible because about 60% of the customers in the panel have moved their consumptions according to the price signal provided by the ToU tariff; the positive effect of such behaviour has been balanced by the remaining 40% of the customers who have modified their consumption habits in the opposite way that the ToU was supposed to induce.

Therefore, there has been a limited shift of consumptions from peak to off-peak hours in the period July 2010 – June 2012 after the introduction of the mandatory ToU tariff: it has resulted to be around 1%, with an overall savings of about 6.45 M€ achieved by all the residential customers in Italy.

Key lessons learnt (to date):

The main reasons which have prevented a larger shift to occur among the customers are:

- consumption allocation during off-peak hours was high even before the introduction of the ToU tariff, thus reducing the amount of consumption which would be shiftable in principle;
- the price signal conveyed to the customers was very low, due to the tiny price difference between peak and off-peak hours.

There are some aspects of the ToU tariff which may be improved, such as the allocation of the hours of the day to the peak and off-peak sets, or the introduction of the “Critical peak pricing” in parallel with the ToU tariff.

Major barriers encountered (to date):

The main barrier is the not uniform customers participation; customers have, in fact, reacted in very different ways, from those who have complied with the dictates of the ToU tariff, to those who have ignored it. It is difficult to explain all the reasons behind that, especially the ones not directly connected with the introduction of the ToU tariff.
References:

S. Maggiore, M. Gallanti, W. Grattieri, M. Benini, “Impact of the enforcement of a Time-of-Use tariff to Residential customers in Italy”, CIRED 22nd International Conference on Electricity Distribution, June 2013;

KR1. Jeju Island

Description:
Jeju test-bed was selected based on her renewable potentials, island characteristics and public relations to general tourists. The primary focus of this project was to connect different electronic devices that never connected before and to develop feasible business model and commercial solutions for national market.

Republic of Korea is a partly unbundled electricity market. While generation side has been competitive since 2001, the demand side has been in the hand of monopsony retailer, KEPCO (Korea Electric Power Corporation). This project involves most of the renowned business names in Korea such as Samsung, KT (Korea Telecom), SKT, LG (LG Chem), POSCO, and KEPCO.

Among 5 domains, Smart Place (smart consumer) aims to simulate competitive retail electricity market and to provide new bundled services with new pricing schemes. In addition, aggregated demand resources take part in the wholesale market in order to give pricing signals from demand side, which does not exist in Korea yet.

Customers involved:
About 2,300 homes and a few businesses are taking part in the trial, they are located in a rural community.

Technologies deployed:
Smart meters, IHD (In-Home Display), PV panels, smart appliances are the focus of residential consumer technologies.

Customer offerings:
The each consortium develops various dynamic tariff types and services while the incumbent utility tried to test real-time pricing scheme based on her current tariff.

A technical solution enabling customers with solar photovoltaic (PV) panels to use the power they generate within the home is also included in the trial.

Customer engagement approach:
At the initial stage, customer engagement was not considered to have significant importance. During the course of test-bed implementation, customer empowerment and proper education have been recognised as critical to the successful deployment of consumer technologies such as smart meter, IHD and smart appliances. Since the test-bed is located at rural area where power of community elders is strong, each consortium was deliberately very careful to interview and select potential test participants. Local elders and key opinion leaders in the community were consulted in advance.

While participation in the trial is voluntary, customers are offered indirect financial incentives to participate. Smart appliances, PV panels, and IHDs were provided without any cost burden to customers. Some customers agreed to participate before the incentive was mentioned while some others strongly complained when they did not receive free smart devices.

Preliminary survey results have shown that the majority of participants (86.2%) have interests in electricity consumption reduction. After participating in the trial, 42.6% of the consumer answered that their electricity consumption behaviour has changed while the other 57.5% said their behaviour hasn’t changed. Since the trial in consumer side is basically a simulation, which means that there had been no financial obligation for consumers, more detailed researches are needed before reaching a conclusion.

Smart metering:
Smart Meters are being rolled out to about 2,300 customers. The Smart Meters include the following functionality:
- Automated meter reading controlled by HEMS, with data captured in 5-minutes and 15-minutes intervals
- In-home display, providing information on consumption and cost of electricity with various time intervals from hourly to daily
- Demand response test using smart meter function

Data analysis of Smart Meter data is already completed as part of this project (analysis of data from approximately 2,300 residential customers). However, the official outcome is yet to be opened after the government’s final test-bed review in July 2013.

**Tariff (Intervention type T)**

Pricing schemes are still being developed – no further details available.

**Remote / Automatic Control of Appliances (Intervention type)**

N/A

**Information and Data Sharing (Intervention type F)**

Real time energy metering and energy consumption data – no further details available.

**Advice / Customer Engagement (Intervention type)**

N/A

**Results:**

It is too early to be able to assess the results of the trials in terms of the amount of peak energy reduction or energy savings achieved.

**Key lessons learnt (to date):**

- It is important to include diversified customer groups in terms of age, location, number of family member, household income
- It is very important to share customer’s historical consumption data among test participating firms
- Customer engagement procedures are needed to be developed and introduced as a formal requirement before more wider implementation of smart meters
- Customers should bear part of financial burden if the customers were willingly to choose their tariffs. Simulation of electricity tariff choice was ineffective

**Major barriers encountered (to date):**

- Lack of real money incentive
- Lack of customer diversity. Most of the customers in the test-bed are homogeneous
- Law and regulation that do not allow bundled services including electricity, gas and IT services.
- Systems may not allow all tariff types to be trialled
- Conflict of interests between new entrants and transmission/distribution/retail monopoly. Neutrality of network access was not fully tested

**References:**

Further information on this project can be found at:

http://www.smartgrid.or.kr
NL1. ADDRESS

Description:

ADDRESS is a large-scale Integrated Project co-founded by the European Commission under the 7th Framework Programme, in the Energy area for the "Development of Interactive Distribution Energy Networks".

The project started on June 1st 2008 and will last 5 years (2008 - 2013).

It is carried out by a Consortium of 25 partners from 11 European countries, carefully selected to meet the needs of the project in terms of skills, competencies and understanding of the problem and possible solutions, each of them bringing specific knowledge of at least one aspect of the supply chain. Enel Distribuzione is the Coordinator.

The total budget is 16 M€, with 9 M€ financing by the European Commission.

Within the ADDRESS project tests will be performed to validate the solutions developed in the project. The validation will be partly done by means of simulations and laboratory tests, and partly in three field tests, which are a combination of actual field-testing and developed prototypes.

The ADDRESS Consortium has selected the test sites in three European countries with different network topologies and acceptance conditions which, taken together, provide a validation of the entire concept. Additionally, in Spain and France different climate conditions (warm in Spain, cold in France) will ensure different equipment and usage patterns.

ADDRESS stands for Active Distribution network with full integration of Demand and distributed energy RESources and its target is to enable the Active Demand in the context of the smart grids of the future, or in other words, the active participation of small and commercial consumers in power system markets and provision of services to the different power system participants.

To deal with active demand a new approach will be adopted by ADDRESS: it may be called the “Demand Approach” in contrast to the “Generation Approach” that is generally used to deal with generation and in particular Distributed Generation (DG).

Contrary to DG and large industrial customers, domestic customers are not motivated by purely economic considerations. Moreover, they are not able (e.g. due to the lack of appropriate equipment) or not prone to characterize precisely in advance the services and flexibilities that they can provide. Domestic consumers are not likely to “offer” services. Therefore, the services they can provide will be “requested” through the developed price and/or volume signal mechanisms and will be provided on a voluntary and contractual basis.

The French Site:

This test will validate the whole ADDRESS chain: from AD buyers to controllable appliances at the consumers’ premises. The test will be performed in the Houat and Hoedic small islands, in the Brittany Region, under the responsibility of EDF.
Figure 1: Location of French Trial

The main test objective of the French field test is to demonstrate that the ADDRESS solution works from start to the end by means of:

1. Validation of market design (market simulator) and the ability of players to formulate AD needs and offers to the market or to the aggregator in case of bilateral relationships
   - formulation of AD needs and bids by players based on actual requests from electricity system functions/players or based on requests resulting from simulations of possible problems and player’s needs;
   - portfolio management by Aggregator;
   - AD offer formulation by Aggregator;
   - (simulated) interaction of different entities with aggregation platform and (simulated) market interaction.

2. Validation of technical validation of AD requests by DSO simulator

3. Validation of home system and interoperability/communication

4. Verification of AD product provision to AD buyer and of consumers’ response

5. Validation of consumer behavior


The Italian Site:

This field test will be carried out in Carpinone, in the Molise Region, and focuses on the Distribution System Operator (DSO) control system. The test will be performed under the responsibility of ENEL Distribuzione.

Figure 2: Location of Italian Trial
The objectives of the Italian field test are to test the prototypes and algorithms developed for the DSO to enable and exploit Active Demand (AD). Since the Italian field test is focused on the validation of the DSO's control system prototypes and algorithms, the participation of consumers to the AD market will not be taken into account.

The test objectives are:

1. Is it possible to allow AD activations in normal conditions while assuring network security? In order to answer this question a number of underlying issues must be solved, such as:
   - Will the Load Areas be distributed into a wide enough variety to be appealing for market parties?
   - Can the DSO consistently provide enough flexibility on the grid to allow for demand reshaping?
   - Is the DSO (and the Transmission System Operator) able to validate AD bids in time and calculate usable curtailment factors for the Aggregators?

2. Can DSOs utilise AD options to solve short-term network security issues?

3. Is the DSO able to purchase AD products for its own benefits without disturbing the market place?

As this trial does not directly involve customers within the scope of Task 23, it is not taken further in the analysis.

The Spanish Site:

The Spanish field test in Castellon, in Valencian Community, will focus on the low voltage network with the participation of 300 consumers.

Consumption and consumers' behaviour will be taken into account in order to manage loads through the Energy Box (EB), according to the AD signals sent by the Aggregator. The test will be performed under the responsibility of IBERDROLA.

The test objectives are:

1. **Validate social acceptance and customers' commitment.** Different questionnaires will be completed out during the field test period (pre/during/post trials).

2. Full validation of aggregator functionality and ‘core business model’ through the validation of the Aggregator Toolbox functionality.

3. Technically validate proposed solutions and prototypes for the Home System:
- Validation of home system communication;
- Validation of EB interaction with equipment;
- Validation of equipment operation;
- Validation of the EB user interface;
- Validation of EB algorithms;
- Validation of communication between EB and metering equipment;
- Validation of communication between EB and Aggregator;
- Collection and processing of metering information.

Customers involved:
- French site: 50 to 100 customers
- Italian site: Participation of consumers to the AD market is not taken into account (focusing on validation of DSO control system and algorithms)
- Spanish site: 300 consumers

Technologies deployed:

French field test:
The equipment installed at each consumer’s premises consists of:
- one PC with the Energy Box software (EBox PC);
- up to 7 smart wall units to control the electric radiators and the water heater;
- up to 3 temperature sensors;
- 5 smart plugs to control some types of classical electric appliances; and
- Smart washing machines developed in the project and able to communicate directly with the EBox are installed at some 10 consumers.

Spanish field test:
The Spanish field test is carried out in the Mediterranean city of Castellon de la Plana; it is focused on the validation of the relationship between the Aggregator and the Energy Boxes (EBox_es), as well as the interaction between the EBox_es and the equipment downstream inside the consumers’ dwellings. Three hundred (300) consumers are participating in the test with the following equipment:
- one EBox;
- five smart plugs;
- one smart washing machine (25 participants);
- one air conditioning management system (30 participants); and
- one dedicated measuring device, plus the official smart meter. – see picture below.
Customer offerings:
No detailed information has been found on customer offerings.

Customer engagement approach:
No information is available on the recruitment process used for the trial in France.

Spanish field test:
The process to recruit the consumers was divided into phases. The first one was carried out by phone calling potential consumers in order to request their availability and desirability for participating in the field test. During the conversation with consumers, the requirements, rights and obligations were presented and the incentives to participate were explained.
The second phase of the recruitment is the gathering of all the contracts signed by the consumers. Iberdrola has subcontracted a local company in the area where field test is being developed to carry out this activity. This subcontracted company visited all the recruited consumers in order to:
- Sign the ADDRESS contract.
- Analyze the different appliances inside the house in order to configure the EBox according to these possible loads.

During this process some consumers rejected to participate in the project due to different reasons:
- Time between phone recruitment and signature of the contract (mostly); for instance, some consumers did not remember when they had accepted to participate in the project.
- Consumers did not like the explanation of the objectives of the project.
- Consumers did not agree with the rights and obligations defined in the contract.

Smart metering:
The EnergyBox is in the project developed. The role of the smart meter seems to differ between the pilots:
- Spanish field test: the meter appears to only be used for billing (see picture within ‘Technologies Deployed’ section).
- French field test: There appears to be no special role for the meter in the context of this project, based on the figure below.
Tariff (Intervention type T)
Not applicable for this trial.

Remote / Automatic Control of Appliances (Intervention type C)
Both the French and Spanish trials involved the use of an Energy Box (EBox) to control appliances and make measurements. A Home Area Network will be tested with the equipment installed in the different houses:

- Energy Box gateway between consumers and Aggregator toolbox which manages the loads downstream (i.e. in the house)
- Measurement devices measures the global consumption in the house
- Smart plugs and smart loads receive the orders from the EBox and schedule or interrupt their cycling work according to them.
- The Energy Box manages the thermal, shiftable and interruptable loads taking into account the user’s preferences and the signals received from the Aggregator.

Information and Data Sharing
Spain:
The consumers will participate during the entire test with the equipment\(^1\) installed in their houses. All the information regarding the use and measurements are sent to the Aggregator server everyday, where the measuring data is collected, in order to assess and analyze the consumers’ response to the Active Demand events. With this information and the information gathered through different questionnaires/ interviews done during the test (at the beginning, in the middle and at the end), the consumers are classified into different clusters and are identified with a prototype load curve.

Advice / Customer Engagement
In the case of Active Demand, previous experience shows that people are reluctant to take part in field tests due to concerns over its impact on comfort and lifestyles, as well as unease over data protection and safety. Control is another issue, with experience suggesting that the option to override comfort settings at any time gave participants more confidence in participating, even though they seldom used that option during the testing period.

\(^1\) The equipments installed in all the dwellings are: EBox (ZIV): five smart plugs (Philips and ZIV) where different appliances will be connected (water heater, washing machine, dishwasher, dryer …); additional measuring device that will be used to communicate with the EBox, and official smart meter, which was already installed. Additionally, the following equipment will be also installed in some of the houses (full HAN consumers): smart washing machines (25) from Electrolux; air conditioning management system (30) from Intesis.
For this test, Iberdrola has recruited 300 consumers in order to deploy the equipment that will be tested during the field test (6 months). The recruited consumers have signed a contract and will receive a fixed incentive for their compromise in participating in the field test. Additionally, consumers will receive a variable incentive based on the quality of their participation in the experience, according to the signals received from Aggregator and how they let EBox to manage their appliances with these signals.

Results:

Results in relation to peak reduction or overall improvements in energy efficiency are not yet available. However, a number of conclusions have been published showing customers experience of using the technology (E-Box) and their motivations for taking part, as follows:

- Before the trial, consumer expectations of living with the technology were positive (In France and Spain 85% and 62% respectively thought living with the EBox would be either “fairly easy” or “easy”).
- Many consumers also expected programming the EBox to be straightforward- 64% in France thought it would “easy” or “fairly easy” in France, compared with 42% of those in Spain. 43% of Spanish trial participants did not know what to expect in relation the EBox.
- For some participants their experiences during the trial did not live up to the positive expectations; these consumers found using the EBox difficult and for many, the technology was invisible.
- Motivations for adopting AD go beyond financial incentives. Results suggest wider system benefits are important to people:
  - Participants in France are motivated because ADDRESS was a new technology (29%), and others are driven by more collective concerns about the environment (29%) and improving energy security in the islands (21%), whilst only 21% are interested in saving money (Figure 6).
  - The majority of participants in Spain (68%) are interested in saving money, 11% expressed interest in ADDRESS as a new technology and 8% in protecting the environment and energy security (3%), whilst other reasons (7%) were a combination of the above factors, mainly interest in the technology and environmental concerns featured strongly (Figure 6).
- These motivations are mirrored by participants’ rationales for saving energy. In France, 68% wish to save energy equally for money and environmental concerns, compared to 47% in Spain. Similarly, 8% in France wished to save money more than protecting the environment compared to 35% in Spain. Furthermore, there was considerable interest in other aspects of AD, such as feedback on household energy consumption, evident through conversations with participants in France.
Key lessons learnt (to date):

- For positive consumer engagement with AD, the usability of the technology, contracts and contextual issues are all important.
- User interfaces must be easy to understand, allowing users to input settings and to access the different functionalities that the EBox can provide.
- Accessing information about electricity consumption was very important to consumers in this respect.
- Consumers need support with the installation of AD technology to minimise technical problems and to facilitate setting the parameters of the load control.
- The ability to over-ride the system when needed is central to acceptance.
- Contracts need to be understandable, transparent and clearly set out the potential financial benefits and implications of different actions;
- Consumer privacy and data must be protected.
- Financial savings are important to consumers, although other factors such as environmental protection are important in their decision to adopt AD technology. The full range of benefits must be clearly communicated to consumers to ensure as wide a take-up as possible.

Major barriers encountered (to date):

See also lessons learnt

References:

http://www.addressfp7.org/
**NL 2. Power Matching City 2**

**Description:**
A project to demonstrate the energy system of the future with smart energy services, as well as the validation of costs and benefits of this system in practice in order to enable the energy transition.

PowerMatching City aims to predict what the energy system of the future will look like. The system allows consumers to “freely and automatically exchange electricity, while keeping u the comfort level.” Grid operators can use the concept for peak load reduction for capacity management, while utilities can use it as virtual power plant. Phase 2 (Power Matching City 2) focuses specifically on how smart grids can be integrated in the wholesale processes of an energy company. Power Matching City 2 will also examine capacity management.

Project will run until September 2014

**Customers involved:**

Power Matching City 2 is a follow up on Power Matching City 1. In Phase 1 22 households were involved, that were mainly part of a neighbourhood association, with already interest in ‘Green projects’. Households were spread over Hoogkerk and surroundings.

In Phase 2 18 households were added to the 22 from Phase 1. These 18 households are all living in the same street in Groningen, about half of all households in the street are involved in PowerMatching City 2. This is relevant, as it might give different dynamics.

The 18 ‘new’ households are connected in a Home Owners Association (and live in relatively expensive dwellings 400-500k Euro).

**Technologies deployed:**

Includes:
- Heat pumps (already installed in the dwelling, but slightly adapted)
- Micro-CHP (installed specifically for the project, to replace condensing boilers)
- Washing machines
- Thermal heat storage (300 litre tanks)
- EVs (included in the project, but driving at a location >100km from the pilot site)
- PV

**Customer offerings:**

Households pay €1000 start fee (to cover costs for e.g. smart appliances). During the project the €1000 is paid back to the participants.

New energy services have been developed in the context of the project, together with the participants of the project (co-creation).

1. Save smart (buy electricity as cheap as possible, sell it for the highest possible price at the APX or the balancing market).
2. Together comfortably sustainable. Try to be as sustainable as possible with the community as a whole. About half of the participants have PV. There is then a prioritization of options:
   - 1) try to use electricity generated by own PV.
   - 2) use power generated by neighbors
   - 3) use power from grid.

Portals: Participants get a tablet with energy display, to get insight in own consumption and production, share of renewable, forecasts, costs, forecasts of costs, etc.
Automated control:

- MicroCHP/ heat pump: fully automated.
- Washing machine, diswasher: you set time when it should be finished, the rest is automated (but can always be overruled).
- For other appliances (e.g. vacuum cleaner): price and sustainability indicated at any moment and time so that the resident can decide when to use it.

Monitoring: starts 1 September. Currently monitoring for baseline. One year price profiles will be shared with residents. Interviews and workshops during the year. And measurement of how much energy is consumed to validate cost-benefit models.

Some more detail: 2030 profiles (much RE, much gas) are used for APX and balancing market. Average price is about 30-37 cent/kWh, but prices vary between 0 – 50 cent/kWh. The changes in prices will determine costs for end user (incl. commodity costs, capacity costs and taxes).

Customer engagement approach:

Home owners association was very enthusiastic, and started to recruit participants.

Street was constructed in 1990. Before joining Power Matching City 2, there were initiatives to collectively buy PV, to collectively buy heat pumps. Participation in a smart grid was a logical next step.

Sustainability and independence are main drivers.

Smart metering:

Smart meters are used (15 min. values), for information gathering for billing. Currently no ‘actual billing’, based on the price profiles of 2030 – see previous questions. Furthermore, billing system in the Netherlands is currently based on a fixed monthly pre-payment, not on actual use of the period. But a ‘dummy’ bill will be produced based on time of use prices (real time pricing).

Tariff

Tariff: please see the above. Virtual prices and tariffs were used, based on APX and balancing market (15 min. base).

Remote / Automatic Control of Appliances

See also previous questions.

Mix of ToU, forecasting and real time.

Information and Data Sharing

No third parties involved in the project.

Partners included: a DNO (Enexis) + retailer (Essent), ICT (ICT Automatisering) TNO (Knowledge Institute developing the PowerMatcher technology) and Gasunie (gas infrastructure company).

Further partners: Technical University of Eindhoven (Faculty of Electrical Engineering). Technical University of Delft (Faculty of Industrial Design) and Hanze University of Applied Sciences (for socio-economic analysis)
Advice / Customer Engagement

Co-creation and decisions on services; took place together with project participants. Saving tips were shared during the meetings.

Helpdesks in place (just for technical problems).

Results:

The aim of project is to understand if the services that have been developed will have impact or not, what works and what doesn't. Technically everything is feasible. But what will be impact on costs, on level of RE used locally. Information will be used to validate cost benefit models for the various stakeholders.

Key lessons learnt (to date):

Lessons: everything can always better. But: innovative projects require some flexibility. The challenge is to get started and not keep brainstorming on even more fantastic ideas.

Lessons from Phase 1 implemented in Phase 2. Suppliers of appliances are involved, which wasn't the case in Phase 1. This makes it easier to upscale to other locations.

Lighter computers being used, ICT in the cloud, just a small box near the meter (this is cheaper, makes it easier to upscale).

One of the main lessons from Phase 1 was "that it is only through the efforts of all parties along the entire energy chain that it becomes possible to fully exploit the opportunities in smart grids".

Households have perceived a high(er) level of comfort and indicate that they do not experience any inconvenience from participating in PowerMatching City’s smart grid, since the energy trading on the local market is fully automated. The acceptance level amongst consumers is high.

The frequency of visits to the energy portal by consumers participating in the project indicates that it provides relevant information of interest to the customer.

A “bi-directional, interactive relationship between households and technology” is required so that households can understand the consequence of their energy actions. A learning loop is required that answers their questions about the operation of the system and helps them to achieve their energy goals.

Major barriers encountered (to date):

- Customers are not able to use the "energy portal" to evaluate the payback period for investment decisions (e.g. new appliances or changes in heating technologies). Historical energy consumption data from before the installation of the smart meter is not available via the portal and it does not provide any support enabling the end user to evaluate investments themselves. This represents a challenge for the development of future energy portals.
- Households have indicated that they would like more advice on what to do/ how to use the portal.
- Appliances and equipment which is not part of the PowerMatching project do not provide device level consumption data to the portal and so the impact of consumers' use of these appliances is not clear.

References:


NL3. Rendement voor iedereen

Description:
Testing eight different services across two pilot sites (Utrecht and Amersfoort).

Customers involved:
In Amersfoort 100 households are involved, all from one neighbourhood. It is a bottom up project, where service offerings have been co-created with the residents. Almost all households have PV panels on their roof.
In Utrecht also 100 households are targeted, but are recruited by a small local commercial company, also offering internet access in the same neighbourhood.

Technologies deployed:
Net-to-grid system (comparable with Plugwise systems). Centrally controlled, with plugs at appliance level. Appliances controlled: tumble dryer, refrigerators, dish washers, washing machine. PV.

Customer offerings:
In Amersfoort and Utrecht each 4 services have been defined.
In Amersfoort focus is on how to ‘actively involve’ end users. How to communicate services to end users. No system for actual billing (like in Power Matching City), less focus on market mechanisms (like in Power Matching City). Testing of messages/concepts end users are sensitive to. Questionnaires are used to analyse behavioral component.
Still unclear whether price incentives will be used.
Recruitment of participants: ‘area ambassadors’ used to recruit participants. The ambassadors were working together in a working group and have contributed on the set up of the pilots: requirements of the appliances, content of contracts for the households. Ambassadors recruited 100 participants.
Model (of using ambassadors) works well. But there need to be someone that coordinates/organizes/invites ambassadors, this requires a certain investment.

Customer engagement approach:
See text above: both pilot sites are based on an opt in set up.

Smart metering:
Smart meters have been installed in the context of the project. See also ‘8 services’ for better understanding of what has been offered.

Tariff
No information available yet, as services are defined, but not yet developed in full detail. Flexible pricing/price incentives may be used (depending on the services being tested – see list of 8 services that have been defined –, but it will not be used for actual billing.

Remote / Automatic Control of Appliances
Bottom up – co-creation process – based on opt in: the best way to avoid complaints.
There might be complaints, but I am not aware of any.
8 services/concepts are being tested (1-4 in Amersfoort, 5-8 in Utrecht):

1. Insight in consumption (no control of load). This leads to savings (at least in the short term). Ambassadors have saved about 10%. (not clear yet if these savings will be achieved also by other households, nor clear whether they will remain over time. Ambassadors helped to translate information to the context of the households (easier accessible information).

2. Insight in consumption combined with saving recommendations. (Try to consume at times that PV generates power) guiding households in how they can achieve this.

3. Insight + price incentives
4. Insight + automated control. (can always be overruled by household).
5. Storage – vehicle to grid
6. EV- rental car service (green wheel concept).
7. Neighbourhood optimization (use each other’s energy, try to reduce as much as possible).
8. PV BOX - test a technology to predict PV generation.

Energy savings not an aim, but load shifting is.

Information and Data Sharing

What information (energy data) was shared, and who was the data shared with. Were any third party organisations involved

No information available yet, as services are defined, but not yet developed in full detail.

Advice / Customer Engagement

No results yet (pilot is still running).

Results:

Ambassadors have saved around 10% of their energy consumption via the use of an ‘insight into consumption’ (without control of load), although it is not clear if these savings will persist over time or be replicated by other trial participants.

Key lessons learnt (to date):

No results yet (pilot is still running).

Major barriers encountered (to date):

No results yet (pilot is still running).

References:

http://www.smartgridtv.nl/article/home/64/smart-grid-rendement-voor-iedereen-in-utrecht-en-amersfoort/ (only available in Dutch)

Interview with Petra de Boer, DNV KEMA.
NO 1. Malvik Norway

Description:
This case description reports on a pilot project testing Demand Response (DR) among households in Norway. The main elements of the project were:
- smart metering
- remote load control functionality
- time variable grid tariff (Time of Use)
- hourly spot energy price.

40 household customers in the municipality of Malvik in Mid-Norway participated in the pilot study, which lasted for one year (~2007). Results from the study are publicly available.

Most information for this case study report is from Sæle and Grande (2011).

Customers involved:
40 "typical" Norwegian household customers were part of this pilot. A key characteristic of the customers is the presence of an electric water heater (storage tank) for tap water or even an electric boiler for a hydronic space heating system. These units demand much power, from 2-3 kW up to 12-15 kW, while also having substantial heat storage capacity.

Technologies deployed:
A major objective with the pilot was to induce shifting of power loads for the mentioned water heaters away from peak hours. Smart meters with hourly readings and Remote Load Control capabilities were used to achieve this. The necessary hardware was paid for and installed by the network owner.

Customer offerings:
The contractual arrangement between the supplier/grid owner and the electricity customer included the following:
1) An hourly spot price as the basis of the energy contract
2) A grid tariff with three elements:
   - a fixed part (annual amount)
   - variable part, per kWh
   - a peak hour payment (per kWh, only during defined peak hours)
3) Option to have loads remotely controlled (by network owner)
4) A graphical "sticker" – reminder of peak hours, to stick on appliances
5) Two information meetings during the pilot
6) Web site with network costs and other relevant information.

The figure below shows the sticker used as a reminder of peak hours.
Customer engagement approach:
Customers were recruited via an article in a local newspaper and via letters sent by email. Participation was voluntary.

Two meetings were offered to inform and motivate customers for load shifting. The "sticker" was reminding people that both the energy price and the network tariff were higher in peak hours (08 to 10 and 17 to 19).

Customers were encouraged not to use the most power-demanding appliances in the peak hours, this to avoid the peak hour grid payment and the higher energy price in these hours.

Smart metering:
An automatic meter with weekly readings had already been installed for all customers in this network. The 40 participants in the pilot had their meters adjusted to accommodate hourly reading, thus enabling network and energy contracts based on one hour time resolution. Consumption data was fed back to the network operator.

In addition, the meters were modified to enable load control (on-off) for electric heaters.

Tariff:
The pilot introduced the Time of Use Tariff. This tariff was designed by adding a specific peak element to the existing standard network tariff. This element can be described as a "penalty" – fixed rate per kWh – for consumption in the predefined "peak hours". Peak hours were between 08 and 10 in the morning and between 17 and 19 in the evening, on weekdays. There were no peak hours in weekends.

The elements of the tariff were the following: fixed element: 187.5 Euros/year, variable part: 0.875 Eurocents per kWh, and peak hour payment: 7.88 Eurocents per kWh (in peak hours).

In addition a spot price based energy contract was recommended, although it was allowed for the customer to continue with any previous energy contract. High spot price would usually coincide with the peak hours, and would be an added incentive to shift loads.

Remote Control of Appliances
Achieving load control in the peak hours was a major objective of this project. The primary end use technology addressed was water heaters. These installations require high power loads, and typically engage in a predictable time pattern as a result of water use habits of the households. Water heaters thus are important contributors to the morning and evening peak loads in the Norwegian power
system. On the other hand, these installations represent substantial energy storage capacity, and the time of loading this storage does not substantially affect the comfort of use. It is therefore possible to move large power loads without reducing the comfort of the household. The water heaters were remotely controlled by the distribution system operator.

In addition, the pilot addressed other high power household appliances, such as dishwashers and washing machines. These appliances were controlled by the household, inspired by the general information around the pilot, and by the information stickers put on the appliances.

**Advice / Customer Engagement**

In addition to remote control, customers were advised to avoid using electricity in the peak load periods, with an emphasis on appliances with a high energy demand.

The main intervention to achieve this, in addition to general information provided by the DSO, was the information sticker to be placed on the relevant appliances as a reminder to avoid peak hour use (see figure above).

**Results:**

The average registered demand response in this pilot was the following, measured as a reduction in load in the peak hours:
- 1 kWh per hour for customers with standard water heaters
- 2.5 kWh per hour for customers with electric boilers for space heating.

The effect is illustrated in the figure below.

![Average 24 hour profile](image)

It has been estimated that an aggregation of this DR to all Norwegian households, would sum up to a 4.2% reduction in the registered national peak load demand.

**Key lessons learnt (to date):**

Significant load shifting is possible, given:
- motivated customers (here: small pilot group)
- suitable economic incentives (tariff and spot price)
- good information and “behavioural trigger”

Customers were mainly motivated by economic savings, but also electricity savings mattered.
Remote load control by the DSO was accepted, as long as it did not reduce general comfort. Some customers adjusted other energy behaviours to better suit the new tariff. Some also said that their interest in and awareness of own energy consumption had increased during the pilot.

**Major barriers encountered (to date):**

No specific major barriers were identified during the pilot. Participants were generally motivated, and it is uncertain whether same positive results can be achieved in a full scale project.

**References:**

NO 2. eWave in-home display

Description:
eWave is the display technology tested in a pilot project carried out in cooperation with a national research project titled "Environmental benefits from full-scale implementation of smart metering". We refer here also to the pilot project itself as "eWave". Its aim was to investigate ways of increasing customer awareness of own electricity consumption and thereby induce changes in behaviour in order to reduce this consumption. The in-home display "eWave" was a central element of this pilot project.

The pilot project was carried out in the period 2010-2012, and is thus completed as such. To date only preliminary results are available, however final report is expected in 2013.

Customers involved:
Household customers in the municipalities of Follo (Eastern Norway) and Askøy (Western Norway) were selected for participation in this pilot project. The total of 91 households were distributed with 44 and 47 participants in the two respective regions. Follo Energi and Askøy Energi are the two power suppliers involved in the pilot.

The participating household are characterised as general and “average” Norwegian households. Since Norwegian households typically use electric energy for energy demanding end uses like space and tap water heating, their annual electricity consumption is quite high – at least compared to continental European households. Mean annual electricity consumption in Norwegian households is 16000 kWh. The participants in the pilot study are no exception to this, however the homes participating in this pilot were on average somewhat newer than the average Norwegian home. Direct electricity and wood stove were the main heating technologies.

Technologies deployed:
The key technology in this pilot was a new Norwegian in-home display for electricity consumption, eWave (see illustration).

The unit has a range of display options, including graphs and "speedometer". Both current power and accumulated energy consumption, in addition to monetary (cost) variables, are available.

Although the eWave resembles a "smart grid-type" display, a smart meter is not required. A pulse reader connected to the main electricity meter registers the electric power, and communicates with the display. Further, the display is connected with the service provider over the internet via the household Wi-Fi network. This allows for price and other relevant information to be communicated between the service provider (power retailer) and the display.

This pilot aimed at increasing the households’ general awareness of their electricity consumption, thus no specific end use loads were targeted in an explicit way. Still, it follows as a natural result that this increased awareness materialises in behaviour changes targeting the main end uses. The project survey showed that participants in the pilot tended to report behavioural changes such as:

- turning off appliances when not in use
- turning off lights when no one present
- reducing indoor temperature when no one is at home
- reducing indoor temperature during the night.
The implied effect of the eWave technology thus is related to the following end uses: heating, appliances and lighting.

**Customer offerings:**

The in-home displays were offered for free to the customers of the electricity suppliers Follo Energi and Askøy Energi. The displays and necessary hardware were installed by the project. The main offering to the customers was the information given by and functionality embedded in the display and its motivation to save energy.

**Customer engagement approach:**

Participants were recruited on a voluntary basis by an advertisement in a local newspaper and on a relevant web page.

![Facsimile: Advertisement to recruit participants in the eWave pilot project.](image)

Text says: "Free aid to a lower electricity bill”. "This unique offer is given to only 50 of our customers".

Other than this modest recruitment effort, no activities to promote the technology or create further enthusiasm were made. Once installed in the home, the idea was that the information displayed on the unit alone should motivate behavioural changes.

**Smart metering:**

The display unit used in the pilot was not part of a smart metering concept. It was only used to record and process real time consumption data, and "pair" this information with current (tariff dependent) price data from the energy supplier to render the relevant information on the screen.

Metering for billing purposes was made the traditional way (manual reporting).

**Information and Data Sharing**

The main purpose of the pilot was to test the effect of the feed-back display on awareness of own energy consumption, energy savings from behavioural changes, and the general acceptance and perceived usefulness of such a unit. eWave emulates the customer feed-back capabilities of a smart meter based information system, without the actual smart meter. Central smart-meter functionalities related to data storage and transfer, remote control etc., were therefore not part of the pilot. Further, load control, more accurate billing and other benefits associated with smart metering were not addressed.

A few customers discontinued their participation. This was mostly due to technical faults of the display units.

No major concerns concerning data security, privacy, etc. were set forth. This may be due to the fact that consumption data were not used for other purposes than the display, and also that no third party actors were involved.
Consumer experiences were generally positive. A survey taken up during the pilot indicates that very few customers consider the display a "nuisance". On the contrary, positive statements are given regarding saving of both energy and money, and environmental protection.

Further, households participating in the pilot report greater engagement in energy saving behaviours than a control group, with the exception of turning down indoor temperature during nighttime.

Preliminary analyses indicate energy savings in the order of 6 – 8 %. This has to be analyzed further and will be documented the final report of the pilot.

Results:
This pilot shows that ONLY the feed-back of relevant price and consumption data on (well designed) display unit in itself may induce behavioural changes that result in energy savings. In this case the savings were in the range of 6 to 8 percent.

When interpreting these results, one must keep the recruitment process of the pilot in mind. A voluntary and limited participation, requiring an active response for signing up, could indicate that the participants are more interested in energy saving issues than the average household. Part of the reported effects could be attributed to this possible bias.
Key lessons learnt (to date):

Customers reported behavioural changes such as:
- Turning off appliances when not in use
- Turning off lights when no one present
- Reducing indoor temperature when no one is at home, or during the night

Customers were able to make energy savings of 6 to 8%, even without engagement after the installation of the meter.

Major barriers encountered (to date):
- No major barriers encountered, although it is not clear whether the results (energy saving and willingness to engage) would be replicated in the general population.

A few customers discontinued their participation mainly due to technical faults of the display units.
SE 1. Consumer reactions to peak prices.

Description:

This is a project testing the price sensitivity of households having electric heating systems, but also has other heating options available. The trial was performed during two winters: 2003/2004 and 2004/2005. The project included customer surveys and in-depth interview with participating customers. The results from the project are summarized in the report [1].

Customers involved:

The customers involved consisted of single family houses. The category “Households – General” in the customer segmentation table would be the most appropriate classification of the participating households in this project.

During the winter 2003/2004, 45 households connected to the grid of Skånska Energi participated in the project. During 2004/2005, 53 households connected to the grid of Skånska Energi participated, and an additional 40 households connected to Vallentuna Energi was also involved.

Technologies deployed:

No technologies were deployed in this project. The involved households all had electric heating, but the majority of them also had other heating options, typically by burning fuels like oil or wood. Typically the houses were equipped with water borne heating systems, which can be heated with either electricity or using oil or wood. However, the number of households having the different alternatives as possible heating options have not been specified.

Customer offerings:

The customer was in this trial offered a supply contract using an alternative tariff structure, where the supplier could charge an extra high price during a certain hours per year. No other offerings were made.

Customer engagement approach:

The customers were recruited by mail. The first year, 200 randomly picked households were sent an offer to participate in a trial with a new and special price list. Together with the offer, a list of advice was appended, describing how to decrease electricity consumption during the extra expensive hours. This was followed by a telemarketing approach in a second round to consumers who had got the offer. Finally, 45 households accepted the new offer.

The second year, a similar approach was used to engage more households. The first 45 households from the first year participated also the second winter, together with another 8 at Skånska Energi (hence a total of 53 households) and an additional 40 households at Vallentuna Energi.

Smart metering:

In order to perform hourly billing, hourly meter reading was applied in the project. The smart meters were only used for collecting data, no feedback information to the consumers was performed using the meters. The feedback to the consumers was performed through the energy bill only.

Tariff
The customers were offered a price scheme based on hourly pricing. The supplier had the right to apply an extra high price 40 hours/year. The remaining part of the year, the customers get a rebate on their usual electricity price. The rebate was 7.6 öre/kWh (including tax and VAT), and the extra high price was in the interval 3-10 SEK/kWh.

The price scheme was designed so it would be cost neutral in relation to the normal prices if the consumers didn't take any actions. If the consumer reacted on the price signal, the consumers could reduce their electricity bill. The offering from Skånska Energi implied a 1400 SEK/year cost reduction if the consumer reduced their consumption with 75% during the hours with an extra high price. During the experiment at Vallentuna Energi during winter 2004/2005, the cost reduction was decreased to 1000 SEK/year in order to see the interest also at a lower cost decrease.

Remote / Automatic Control of Appliances

Not applicable in this project.

Information and Data Sharing

The consumers got information about situations with extra high prices by text messages to their mobile phones the day before the actual hour. Thereby they had time to react to the peak prices. The information to consumers consisted by their ordinary bill (no extra information was provided).

Advice / Customer Engagement

The households received advice on how to temporarily reduce their electricity consumption when they were given the offer to join the trial. This was performed by supplying the consumers with a short document in the same mail. Hence, the information was provided by the power company. The document concerned general advice (e.g. avoid using dish washer) and advice depending on the heating system that the consumers were equipped with (e.g switch to firing bio fuels for heating).

Results:

During 2003/2004, the extra high price was used for 39 hours during 15 different occasions. During 2004/2005, the high prices was used for 37 hours during 14 occasions for Skånska Energi, and 39 hours during 15 different occasions for Vallentuna Energi.

The trail showed a average decrease in electric power consumption by 50% the hours when the consumers were subjected to extra high prices. In fact, the actual decrease can have been even greater since some households switched to oil or biofuels the night before they were subjected to the high prices.

At the end of the trail, a survey was performed including all participants, and in-depth interviews was performed with 20 households. The overall results from the survey and interviews show that the majority of the households participated actively in the peak reductions and that the overall impression of the trial was positive.

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1 öre = 0.01 SEK.
Key lessons learnt (to date):

Key lessons:

- Even though no technical equipment was installed at the consumers, it is still possible to achieve significant peak reductions.
- The results are robust in the sense that there seems to be no difference between the years or between the consumers of the two power companies being in different parts of the country.

The consumer experiences, which was mainly analyzed through the interviews, can be summarized by the following:

- The trial was considered as a positive experience.
- There were different motives to why the consumers joined, such as: It was economically beneficial; it was both economically beneficial and interesting; it is considered as good for the environment; it was considered as a challenge to reduce the consumption.
- There were not really any major troubles to reduce the peaks.
- No disadvantages with decreasing the consumption was experienced.
- The rebate and the economical incentives are important, but the level are not that important, it rather the “symbolic value” that is of importance.
- The majority didn’t have any knowledge about how much money they saved, but it was still considered as a positive experience.
- There were households that were prepared to install some kind of control system for reducing consumption levels on their own expense.
- The general experience was that there would not cause any major problems to introduce this on a larger scale.

Major barriers encountered (to date):

No key barriers were pointed out in this project.

References:

SE 2. Consumer reactions to peak prices – continuation project

Description:

This project is a continuation of the project “Consumer reactions to peak prices” (SE2) [1]. The main reason is an increasing number of heat pumps, which leads to an uncertainty and concern considering the power demand in occasion of very low outdoor temperatures. By prolonging the project, and increase the number of participants in the project, a greater knowledge is expected to be achieved by heat pumps, and in particular the possibility to indirect control these consumers with peak pricing.

The trial was performed during the winter 2005/2006. The results from the project are summarized in the report [2].

Customers involved:

The customers involved consisted of single family houses. The category “Households – General” in the customer segmentation table would be the most appropriate classification of the participating households in this project.

Customers to Skånska Energi that have participated earlier years to the project were offered a prolonged contract for an extra year. The number of participants was increased by 50 customers that have installed a heat pump. In total 75 households participated in the project. An additional 75 customers to Skånska Energi that will not be alerted of peak prices, are used as a reference group.

Technologies deployed:

No extra technologies were deployed in this project.

Customer offerings:

The customer was in this trial offered a supply contract using an alternative tariff structure, where the supplier could charge an extra high price during a certain hours per year. No other offers were made.

Customer engagement approach:

The customers involved in the preceding project were sent a regular mail with the new offer in a similar way as the previous project. The report [2] does not describe how the new customers were engaged in the project, but it is reasonable to assume that the same procedure by using mail was applied. Hence, the customers voluntarily made the choice to join the trial.

Smart metering:

In order to perform hourly billing, hourly meter reading was applied in the project. The smart meters was only used for collecting data, no feedback information to the consumers was performed using the meters. The feedback to the consumers was performed through the energy bill only.

Tariff

As for the preceding project, the customers were offered a price scheme based on hourly critical peak pricing with a rebate for all the remaining hours. However, in this project the rebate is modified to
reflect a proportional rebate to the number of hours of peak prices. If peak price was applied for 40 hours/year, the rebate was 7.6 öre²/kWh. If peak price was applied for 20 hours/year, the rebate was decreased to 3.8 öre/kWh. If more than 40 hours of peak pricing was applied, the rebate was proportionally increased.

Also in this project, the price scheme was designed so it would be cost neutral in relation to the normal prices if the consumers didn’t take any actions. If the consumer reacted on the price signal, the consumers could reduce their electricity bill.

**Remote / Automatic Control of Appliances**

Not applicable in this project.

**Information and Data Sharing**

The consumers got information about situations with extra high prices by text messages to their mobile phones or by e-mail the day before the actual hour. Thereby they had time to react to the peak prices. The information to consumers consisted by their ordinary bill (no extra information was provided).

**Advice / Customer Engagement**

The households received advice on how to temporarily reduce their electricity consumption when they were given the offer to join the trial. This was performed by supplying the consumers with a short document in the same mail. Hence, the information was provided by the power company. The document concerned general advice (e.g. avoid using dish washer) and advice depending on the heating system that the consumers were equipped with (e.g. switch to firing bio fuels for heating).

**Results:**

During the winter 2006/2006, very low outdoor temperatures occurred. Within one period night temperatures was as low as -15 to -18 degrees Celsius three nights in a row. The extra high price was applied for 33 hours during 11 different occasions. 8 of these occasions concerned the time period 7-10 am, and the remaining three occurred between 8-10 am, 4-7 pm and 6-7 pm.

The results show that load reduction in percent was lower than in the former winter periods of the preceding project. The reason for that is probably the high numbers of heat pumps than earlier. The need for electricity for heating purposes has thus been lower. In contrary the reduction in kW has been higher due to lower average outdoor temperatures, which means need for increased heating.

\[1 \text{ öre} = 0.01 \text{ SEK.}\]
Key lessons learnt (to date):

Key lessons:

- Even though no technical equipment was installed at the consumers, it is still possible to achieve significant peak reductions.
- Even when very low outdoor temperatures, customers are willing, capable and persistent to substantially reduce the load when peak prices are alerted. This has not been proven during earlier years, due to milder winter periods. The business model has thus proved to be valid even at temperatures when load shortage is more likely to occur.
- The results of the analysis considering the load characteristics of the heat pumps which extract heat from the outdoor air, shows a surprisingly linear function of outdoor temperature. This means that the concerns of an electricity supply network power shortage in case of low temperatures caused by an increasing number of heatpumps, in not as serious as expected. This has been shown at temperatures down to -18.
- Due to the thermal heat storage in the house, the need for heating is even out during the day. During the test period the outdoor temperatures varied substantially between day and night, which strengthen the impact of the thermal heat storage on the test results.
- The analysis also showed that the economic advantage of heat pump is not as extensive as expected. This can be explained by the fact that the heat pump does not serve the total need of heating. It is likely that many homes in addition to heat pump have direct heating in bathrooms, hallways and kitchen. In addition many households have not of practical or economic reason, converted to heatpump heating in other building such as garage, storage buildings etc.

Major barriers encountered (to date):

No key barriers were pointed out in this project.

References:


Description:

The distribution system operator Sala Heby Einät AB, a local distribution system operator located in the eastern part of Central Sweden, installed smart meters and introduced in April 2006 a new tariff structure to investigate the possibility to decrease the system load using a demand charge in the residential sector. The new tariff was introduced in April 2006 and analyses of the impact on the demand for time period April 2006 - December 2008 are available. The study was performed by statistical analyses and by in-depth interview with a sample of the households. The results from the project are summarized in the paper [1].

The period of analysis comprised the twelve-month period preceding the introduction of the demand-based tariff, i.e. April 2005–March 2006, and the two twelve-month periods following the implementation, i.e. April 2006–March 2007 and April 2007–March 2008. In accordance with the above delineation, the period of analysis was further divided into the summer seasons 05, 06 and 07, the winter seasons 2005–2006, 2006–2007 and 2007–2008 as well as peak and off-peak periods.

Customers involved:

The customers involved in the project would fall into categories the “Households – Non fuel poverty” and “No on-site generation”. In total 500 households were exposed to the new tariff in the project, whereof 232 households were included in the study presented in [1].

Technologies deployed:

No technologies was deployed in this project.

Customer offerings:

The consumers were exposed to a new grid tariff design by the DSO. There were no possibilities to change tariff, and hence, no offers were made to the consumers in that sense.

Customer engagement approach:

All the 500 households covered by the pilot project were contacted by phone and requested to answer a set of questions on date of moving in, number of family members, square meter living space, space and water heating system and any recent changes in that regard, use of the statistics service and whether they would consider participating in an interview study. 362 of the 500 households answered the survey questions. Among those, 232 respondents were favorably disposed to being interviewed. These households were grouped into categories according to space heating system, and further divided according to the number of household members. Outgoing from this, ten families with an aggregate of 19 family members living in single-family and row houses were picked for in-depth about electricity consumers’ perception of and experience with the time-of-use tariff.

Concerning the statistical analyses, the distribution system operator provided the tariff rates and hourly meter readings of the individual households. However, due to incomplete time series, the number of households included in the analyses had to be reduced to 50.

Smart metering:

In order to perform hourly billing, hourly meter reading was applied in the project. The smart meters was only used for collecting data, no feedback information to the consumers was performed using the meters. The feedback to the consumers was performed through the energy bill only.
Tariff

In the project and demand-based time-of-use grid tariff was applied. The demand-based tariff is made up of a fixed access charge (EUR) depending on fuse size (A) and a variable distribution charge (EUR/kW) that is calculated on the average of the five highest meter readings (kW) in peak hours. In off-peak hours electricity distribution is free of charge. Hours in weekdays between 7a.m. and 7p.m. have by the distribution system operator been defined as peak hours, while remaining hours are referred to as off-peak hours. The rate of the demand-based tariff also varies between the summer and the winter seasons, which range from April to October and November to March.

The households did not have the choice to opt in for the tariff or not; they were all subjected to the grid tariff. The tariff was introduced in April 2006 and is still in use.

Remote / Automatic Control of Appliances

Not applicable in this project.

Information and Data Sharing

For billing purposes the distribution network owner collects hourly demand data, on which the bill is based. This information is only used for this purpose and no third party has access to this data. The feedback information to consumers consists of the information in their electricity bill, but also by statistics presented through a personalized web page supplied by the DSO.

Advice / Customer Engagement

The households were informed about the tariff through a booklet on the demand-based tariff that was distributed together with the electricity bill in connection with the implementation of the new tariff. Hence, the information was provided by the power company. The document described the different components of the tariff.

Results:

The changes in the demand curve is illustrated in the figure below from [1]
The figure shows the following: (a) Relative changes in the shape of demand curves representing weekends and weekdays in the summer seasons of 2006 and 2007 in relation to the summer season of 2005. The light gray areas represent off-peak hours, whereas the white area represents peak hours. (b) Relative changes in the shape of demand curves representing weekends and weekdays in the winter seasons of 2006–2007 and 2007–2008 in relation to the winter season of 2005–2006. The light gray areas represent off-peak hours, whereas the white area represents peak hours. Source: [1].

As can be seen in the figure, an overall decrease in electricity usage can be identified. Further, the shift in the demand has resulted in a new peak in demand between 8 and 9 pm during summer, and 7 and 8 during winter. Seeing that these peaks occur in off-peak periods, they are however of no negative consequence to the distribution system operator in question.
**Key lessons learnt (to date):**

Households are generally sympathetic to being charged according to a demand-based tariff, seeing as how the distribution system operator’s motive for introducing it relates to environmental issues.

Assessing the hourly meter values are not always easy, and the databases containing the data are not always adapted for presenting feedback back to the consumers.

Feedback through web pages on the consumption levels is considered by many consumers as too longwinded and time consuming for them to get around and use it regularly.

**Major barriers encountered (to date):**

No key barriers were pointed out in the reporting of this project.

**References:**

SE 4. Information through digital channels and its potential to change electricity consumption patterns

Description:

The main objective of this project was to investigate the potential of changing electricity use patterns in various types of housing thanks to improved information. Three case studies were conducted in collaboration with three grid companies:

1. Skånska Energi AB (in Södra Sandby outside Lund) with an Internet-based statistics service “My Electricity Use” [1];
2. Öresundskraft AB (in Helsingborg) with its service “Your Pages” [2]; and
3. E.ON Sweden AB (in Malmö), with Internet-service “Energy Dialog - Private” [3].

A synthesis of these three trials is presented in [4].

All the studies used statistical data to analyze how the annual energy consumption changed between years, and if there were any impact of the use of the web based services provided by the DSOs where the households could follow their electricity consumption. Also, questionnaires were sent out to the participating households containing questions about the household, their energy behavior and the use of the statistical service.

The statistical data varied some between the three studies. In 1, data for the years 1999 – 2008 were used. In 2, the corresponding time frame was 1998 – 2008, and in 3 June 2008 – May 2009.

Customers involved:

In all three case studies, the participating consumers were selected by the researchers and the DSO in cooperation. The projects themselves included many more consumers, which all had access to the web service, but could use it as they pleased.

In study 1, 300 households were selected to be included in the study. The selected households consisted of single family houses, and constituted a mix of electric heating, heat pumps, and other heating alternatives. They had all fuse size 20 A.

In 2, 446 households were selected. These were grouped into 3 categories according to the following:

- 200 single family houses having an electricity consumption more than 10,000 kWh/year and a fuse size of 20 A or more. These households all have a heating system based on electricity (direct heating or heat pump).
- 207 flats having no electricity based heating.
- 10 consumers that did not have access to the web based service provided by the DSO. These would act as a reference group in the analyses.

In 3, 500 households were selected by EOn using selection criteria provided by the research group performing the analyses. The households were grouped into the following three groups:

- 200 single family houses having an electricity consumption more than 10,000 kWh/year and a fuse size of 20 A or more, that participated in the “Energy Dialog - Private” trial.
- 200 flats (without electric heating) participating in the “Energy Dialog - Private” trial.
- 100 mixed households not participating in the “Energy Dialog - Private” trial. These worked as a reference group in the analyses.
Referring to the customer segmentation, all households that participated in the trial would fit into the category, “Non Low Income/ Non Fuel Poverty Household” and “Without on-site generation”.

**Technologies deployed:**

No technologies was deployed in this project. However, the three trials all included web sites presenting statistics as feedback to the consumers.

**Customer offerings:**

The three projects all had web services where the customers could get information about their electricity consumption. No other offers were made.

**Customer engagement approach:**

The approach for consumer engagement was similar in the three trials. The consumers were offered to use the web page provided by the DSO in order to get a better understanding and control of their energy consumption. Hence, the consumers voluntarily joined the project. The offers were distributed by regular mail.

The analyses of the trials, including sending out the questionnaires, was performed by Lund University. The sender was thereby the university and not the DSO.

**Smart metering:**

Smart meters were not a part of these trials. The statistical service provided by the DSO was not based on hourly metered values, and the analysis was based on annual energy consumption levels.

**Tariff**

No specific tariffs were applied in these projects.

**Remote / Automatic Control of Appliances**

Not applicable in this project.

**Information and Data Sharing**

No data was shared with any third party in the projects. The consumption data was used to give feedback to the consumers on their consumption levels

**Advice / Customer Engagement**

The consumers were engaged in the trial by the involved DSOs. The statistical analyses were performed by Lund University and the questionnaires were sent out by the university.

The information to the consumers mainly consisted of how the web service worked and what kind of information they could get from the web service. Not much information about how to reduce their energy consumption was given. This information was provided by the DSOs.
Results:

Trial 1

The main hypothesis of this study assumed that the statistics service, as a way to inform households, may lead to lower electricity consumption, thanks to better understanding of energy use patterns and costs. This hypothesis was not confirmed; the analysis showed that electricity use totally for all the users of the service as a group actually constantly increased while it decreased for the non-users group. However, the majority of the users of the service have reduced their energy consumption, but since the ones who have increased their consumption have increased a lot, the total mean shows an increase in consumption.

Trial 2

The analysis of trial 2 showed that electricity use totally for all the users and non-users living in flats constantly increased while it decreased for the both groups for households living in single family houses. The decrease for single family houses was almost 15% the third year of the trial, as illustrated in the figure below. The figure shows relative change in consumption for single family houses, where the value 1 is equal to the mean of the 3 years before the start of the trial. As can be seen, the consumption decreases the three years included in the statistical analyses.

Trial 3

The analysis of the consumption levels in trial 3 showed that electricity use totally for all the users and non-users of the web service was on almost the same level as before (-0.04 % for the users and +0.02 % for non-users). In the users group, the share of the households who had increased their consumption levels was 47%, and the share who had decreased the consumption was 44% (the remaining 7% had less than 100 kWh/year in change). The non-users group show a similar behavior.
Key lessons learnt (to date):

The results of the three trials can be summarized in the following conclusions, as stated in [4]:

- It is impossible to state whether the usage of the statistics service leads to reduced or increased electricity use in the households.
- The explanation why the households using the statistics service often have had growing electricity usage could be that the rising power consumption caused a need to have better control over electricity needs and energy bills, and households started to use the statistics services for this reason.
- It is unable to prove that users of statistics services have had significantly better energy use and conservation behaviour than non-users.
- Households that have received the highest grades in the energy use profile belonged often to the user groups "elderly (65+)" and "home owners".
- Energy advice, as part of the statistics service, was required by several customers. There should be more information together with statistics service for users as a tool for achieving better energy efficiency.
- Lack of time, problems with the service and lack of contact with the company were the main reasons to not use of the statistics service.
- It requires a lot of interest and commitment among households if the target is to lower electricity consumption. The statistics service can give residents a good basis for decisions on energy conservation and energy efficiency and provide good information to improve knowledge, attitudes and behaviour.

Major barriers encountered (to date):

No key barriers have been pointed out.

References:


UK 1. Energy Demand Reduction Trial (E.ON)

Description:
The Energy Demand Research Project (EDRP) was a major project in Great Britain to test consumers’ responses to different forms of information about their energy use. Four energy suppliers each conducted trials of the impacts of various interventions (individually or in combination) between 2007 and 2010. The interventions used were primarily directed at reducing domestic energy consumption, with a minority focused on shifting energy use from periods of peak demand. Measures were generally applied at household level but one supplier also tested action at community level.

The trials were undertaken by four energy supply companies: EDF, E.ON, Scottish Power and SSE.

There were over 60,000 households involved in the whole trial, of which 18,000 were given smart meters.

This case study provides a summary of the trial conducted by E.ON.

Customers involved:
The E.ON trial involved a total of 28,450 households, which were divided into one of the following three groups:

- Control group – 13,596 households
- The non-smart meter group - 6,799 households
- The smart meter group - 8,055 households

This trial was novel by virtue of the fact that the customers were not aware they were participating in a trial. E.ON used its customer base in the midlands to recruit for its trial. Rather, customers were selected by the Supplier from its existing customer base. Only customers on standard, Age Concern or green tariffs were eligible for selection. Customers with no consumption history (i.e. new builds or with fewer than 2 actual meter reads in the preceding 12 months) were not included. Customers with pre-payment meters were also excluded.

Interventions deployed:
Each trial group received a range of interventions, as indicated below. Not all customers received all the interventions. For example, some customers only received the energy efficiency tips, whilst others also received the RTD display.

Non-Smart Meter Group
- Additional bill data: graphs on quarterly bills showing historic energy consumption information.
- Energy efficiency advice: monthly tips sent by post.
- Real time display: clip-on RTD showing current electricity use, cost, CO² emissions and historic data.
- Customer engagement: monthly request for customer to read meters and provide the reading to E.ON, so that E.ON could provide accurate bills (referred to as the “Hawthorne” group).

Smart Meter Group
- Smart meter.
- Accurate billing and no meter reading visits.
- Monthly bills.
- Additional bill data: graphs on monthly bills showing historic energy consumption information.
- Energy efficiency advice: monthly tips sent by post.
- Real time display: mains RTD showing current electricity and gas use, cost, CO₂ emissions and historic data, plus a “traffic light” indicator of current consumption.

In each of these Groups, customers were categorised into one of the following:

- Fuel poor (FP)
- Not Fuel poor (NFP)
- High Baseline Use (HU) – with a consumption of more than 7,000kWh/year of electricity
- E7 – with an off-peak tariff

**Customer offerings:**

Customers did not opt-in to the trial, rather they were provided with the interventions identified above as if it was ‘business as usual’. The only exception to this involved the Smart Meter households, who had to consent to having a Smart Meter installed. Again, this was very much presented as a ‘business as usual’ task, and the main issue was with gaining access to the property for the meter installation.

**Customer engagement approach:**

As mentioned previously, households in the non-smart meter trial groups were sent interventions as if this was business as usual. They were not invited to become part of a trial, nor were they aware that they were participating in a trial.

All E.ON control households were selected without the knowledge of the households and received no trial interventions.

**Smart metering:**

All the smart trial groups required the households to accept the Smart Meter. Letters were sent to households describing the benefits of the particular combination of interventions they were being offered. The letter did not tell customers that they would be part of a trial. Towards the end of the recruitment process, E.ON also used the reason of meter recertification as a means of persuading customers to agree to smart meter installation.

**Tariff:**

Customers continued with their existing tariff arrangement, which was a standard flat rate tariff or for the E7 customers, an off-peak tariff with 7 hours of cheap electricity during the night.

**Remote / Automatic Control of Appliances:**

No remote or automatic control devices were evaluated as part of the trial.

**Information and Data Sharing:**

Customers were not aware they were taking part in a trial, and data sharing was ‘business as usual’, i.e. between the customer and the Supplier. As such, no special provision had to be made regarding data sharing. The data was subsequently analysed by an independent company (AECOM). It is not known what provision, if any, was required to enable customer data to be shared in this way.
Advice / Customer Engagement:
The non-smart meter trial participants were sent monthly tips by post. Smart meter trial participants were also given additional bill data such as graphs on their monthly bills showing historic energy consumption information.

The monthly energy efficiency tips were deployed in both non-smart and smart trials. However, the intervention was accidentally withdrawn for 12 months. Thus, the smart meter group only received the full set of inventions measures a year later than intended.

Results:
The data from the trial was analysed by both the Energy Supplier and an independent Consultant (AECOM), and the results are published. Some key findings from these analyses were:

- None of the interventions trialed with the non-smart meter group had a significant impact on electricity consumption;
- Significant reduction in energy consumption were achieved by High Energy users;
- Significant reductions in energy consumption persisted until year 1 / quarter 3. In the fuel poor category, savings increased over time;

Qualitative data was also collated through consumer surveys. The data collated from these surveys have also been extensively analysed to explore the responses and whether or or the responses are linked to the group with which the respondent belonged.

Some of the findings of this analysis include:

Energy Efficiency Advice:

- Respondents were asked whether they recalled receiving advice on reducing energy consumption. The analysis showed there was a significant difference between responses from the trial groups (i.e. with or without a smart meter). Overall, 57% recalled receiving the advice. However, 48% recalled the information if they had been provided with an RTD compared to 65% of those who had not.
- Regarding the usefulness of the advice, 8% of respondents found it “Not at all useful”, 20.7% found it “Not very useful”, 50.9% found it “Quite useful” and 19.6% found it “Very useful”.

Interpretation on the overall findings suggest that

- Advice on heating, lighting and appliances is the easiest place to start
- More work is needed on delivering advice relating to cooking. This could be due to the fact that cooking involves decisions that “distract from, override or are unrelated to energy use”.

Real Time Displays:

Households given a RTD included:

- Those given the a clip on RTD for the electricity consumption only, but no advice was given
- The RTD as above, but this time, advice was provided.
- A mains (i.e. not battery) RTD displaying both gas and electricity data.

Intriguingly, less than half of the respondents (40.7%, 42.0% and 48% respectively) were aware they had a RTD display.
Among those who knew they had one, around half (51-54%) looked at it every day. However, the proportion that looked at is less often increased with the complexity of the intervention.

Approximately 80% of the respondents though the display was either “Very useful” or “Quite useful”.

The RTDs trialed also differed, with different features and displays on the battery-operated units compared to the mains-fed unit. This made it impossible to determine which features were liked overall. The following describes the responses relating to each type of RTD:

- For those with the mains-fed RTD, the most useful feature was the ‘traffic light’ system, with current electricity using in kW the least useful. There was no different in the overall ratings given to numeric or graphic displays of information.
- For those with the battery operated RTD, the respondents rated cost and temperature information the most useful. The least useful was greenhouse gas emissions and usage alarm features.

Action Taken:

Respondents were also asked whether they had taken (and/or were still taking) a range of actions that could reduce energy consumption. The results suggest that a high number of respondents claimed to have taken action. With the claims being similar for across the groups, as summarised in the following Table. This makes it difficult to explain why the High Energy Users exhibited such large reductions in energy consumption if the claimed level of action taken was similar. The authors claim that this might suggest doubts over whether the energy reductions seen by the High Energy Users are in fact genuine, and not a ‘regression to the mean’.
<table>
<thead>
<tr>
<th>Action</th>
<th>Had taken action</th>
<th>Still taking action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FP and NFP</td>
<td>HU</td>
</tr>
<tr>
<td>Turned the thermostat down</td>
<td>70.2%</td>
<td>73.0%</td>
</tr>
<tr>
<td>Reduced the amount of time your heating is on</td>
<td>70.8%</td>
<td>70.2%</td>
</tr>
<tr>
<td>Have showers instead of baths</td>
<td>71.2%</td>
<td>75.6%</td>
</tr>
<tr>
<td>Fitted a hot water cylinder jacket</td>
<td>34.5%</td>
<td>34.2%</td>
</tr>
<tr>
<td>Filled kettle less</td>
<td>75.3%</td>
<td>75%</td>
</tr>
<tr>
<td>Put pans on lids when cooking</td>
<td>73.4</td>
<td>75.2%</td>
</tr>
<tr>
<td>Used lights less</td>
<td>79.7%</td>
<td>78.0%</td>
</tr>
</tbody>
</table>

**Key lessons learnt (to date):**

One of the key lessons learnt is that care must be taken in the original decision of a trial to ensure than statistically meaningful conclusions can be drawn. Even with a trial of this size, it was difficult to ascertain the level of energy reductions delivered and whether these were statistically significant or not.

Other key learning points reported from the overall trial were:

- The overall smart metering system needs to deliver reliable communication. Problems were identified with Home Area Network (HAN) and Wide Area Network (WAN) communications. Greater communication reliability is required for any system that is rolled-out to all customers. Even a small percentage of problems could result in a large number of homes being affected.
- Smart meter data will have inconsistencies and, therefore, data validation processes need to be agreed to check the data, and edit it as necessary, for correct operation. This is particularly the case where data cleaning needs to happen across several different market participants. Furthermore, rules will have to be devised for gap-filling for the half-hourly data if used for billing purposes.
- Marketing and advertising campaigns at a national level, local/community level, and from trusted organisations are required to generate a broad level of awareness across all customer groups.
- Messages should be built into awareness campaigns to mitigate against negative publicity from customers attributing (for example) boiler faults to the meter change and rollout programme.
Major barriers encountered (to date):

It was reported that a significant cause of aborted installations was caused by problems caused by the customers themselves. Examples include where the meters were made inaccessible by fixed items such as kitchen cupboards or alterations to walls at the property. This was generally caused by customers’ lack of awareness of the need to ensure access to their meters. Other problems include lack of space for the smart meter installation.

References:

Energy Demand Research Project Final Analysis
UK 2. Charm Research Project (Home Energy Study, bActive and iGreen)

Description:

Charm is a research project that investigated whether the day to day behaviour of individuals could be changed by feeding back information on their own behaviour and that of others. The study revolved around the use of social norms and practice theory.

Social norms approach attempts to influence behaviours by providing information about what most people do, or think should be done.

The study employed practice theory to understand how participants responded to the digital feedback they were provided, by focusing on practices such as ‘doing the laundry’ rather than on individuals or societies.

The study consisted of three parallel trials, as follows

- Home energy study
- iGreen
- bActive

In each study, participants were divided into three groups:

- feedback group, that received feedback on their own behaviour
- a social norms group, that received feedback on their own behaviour and that of others
- control group, that received no feedback

The aim was to explore the extent to which information on social norms could be used to encourage behaviour change.

Customers involved:

The Home energy study trial involved a total of 400 households professionally recruited via door-to-door contact. However, only 316 of these successfully completed the trial.

The iGreen study used a Facebook ‘app’ to collect information on certain sustainable practices. The ‘app’ was publicised at three Universities and on a number of social networking sites. A total of 2,800 people downloaded the iGreen app, but only 52 completed all seven rounds of the associated quiz about their behaviour.

The bActive trial used a smart phone based ‘app’ to record how much walking participants undertook over a 6 weeks period. As participants were required to carry the phone in their trouser pocket, participation was restricted to male participants. Participants were recruited from the Bristol area, using a free Smart Phone as an incentive for participation. One hundred and fifty one participants took part in the trial, completing pre- and post-trial surveys, and 27 participants completed individual interviews or focus group sessions.
Technologies deployed:

Home Energy Study
The Home Energy Study employed an existing ‘Real Time Display’ connected to the existing electricity meter via a current transformer around the incoming supply. The Display was modified so that the data could be transmitted via mobile phone signal to a central server. Participants in the feedback groups were sent weekly emails showing a graph of their own electricity consumption pattern in two-hourly blocks, together with energy saving tips. Those in the social norms group also received feedback on the average and ‘best performing’ consumption of other participants in the trial.

iGreen
The iGreen trial involved a series of seven questionnaires looking at sustainable behaviours running as an ‘app’ on Facebook. Thus, no specific technologies were trialled. All were asked a set of questions on seven separate occasions over at least a 6 week period, and the responses were analysed to determine whether or not there was any change in the responses during the course of the study. Those in the individual feedback group were provided with information on how they responded last time they took the questionnaire, whilst those in the social norms group were also provided information on how others responded. Those in the control group received no feedback at all. For example, a typical question was ‘Last week, how often did you leave the tap on whilst doing the washing up?’.

bActive
For this trial, an ‘app’ was developed for a Smart Phone, to enable the amount of walking undertaken by participants to be collated via the accelerometer within the phone itself. As with the iGreen study, those in the individual feedback group were provided with information on how much they had walked, whilst those in the social norms group were also provided information on how far others in the trial had walked. Those in the control group received no feedback at all.

Customer offerings:
Participants in the Home Energy Study were offered a £80 incentive to take part in the trial, half paid up front and half on completion.

Participants in iGreen study were incentivised to complete questionnaires through prize draws and access to sustainability themed games that could only be accessed after the questionnaire was completed.

Participants in the bActive trial were incentivised to take part in the trial through the offer of the free phone.

Customer engagement approach:
Home Energy Study
Once in the trial, the consumer engagement focussed around the weekly emails sent to the participants during the 18 week study. The emails comprised an example graph of their own consumption pattern on a single day, which also included information on the consumption of others for those in the social norms group. The number of times that these graphs were viewed (on average) by the households is shown below:
- individual feedback group: 13.4 times
- social norms group: 19.8 times

This suggests that those provided with information on how much electricity was consumed by others were more engaged. However, when asked whether they had tried to save energy and whether they thought they had saved energy, the responses from the two groups were the similar, as indicated below.

<table>
<thead>
<tr>
<th></th>
<th>Claimed that tried to reduce electricity</th>
<th>Claimed that did reduce electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>37%</td>
<td>19%</td>
</tr>
<tr>
<td>Individual</td>
<td>88%</td>
<td>53%</td>
</tr>
<tr>
<td>Social norms</td>
<td>86%</td>
<td>57%</td>
</tr>
</tbody>
</table>

**Smart metering:**

**Home Energy Study**
No smart metering involved – customers retained their existing dumb meters

**iGreen**
No metering involved

**bActive**
No metering involved

**Tariff (Intervention type T)**
None for any of the trials

**Remote / Automatic Control of Appliances (Intervention type C)**
None for any of the trials

**Information and Data Sharing (Intervention type F)**
Examples of the information provided to participants is provided below.
Feedback with social norm data for Home Energy Study trial

Three versions of the app

Control

Individual feedback

Social feedback

Thank you for participating in bActive! Press the home button to leave this screen.

Steps 3490
Calories 174 cal
Distance 2.6 mi

Steps 3490 1797
Calories 174 cal 90 cal
Distance 2.6 mi 1.3 mi

Feedback for bActive trial
Advice / Customer Engagement (Intervention type A)

Customers in the Home Energy Study (excluding those in the control group) received energy saving tips via a weekly e-mail. For example, one of the e-mails warned about ‘vampire energy usage’ to encourage householders to turn off appliances rather than leave them idle or in ‘standby’. Householders were also able to access more detailed information on any of the information raised in the e-mails via a link to a web-site.

Customers in the bActive and iGreen trial were not given any advice or tips, other than the feedback provided to those not in the control groups. However, the games available on the iGreen trial were focussed on sustainable activities such as recycling, which could have helped to raise awareness of green issues.

Results:

In the Home Energy Study, the quantitative analysis showed that the social norms condition did not, on average, change energy consumption more than those who received individual feedback. However, the participants did download the emailed graphs significantly more often. This would tend to suggest that the social norms feedback was more engaging.

In-depth interviews were conducted with 24 participants. The results of this qualitative analysis showed that participants were focused on the issue of wastage, and particularly the avoidance of wastage rather than any monetary savings made. This was identified as a desire to be frugal (i.e. careful use of money or resources) rather than thrifty (i.e. preserving resources for further consumption). However, this desire was offset by a number of other factors including personal preferences, upbringing, identity, social expectations, household relationships and material constraints.

The results also indicated that the level of feedback needs to be disaggregated such that particular behaviours that are wasteful can be identified. This could include feedback in small time intervals so that individuals can match the pattern of consumption to particular practices in the home. Similarly, feedback on how often other people use the washing machine may also be useful.

In the bActive trial showed some interesting results in terms of the impact of social feedback on motivation. Some individuals were very competitive, and liked winning and beating the average. However, others avoided looking at the graphs because of the comparisons. Some participants noted that they walked more on days when they thought they could beat other participants in the trial, but walked less on other days. As with the Home Energy Study, the results of the quantitative analysis showed that despite creating competition, there was no evidence that those provided with social feedback walked more as a result.

Participants in the iGreen study all claimed to have changed their behaviours. This could be due to the questions ‘reactivating’ existing beliefs (norms) and reminding participants to act on existing intentions. Although the participants found the onerous quiz questions to be onerous, resulting in high drop-out rates, the quizzes and games were enjoyable.

In all the studies, participants were able to interpret the graphical traces, and were quickly able to understand the implication of the peaks and troughs and compare themselves against the social norm. Individuals were also able to interpret the graphs and link the display to their own practices.
Key lessons learnt (to date):

Quantitative analysis of the three studies did demonstrate that social feedback resulted in a significant change in behaviour. However, the qualitative analysis did show evidence of increase awareness of existing behavior. It also highlighted that whilst there is often a strong desire to do the ‘right thing’ (be that save energy, walk more or be more ‘green’) there are a number of other factors that impact on behavior change. For example, the desire not to be ‘smelly’ limited behavior changes linked to personal hygiene (washing clothes or showering). Similarly, the responses of other people in the household can frustrate efforts to reduce energy consumption.

The bActive study showed that social feedback produced a strong competitive strong in some, whilst it was strongly disliked by others.

Major barriers encountered (to date):

Each study was a relatively small sample size, that may have limited the impact on determining the impact of social feedback.

References:

This case study is prepared based on presentation made at the Charm Conference, 27 February 2013, British Academy, London. More information can be found at http://www.projectcharm.info/
UK 3. Thinking Energy

Description:

Programme overview:

A smart home can be described as the intelligent integration of household devices into a network that brings benefits and new functionalities to the customer and value to E.ON. For instance, a customer might see advantages in terms of reduced cost, improved convenience, greater control, higher levels of comfort or a smaller carbon footprint.

Attempts have been made in the past to bring the Smart Home to market, but they have failed to reach mass market penetration. It is E.ON’s belief that increased internet connectivity, more user-friendly devices, improvements in open standards and pressure on energy bills mean that the market for smarter homes has moved from a niche to a more desirable one.

However, the ‘winning’ concepts for smart home systems are still unclear. Therefore, E.ON is working collaboratively with platform providers and business partners to achieve the best outcome.

To achieve this, Thinking Energy is a three-year research, demonstration and development programme looking at the Technical Readiness, Customer Acceptance and Value Opportunities of Smart Home technologies in domestic settings.

As part of this, various concepts have been defined from functions of daily domestic life such as Power, Heat, Light, Mobility and Hot Water.

Thinking Energy is used as E.ON’s “factory” where design, development and testing of these concepts will take place. These aim to integrate technologies in a customer-friendly way which may reduce cost, improve convenience, allow greater control, raise levels of comfort or reduce their carbon footprint.

The technology:

Thinking Energy is not primarily about a technology, since customer behaviour is the key to successful Smart Home products and services. However, this is facilitated by the technology which E.ON is testing, developing and launching.

75 households in Milton Keynes (45 miles north-west of London) have been selected as trial participants to give real-life feedback from real people in real homes. This ensures that the products and services which E.ON launch across Europe have been proved in realistic environments.

The technology provides householders with a system which monitors and controls energy consumption, appliances, lighting, heating and hot water. The customers have access to an online portal, mobile phone app and in-home display.

The trial:

The trial is a three-year programme which models itself as a ‘genuine journey of investigation’ as neither the E.ON team nor the participants know where it will lead. Some initial questions were clear (such as “how much energy can be saved by intelligent monitoring and control?”) – other routes of enquiry will come up as research is carried out.

Customers involved:

The customers involved in this trial all volunteered to take part. One of the selection criteria was that householders involved must own their own home, to make permissions for any changes or alteration simpler. Some householders had on-site generation prior to becoming involved in the trial.

Technologies deployed:

Smart Home Platform

Each component of the system communicates with the platform by wireless communications, to ensure that it is plug and play, with no need for re-wiring, plumbing or drilling. Each component can be monitored and controlled remotely by an online portal, smartphone app or in-home display. The control system allows the householder to monitor the energy use of the household or individual
appliance and compare energy use over a time period, or with the energy use of other households of a similar composition (based on number of occupants and size of house at the moment but potentially becoming more sophisticated). Messages and energy saving tips can also be sent through to the system by the energy company. If the household generated electricity the technology can calculate the net saving provided by this generation compared to if the householder was buying all the electricity that they used from their Electricity Supplier.

**Total Household Energy Consumption**

Total household energy consumption data is collected by the system in preference from a Smart Meter, however if a Smart Meter has not been installed consumption data can be collected from a ‘dumb’ meter by other means. The system can also monitor any electricity generation by the household from photovoltaic panels for example.

**Appliance control**

Household appliances can be monitored and controlled via plug-adaptors that go between the appliance plug and the wall socket. Multi-socket strips for multiple appliances are also available. Appliances and lighting can also be grouped so that the entire group can be turned on or off together with ease. Thus appliances that are frequently left on standby because the socket that they plug into cannot be reached could be turned on or off via the system. Data visualisation from the individual appliance can be viewed, and compared to other monitored appliances.

**Central Heating and Domestic Hot Water**

The system allows the temperature to be controlled by a central thermostat via individual temperature sensors in each room. The system also controls when the central heating and hot water turns on. Schedules can be inputted for different days of the week. This schedule can be altered remotely to either advance or delay when the heating and hot water system is due to turn on, or turn the heating or hot water system on or off.

**Customer offerings:**

The technology is being offered to the householder as a means of providing additional Comfort, Convenience and Control. Customers do not need to switch energy tariffs or even be supplied by E.ON.

**Customer engagement approach:**

E.ON posted leaflets to 6,000 households in the Milton Keynes area. Three hundred households responded to the mailshot. Two hundred were selected for face to face interviews. One hundred and twenty had their houses surveyed for suitability. From this group, seventy five households were selected to participate in the trial.

**Smart metering:**

A Smart Meter is desirable when installing the system, but not essential.

**Tariff:**

No tariffs were offered as part of this trial.

**Remote / Automatic Control of Appliances:**

Initially, the participants received whole home energy use monitoring and visualisation, with no control. They were then given appliance level monitoring and control. Some have now received whole home gas central heating control through the system, and full visualisation of PV generation.

The participant are divided into four groups, who are each set to receive different technologies; smart white goods, connected LED lighting, connected electric vehicles and home battery systems and more advanced heating and hot water systems.

The trial continues to examine how much householders are willing to cede control of their energy consumption in favour of increased comfort or reduced bills.
Information and Data Sharing:
The householders’ energy data was not shared with any other organisations apart from for the purposes of research by academic institutions.

Advice / Customer Engagement:
On-going advice will be offered to households via their energy control system suggesting ways that they could reduce their energy use.

Results:
Householders are very positive about the system. They use the system to educate themselves about energy use in the home, and have become far more energy aware as a result. They like the extra control that it gives them over appliances, and their energy consumption. The system also provided them with greater heating comfort, with many suggesting that the system gave them greater control of their central heating system than they had previously been able to achieve. Householders used their ability to remote control appliances in unexpected ways, such as to turn on the kettle as they were about to get home from walking the dog!

Eighty per cent of householders thought that they had reduced their energy usage as a result of the technology, although this did not result in reduced bills necessarily because of increases in the cost of energy over the trial period. Some households made dramatic cost savings as a result of being able to run appliances more efficiently, discovering that they were faulty or not operating in a way that they had expected.

Key lessons learnt (to date):
- Customers became significantly more knowledgeable about their energy use, allowing them to make informed decisions about their usage, including trade-offs
- Customers valued the extra control of their energy usage that this system provided them with;
- Many commented that they were able to achieve a higher level of control and comfort from their heating system with the new technology;
- The technology is valued for its ability to add to a households’ lifestyle rather than its energy saving abilities per se. It is best accepted as a “lifestyle product”.

References:
Further information can be found at:
http://pressreleases.eon-uk.com/blogs/eonukpressreleases/archive/2013/01/14/1913.aspx
UK 4. Customer Led Network Revolution

Description:
While network management and demand response technologies exist and are well documented, this project focuses on deploying these for the first time at the distribution level.

GB is a fully unbundled electricity market. This project involves GB’s largest regional wires-only distributor (Northern Power Grid) and the largest national unaffiliated energy retailer (British Gas).

The aim is to test a range of customer-side innovations (innovative tariffs and load control incentives in association with different low carbon technologies) alone and in combination with network-side technology (including voltage control, real time thermal rating and storage).

This template has been written based on information published by the project up to the end of April 2013. Further detailed results will be released into the public domain as the project progresses.

Customers involved:
Over 14,000 homes and businesses are taking part in the trial in various ‘test cells’ (i.e. trials of different technologies, or different levels of monitoring). This includes the following cells of relevance to Task 23. The numbers given below is based on the number of customers recruited by the end of November 2012:

- Basic monitoring of domestic customer load profile: 8,909
- Enhanced monitoring of domestic customer load profile: 172
- Basic monitoring of SME customer load profile: 1,800
- Enhanced monitoring of SME customer load profile: 88
- Domestic heat pumps: 305 on flat rate tariff, 77 on a ToU tariff, 1 on restricted hours (with some customers to be transferred from the ToU trial), 17 with direct DNO control.
- Domestic micro-chp generation: 13 on flat rate tariff
- Domestic PV generation: 150 (monitoring only)
- Domestic PV with automatic in-premises balancing: 99
- Domestic PV with manual balancing via an In-Home Display: 150
- Domestic electric vehicles: 4
- Profiling for generation under ‘smart tariffs’: 230
- Domestic Time of Use (ToU) tariff: 683
- SME ToU tariff: 51
- Domestic electric hot water: 13 customers with enhanced monitoring (no behaviour change attempted)
- Domestic electric hot water and storage heating: 57 customers with enhanced monitoring (no behaviour change attempted)
- SME restricted hours: 2 (see notes on customer acceptance and the suitability of the offering). It was not possible to recruit any customers for a direct load control trial.

The customer segments (as defined in this project) are therefore ‘general/ non-specified’ customers and those with on-site generation.

Technologies deployed:
At the start of the project it was intended to involve customers with a range of low carbon technologies including electric vehicles, photo-voltaic panels, heat pumps, micro-chp generation and ‘smart appliances’ (externally controllable washing machines).

The uptake of electric vehicles has not been as high as expected and the trials involving this technology have been delayed until further customers can be recruited via other support mechanisms. There have been delays in relation to the availability of suitable externally controllable washing machines.
Customer offerings:
The trial aims to test three tariff types across domestic and small business (SME) customer groups. The three tariff types are as follows.

- **Time of Use** - a static time of use tariff leaving customers with total discretion over how they respond.
- **Restricted Hours** - a static time of use tariff with an additional automated load switching facility which runs key loads outside of peak periods as a default, but allows customers to override this default if they wish.
- **Direct Control** – a proposition which allows certain loads to be occasionally interrupted through external dynamic signals and which does not allow customers to override the interruptions.

A technical solution enabling customers with solar photovoltaic (PV) panels to use the power they generate within the home is also included in the trial. Two systems are under investigation - one automatic system, and the other relying on manual intervention by the consumer (who is informed via an In-Home Display). CLNR should provide insight as to which solution gives most value to the consumer.

Customer engagement approach:
Successful engagement with customers is recognised as critical to the deployment of technologies required for the successful transition to a low carbon economy. Specific tasks include: prioritisation of profile of customers for participation and development of propositions to be offered to customers.

Participation in the trial is voluntary, but customers are offered a £100 incentive to participate (£50 up after enrolment, and £50 once the trial is complete), some customers agreed to participate before the incentive was mentioned.

Preliminary results have reported that the majority of customers have signed up to trials as they feel they can make savings on their bills, and only a few appear to be motivated by reducing their carbon emissions.

The take-up rates experienced to date include 11% for PV propositions and 8% for ToU tariffs. The domestic ToU elements of the trial are now oversubscribed. This runs contrary to the current perception in the UK that consumers require fewer options and reduced complexity in the tariffs system.

It was intended to recruit SME customers to restricted hours and direct control trials. This has encountered difficulties in recruiting customers. 270 customers were initially attracted to the proposition but subsequently withdrew, often citing difficulties in adapt their business at the times required.

Smart metering:
Smart Meters are being rolled out to a large number of customers as part of the CLNR trial. British Gas is also providing historical data for 11,000 existing smart meter customers. The Smart Meters include the following functionality:

- Automated meter reading, with data captured in half-hourly intervals
- In home display, providing information on consumption and cost of electricity and gas
- Direct load control capability

Data analysis of Smart Meter data is currently underway as part of this project (analysis of data from approximately 5,000 residential customers). Less than 2% of customers have opted out of having their data included in this analysis.

Within recruitment for the ToU trial two groups were targeted ‘Smart Exiting’ (those already with Smart Meters) and ‘Smart Eligible’ (those without Smart Meters who could have them installed to take part in
Recruitment rates were 11% higher in the ‘Smart Eligible’ group, suggesting that the installation of a Smart Meter may have been seen as an advantage by the customer.

**Tariff:**

The Time of Use tariff used consisted of a three-rate system, as follows:

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Description</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:00-16:00</td>
<td>Day</td>
<td>4% below standard rate</td>
</tr>
<tr>
<td>16:00-20:00</td>
<td>Peak</td>
<td>99% above standard rate</td>
</tr>
<tr>
<td>20:00-07:00</td>
<td>Night</td>
<td>31% below standard rate</td>
</tr>
</tbody>
</table>

**Notes**

The night rate applies all weekend (Saturday and Sunday).
A standing charge is applied in addition to the per-unit costs

The tariff was designed to be “cost neutral” for the purposes of the trial, such that customers who exhibit no behaviour change on average will not suffer any financial penalty. The incentive available relates to cost savings through load switching (i.e. a reward of a lower bill than normal, not the risk of a higher one). The tariff was only available to customers taking part in the CLNR trial.

Customers opted-in, with a take-up rate of 8% from those approached. The test cell relating to ToU tariffs was oversubscribed.

The tariff was effective from 1st May 2012 and will run for the length of the trial. It is not yet clear if customers will be able to stay on the tariff at the end of the trial.

**Remote / Automatic Control of Appliances:**

Customers in Test Cell 20(auto) had PV generation and automated in-home balancing via the diversion of excess PV generation to heat water via an immersion-heated hot water tank. The customers in this test cell did not also have an IHD.

**Information and Data:**

N/A

**Advice / Customer Engagement:**

Some customers in the PV in-home balancing trial were provided with an In Home Display (IHD) which showed the real-time excess generation. The customer could then use this information to decide whether they could make use of this energy ‘in-home’ rather than exporting to the grid. The display provided is shown below. The green region indicates excess generation (net export) and the red region indicates import of power from the grid.
Results:

Time of Use Tariffs:

It is too early to be able to fully assess the results of the trials in terms of the amount of peak energy reduction or energy savings achieved. Work is ongoing to determine both these results, and conclusions in relation to customer acceptance and behaviour. An interim report has been published showing the early results from the time of use and PV in-premises balancing trials. Detailed surveys are being held with a cross-section of the customers involved in the trials.

Some preliminary results are available in relation to the response of customers to the ToU tariff in the summer. This is shown below, where TC1a (Test Cell 1a) and TC9a (Test Cell 9a) refers to customers on a standard tariff (no intervention) and a ToU tariff respectively.

ToU customers appear on average to have a lower demand between 18:00 and 20:00 hours compared to test cell 1a customers for the same day, implying that the tariff has indeed induced a shift on these two days during the summer. It is also useful to consider the difference in consumption for the trial participants before and after they adopted a ToU tariff, this is shown below.
Customer Recruitment and Acceptance

Interim results are available in relation to customer recruitment, as follows:

- Take-up rate for Time of Use tariff trials was 8%
- Take-up trials involving customers with PV generation was 11%

Almost all the potential customers for involvement in the heat pump trials were in the social housing sector. This identified 950 customer prospects. Of these, approximately 500 were not taken forward, 100 of those were tenant refusals. The main reasons that were given were:

- They were happy with their existing system
- They were not sure about the technology
- They did not want either the upheaval of changing heating system or larger radiators.

The reasons behind high customer take-up rates for the ToU tariff trials have been investigated, leading to the following conclusions:

- Saving money on bills was a factor. The majority of customers believe they can save money as a result of being on a ToU tariff, particularly if they rarely use electricity at the peak times.
- Customers with solar PV generation appear to be highly engaged in their energy usage/generation

In-Home Balancing of PV Generation

Manual Balancing via an IHD

The preliminary analysis of customers with advice only (i.e. not automatic control) is given in the table below. Graphs of the resulting profiles are given in April 2013 report (see References section).

<table>
<thead>
<tr>
<th>Consumption (kWh)</th>
<th>January 2013</th>
<th>September 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Cell 5 (PV only)</td>
<td>Test Cell 20man (PV with IHD)</td>
</tr>
<tr>
<td>Peak Period</td>
<td>3.4</td>
<td>3.8</td>
</tr>
<tr>
<td>Daily Total</td>
<td>10.8</td>
<td>12.7</td>
</tr>
<tr>
<td>% of mean daily consumption</td>
<td>26.7</td>
<td>26.1</td>
</tr>
</tbody>
</table>

- Peak power and relative peak consumption is similar between the two groups
- Mean total consumption is greater for the manual intervention customer group (Test Cell 20) which appears to be a consequence of increased daily consumption.
- A social investigation will hopefully illuminate whether this is due to underlying socio-economic factors such as occupancy during the day, or whether the PV/IHD combination is encouraging a change in behaviour.
Automatic Balancing using Immersion Heated Hot Water Tanks

For customers with automatic balancing in the summer there is a clear increase in demand between 8:00 and 16:00 (total demand, including that served by the PV generation) and a much lower evening peak. The demand is dispersed throughout the day. The results from the two test cells are shown in the table below.

<table>
<thead>
<tr>
<th>Consumption (kWh)</th>
<th>January 2013</th>
<th>September 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Cell 5 (PV only)</td>
<td>January 2013</td>
<td>September 2012</td>
</tr>
<tr>
<td>Peak Period</td>
<td>3.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Daily Total</td>
<td>10.8</td>
<td>7.5</td>
</tr>
<tr>
<td>% of mean daily consumption</td>
<td>26.7</td>
<td>23.9</td>
</tr>
<tr>
<td>Test Cell 20auto (PV with automatic balancing)</td>
<td>September 2012</td>
<td></td>
</tr>
<tr>
<td>Peak Period</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Daily Total</td>
<td>17.6</td>
<td>16.3</td>
</tr>
<tr>
<td>% of mean daily consumption</td>
<td>22.6</td>
<td>18.7</td>
</tr>
</tbody>
</table>

- Test cell 20 customers have a much greater daily electricity consumption than those in test cell 5. This can be attributed to the use of electricity for hot water heating.
- Although they have a higher overall energy consumption the relative peak load of test cell 20 customers is lower than that of test cell 5.
- A shift in peak load is witnessed for the days analysed during the summer period where customers appear to shift their energy consumption.

Key lessons learnt (to date):

The load profiles for all customers (TC1- no intervention, TC5- PV but no intervention, TC20manual- PV with an IHD and TC20auto- PV with automatic balancing) on two summer days are shown below.

- The preliminary results indicate that ToU tariffs reduce the early evening peak, at least in the summer. However, there is a significant payback as demand increases at the end of the peak rate period. From a network perspective, there may therefore be limited value in such tariffs.
- It is important to trial tariffs that are likely to be viable, rather than aiming to set tariffs that deliver the maximum amount of DSR.
- Useful learning can be gained from offering tariffs, even if take up is low.
The supplier of a ‘smart’ (externally controllable) washing machine for the project has stressed the importance of the customer experience. As part of this they also note that any remote control by a third party should not be made available to the detriment of the appliance's intended functionality, so the customer has an override option. The DNO therefore needs to accept that they will not receive 100% of the available resource when a request is made as some customers will chose to override the interruption.

Early indications show that SME customers who are considering adopting a ToU tariff appear to be unwilling to change behaviour to any great extent to access cheaper rates, particularly if doing so would have an impact on business operation.

SME customers would not accept either the restricted hours tariff, or direct control if it would have any impact on their core business activities.

The reasons expressed by business customers for taking part include:

- Enthusiasm for environmental projects
- Wanting to save money
- Having an interest in the results of the monitoring trial if possible
- Agreeing to take part as long as it’s not intrusive to the business

Major barriers encountered (to date):

- Not all tariffs that will be useful in the future are possible to trial now:
- Domestic Hot Water heating was not suitable for providing peak time DSR, as the majority of these customers are on an Economy 7 tariff and so do not heat their hot water at peak times.
- Not many customers with low-carbon technologies such as heat pumps and EVs. For heat pumps this has been affected by delays in the implementation of the Renewable Heat Incentive scheme (a government subsidy).
- Systems may not allow all tariff types to be trialled
- Lack of white goods suitable for direct control
- Difficult to recruit SME customers for direct load control/ restricted hours, because the impact on a customer’s operations is considered to be too great.
- ZigBee smart plugs have been used for monitoring, and could be used for interventions. However, where plugs are not hard-wired there have been instances of customers accidentally turning them off/ removing them. Hard-wired smart switches would overcome this problem.
- A broadband internet connection was intended to be used to facilitate monitoring and demand management within the trial. The average take-up of broadband in the UK was approximately 67% in August 2011. However, within the social housing sector the take-up is substantially lower at 45% and so flexibility is required regarding the communications method to be used.

- The reasons cited by business customers for not taking part include:
  - Previous problems with installation of Smart Meters in their business
  - Don’t like the idea of equipment being installed
  - Concerns about the size or impact of the monitoring and control equipment
  - They don’t want overlap between the trial and existing energy saving/ environmental projects
  - They do not have the power to make the decision to take part- for example they may have a landlord or contract for their electricity through a broker.

References:

Further information on this project can be found at:

http://www.networkrevolution.co.uk

The information included in this template is based upon the results reported in the 3rd and 4th progress reports, available from:

http://www.networkrevolution.co.uk/industryzone/projectlibrary
The 4th Progress report (including work up to the end of November 2012) referenced the production of a “customer recruitment appraisal and lessons learnt report” for residential and SME customers.
UK 5. Low Carbon London

Description:
This is a Tier 2 Low Carbon Network Fund (LCN Fund) project being undertaken by UK Power Networks (a UK DNO) in Inner and Outer London, with a total project cost of £36 million.

The project was approved in the first round of LCN Fund projects (December 2010) and is planned to conclude in June 2014. The project involves both commercial (contracts for demand response, energy efficiency consultation, network support from distributed generation and Time of Use (ToU) tariffs supported by Smart Meters) and technical (an active network management system, smart meters, an operational data store, electric vehicle charging and micro-generation) solutions.

The trials as part of this project are ongoing and only minimal results have been released to date. Progress with trials is summarised below, based on the latest progress report submitted to Ofgem (the UK regulator responsible for LCN Fund trials).

Customers involved:
There are a wide range of trials involved in the overall Low Carbon London project, including:

- Demand Response with Industrial and Commercial (I&C) customers, via the use of aggregators (at least 60 customers stated in the bid document);
- Residential customers: Plans to access data from 14,000 smart meters in residential properties, bid also suggests the project is to “include at least 5,000 residential customers (with their consent) through efficiency measures, ToU tariffs and responsive demand contracts”.
- SME customers

Technologies deployed:
There is an intention to carry out trials in relation to heat pumps, small scale embedded generation, photovoltaic installations and electric vehicles.

Customer offerings:
The Low Carbon London trial includes the following domestic and SME customer offerings:

- Smart metering of approximately 6,500 domestic and SME customers.
  - 5,600 of these participants have been invited to complete detailed energy behaviour surveys. As of December 2012 2,140 surveys had been returned,
  - Over 1,000 of the customers with Smart Meters agreed to participate in a dynamic wind-twinning time of use tariff,
- Various Electric Vehicle propositions including:
  - A time of use tariff for domestic customers,
  - Monitoring of charging posts (at commercial premises, public charging posts owned by Transport for London and private residential charging facilities)
- Monitoring of domestic and Industrial and Commercial size heat pumps,
- Monitoring of residential and Industrial and Commercial size Small Scale Embedded Generation (usually PV),

Customer engagement approach:
The June 2012 project update states the following in relation to engagement/ recruitment of customers:
“Significant effort has been expended in trial participant recruitment—far in excess of that envisaged in the original bid or the early stages of the project. This investment has been made in recognition of and to address some of the challenges presented by the prevailing economic downturn and the reluctance of potential participants to commit to participation in the various projects trials. The efforts have included engaging a specialist market research company to undertake a detailed investigation and analysis of the I&C market with regard to its appetite for demand response and automated network management of distributed generation facilities.”

**Smart metering:**

Under the project, over six and a half thousand Smart Meters had been installed by the end of 2012. These are L&G 5236 smart meters. All Smart Meters are accompanied by In Home Displays. The demographic profile of the smart meter trial participants has been carefully managed to be representative of London.

**Tariff (Intervention type T)**

Residential and SME customers were recruited onto a Dynamic Time of Use tariff. The tariff will have three bands, high, medium and low. The bands are twinned to wind generation. Participants will be informed of any change to the band of their electricity the preceding day, either by text message or a device attached to their Smart Meter. The Low and Medium bands will be cheaper than the supplier’s (EDF Energy) Standard (Variable) rate. To be able to participate, a householder must already be an EDF Energy customer and have had a Smart Meter fitted and part of the Low Carbon London trial.

The price bands are (including VAT) per kWh unit:

- Low – 3.99p
- Medium – 11.76p
- High – 67.20p

Consumers will be reimbursed if their electricity costs them more on this tariff than it would have done on their previous tariff. They will be paid £100 for signing up to the tariff and £50 for completing the trial and the final survey. They are allowed to leave the trial at any point, but would forfeit the final bonus payment.

The trial is targeting 1,521 participants

The tariff will be trailed between January and December 2013.

A separate time of use trial is being carried out with new and existing Electric Vehicle owners. This time of use trial is designed to encourage EV owners to charge their vehicles at night or at the weekend. Electric Vehicle owners are being recruited onto a tariff based on EDF Energy’s “Eco 20:20” tariff. The charge for off peak periods is 20% cheaper than the standard charge.

**Remote / Automatic Control of Appliances (Intervention type C)**

N/A

**Information and Data Sharing (Intervention type F)**

N/A

**Advice / Customer Engagement (Intervention type A)**

Residential and SME trial participants have been recruited from within EDF Energy’s customer base on the whole; however some British Gas customers with Smart Meters were also recruited. The means of recruiting these customers into the trial is not clear.

At this point, no information has been released about any advice issued to trial participants with reference to changing their consumption patterns or becoming more energy efficient.
Results:
Results are not yet published, but the bid specifies a number of reports which may be of relevance to Task 23 (or other work in this area), as follows:

- L1-1 Accessibility and validity of smart meter data;
- L4-1 Impact of Energy Efficiency Programmes;
- L6-1 Consumer attitudes to flexible energy rates;
- L6-2 Consumer/ SME responsiveness to ToU rates;
- L6-3 Public participation in supply demand matching (Workshop); and
- L6-4 Smart appliances for residential response.

The projected publication dates of these reports are not clear.

Key lessons learnt (to date):
- Incentives were required to attract participants onto the trial.

Major barriers encountered (to date):
- Recruitment for the trials domestic heat pump element has been difficult. A government support mechanism that was expected to be implemented was not, which has resulted in fewer heat pump installations than expected. Additionally, London is not a promising area to install heat pumps because of geological considerations and limited ground space caused by population density. Therefore a decision has been made to cease active recruitment for this area of the trial. Approximately five domestic heat pumps and fifteen industrial and commercial heat pumps have been recruited. No active trials are planned with these participants, rather to monitor their effect on the distribution network.

- Conflicting and contradictory messages to electricity consumers effected recruitment rates. The media backdrop and messages from the energy regulator and Government calling for a simplification of energy tariffs made attempts to recruit participants onto a time of use tariff more difficult.

References:


UK 6. New Thames Valley Vision

Description:
The New Thames Valley Vision project is located in the area around Bracknell, to the West of London. The area a mix of industrial, commercial and domestic energy users. At the start of the trial the energy use in the geographical area was traditional in character, with little penetration of renewable generation or new electricity loads (e.g. heat pumps or electric vehicles).

Through improved consumer end use monitoring and sub-station monitoring this project assist via the more efficient management of the distribution network.

Automatic Demand Response (ADR) will be deployed with large business customers. Once this has been successfully deployed, the role out of these principles to smaller SME businesses will be investigated in order to understand the extent that similar principles could be applied to this sector.

Customers involved:
- Domestic – 1000 homes will have Smart Meters installed;
- SME – 100 will have Smart Meters installed and the potential of ADR will be investigated with around 30 small businesses;
- Large Commercial – demonstrate the deployment of ADR.

Technologies deployed:
- Smart Metering;
- ADR solution.

Customer offerings:
There were no customer offerings as part of this trial.

Customer engagement approach:
- A shop was opened in the shopping district of Bracknell called "Your Energy Matters" to form a test bed for building relationships between customers and DNO;
- Commercial customers were engaged via a Consumer Consortia Event held in conjunction with Thames Valley Chamber Of Commerce;
- An internet site has been rolled out.

Smart metering:
Smart Metering will be used to gain accurate data about the electricity network. One thousand domestic homes and one hundred SME will have Smart Meters installed.

Tariff:
There was no tariff intervention as part of this trial
**Remote / Automatic Control of Appliances:**
ADR technology will be installed in large commercial premises. The project will then investigate the potential for installing this technology in SME sites.

**Information and Data Sharing:**
There is no data sharing as part of this trial.

**Advice / Customer Engagement:**
An important aspect of this trial is about improving methods of engagement with large industrial and commercial customers.

**Results:**
There are no results from this trial to date.

**Key lessons learnt (to date):**
- Trial selling points that have assisted the recruitment of commercial customers include: service/benefits the company could gain, energy audit to identify potential energy savings, reduction in energy bill, local aspect of the trial, opportunity for Bracknell businesses only, link with the local council, positioning the project as a ‘business in the community’ initiative, asking for permission to check eligibility - thus positioning the project as selective and exclusive rather than in need of participants,
- A brief ‘pre-audit’ of a company’s site was useful to enable companies to get a better understanding of the scheme and allow them to base decisions on figures relating to their own premises;
- A new commercial customer engagement framework has helped the processing of companies interested in participating in ADR.

**Major barriers encountered (to date):**
- Businesses did not respond well to: LCN fund (businesses were averse to taking Government money), focus on searching for sites to put trial kit in for a project, environmental benefits;

**References:**
Further information on this project can be found at:
- [http://www.thamesvalleyvision.co.uk/](http://www.thamesvalleyvision.co.uk/)
UK 7. Sola Bristol

Description:
The Bristol (So La Bristol) project will investigate long term methods of managing network issues caused by customers with installed PV. In order to do this the project will combine installing energy storage and a DC network in customer's premises and the use of variable tariffs. This DC system will be shared by the customer and the DNO. The project will include 40 premises which it is anticipate will include 30 homes, 10 schools and a section of an office.

Customers involved:
It is anticipated that the trial will include 30 homes from Bristol City Council social housing stock, 10 schools and a section of an office.

Technologies deployed:
The trial will investigate the following technologies:

In domestic homes:
- Up to 4.8kWh battery storage;
- 2kWe PV panels connected to a DC network;
- Lighting converted to operate on the DC network;
- Computing converted to operate from the DC network;
- Central heating pump and controller converted to operate from the DC network;
- Smart appliances controlled via the LC Connections manager;
- Variable tariffs.

In Schools:
- 19.2kWh battery storage;
- PV panels connected to the DC network 3.6kWe;
- Up to 40kWe connected to the AC network;
- Lighting converted to operate from the DC network;
- Computing converted to operate from the DC network;
- Three phase balancing.

Office:
- 19.2kWh battery storage;
- PV panels converted to the DC network 10kWe;
- Lighting converted to DC network;
- Computing converted to DC network;
- Three phase balancing;
- Supplemented by a feasibility study on a large office of IT centre.

Customer offerings:
Domestic participants will be offered a shadow tariff (not affecting their current supply arrangements). This variable tariff will be designed to reward customers for taking advantage of the installed battery storage and PV generation. The tariff has been designed to be as simple as possible for the customer to understand, as well as being socially acceptable. A Dynamic fixed tariff was therefore designed that will offer a scaling factor based on the customer's existing flat tariff based on supply and DNO savings. This scaling takes into consideration DNO savings achieved through deferring network reinforcements, and the reduction in importing electricity during the period of peak electricity cost. Using these tariffs and the installed technology, customers can reduce their electricity bills by:
- Using energy from their PV panels, especially when they are generating at or near peak;
- Storing excess generation in their batteries, ideally for use during the peak period (normally 5-7pm);
- Reducing use of electricity at the peak period, for example by turning off appliances etc. when not in use.

**Customer engagement approach:**
Domestic customers are to be recruited from the Bristol City Council social housing stock.

**Smart metering:**
A LV Connection Manager home energy management system device will be used to monitor the network voltage profile, battery storage and demand response. The device can also:
- Forecast the homes next day electricity demand;
- Estimate micro generation output for different periods of the day, charging the battery during periods of excess generation;
- Move any smart appliances to periods of micro generation output;
- Calculate if the battery needs additional charging using off peak or low carbon intensive electricity.

**Tariff:**
Detailed information about the tariff offered to householders is not available however it was designed to be simple to understand and socially acceptable. The tariff offered is a Dynamic fixed tariff. It will offer a scaling factor that considers the householders existing flat rate tariff. The scaling factor will consider the reduction in imported electricity during high peak periods, and the DNO saving from solving network constraints.

**Remote / Automatic Control of Appliances:**
The battery at each property will charge and discharge intelligently. The LV connection manager will optimise charging and discharging of the battery for each property according to their individual consumption pattern. Eight different charge and discharge schedules – one for weekdays and weekends for each of the four seasons – will be programmed into the LV connection manager. Spare capacity in each battery will be reserved for DNO contributions. The customer will not be aware of any changes to the optimisation of their battery.

The householders lighting, heating pump and computing equipment will be wired off a DC network to take direct advantage of electricity generated by the properties solar panels either directly, or from the battery storage device. Smart appliances will be managed by the LV connection manager to perform as cost effectively as possible.

**Information and Data:**
Information available to date indicates that there was no information/data sharing as part of this trial.

**Advice / Customer Engagement:**
To date there is no information available about the advice offered to householders.
Results:
This project is still at an early stage.

Key lessons learnt (to date):
This project is still at an early stage.

Major barriers encountered (to date):
This project is still at an early stage.

References:
Further information on this project can be found at:
http://www.ofgem.gov.uk/Networks/ElecDist/lnf/stlcnf/year2/bristol/Pages/index.aspx
and
http://www.westernpowerinnovation.co.uk/So-La-Bristol.aspx
UK 8. Domestic Demand Side Management

Description:
This trial was a small scale investigation into the benefits of a new generation of storage heaters and water storage tanks. It sought to investigate if they could provide a higher comfort levels for householders whilst satisfying the heat requirements more efficiently. The trial also explored whether the new technology provided the local Distribution Network Operator with an extra measure to overcome some of the issues created by supplying electricity to a small island without an electricity connection to the UK mainland.

Customers involved:
The trial involved six properties in Lerwick, Shetland owned by Hjaltland Housing Association. The properties included three one-bedroom flats, two two-bedroom bungalows, and a three-bedroom semi-detached house. The properties were selected by the housing association based on:

- Their relationship with the tenants;
- Their knowledge of the tenants willingness to participate in a trial that may cause some disruption;
- The tenants’ willingness to provide feedback when the trial concluded.

The households were offered a £100 ex-gratia payment as an incentive to participate in the trial.

Technologies deployed:
12.1 and 14.9kWh storage heaters and 14.0 and 17.1kWh hot water cylinders were installed according to the requirements of the participating property. The hot water cylinders and storage heaters were from Glen Dimplex’s new Quantum range. The storage heaters were direct replacements for existing storage heaters in the properties. Their main features of the new storage heating system include:

- Highly insulated to prevent heat loss during non-heating periods;
- Energy efficient output, controlled by a timer and temperature control;
- Variable power output;
- User interface for programming comfort levels and heating periods;
- External control compatible with DNO interface to provide:
  - Communication to utility to provide frequency response and demand side management,
  - Mains frequency monitoring,
  - Variable frequency response,
  - Variable input power,
  - Core temperature sensing and setting,
  - Room ambient temperature setting and sensing.

The main features of the new hot water cylinders are:

- Three immersion heating element design to provide variable input power,
- Water temperature sensor built into immersion element to provide thermostat and over temperature safety cut out,
- Additional 3kW boost element;
- Foam insulation to minimise standing heat loss;
- Inlet diffuser to prevent hot and cold water mixing,
- Minimal stratification
- External control compatible with DNO interface to provide:
- Communication to utility to provide frequency response and demand side management,
- Mains frequency monitoring,
- Variable frequency response,
- Variable input power,
- Water temperature control – thermostat senses water temperature.

**Customer offerings:**

The trial did not include any change in the participant’s electricity tariffs.

**Customer engagement approach:**

The customers were recruited on the basis of the likelihood of their receptivity to be involved in this trial by the housing association who managed the properties.

**Smart metering:**

This trial did not involve Smart Metering.

**Tariff:**

The participants in this trial were not asked to change their electricity tariff.

**Remote / Automatic Control of Appliances:**

The trial involved remote control of the heating and hot water systems. It was discovered that the way that the logic programmed into the storage heaters and hot water tanks was constructed meant that any heating demand for the comfort of the householder would override the requirement of the DNO to control the devices. The devices also ignored load instructions to charge if the maximum charge temperature had been reached.

The devices have the potential to deliver frequency control response when requested by the DNO. This capability was tested during the trial and was partially successful.

**Information and Data Sharing:**

This trial did not involve data or information being shared with a third party.

**Advice / Customer Engagement:**

It is unclear what advice the trial participants were given about how to operate their new heating and hot water systems, and the format of this information. Some information was given, and participants had the opportunity to ask the installers if they had any queries about how the system should be operated. It is unclear if any suggestions were made about the optimum way that the technology could be run in order to be cost effective and of greatest benefit to the electricity network.

The use of the technology during the trial suggests that some households understood their heating and hot water system and were using it in an effective manner; some did not and were using the system to provide heat on demand rather than pre-charging the system.

The survey completed by participant’s after the trial was concluded suggests that some households did not fully understand the advice and information that they had been given when the technology was installed.
Results:

- The trial demonstrated that the new storage heaters and hot water cylinders are more controllable than the existing system that was removed from households;
- The new equipment was well received by householders;
- Evidence suggests that the new equipment was no more expensive to run than the system removed;
- Some of the householders did not fully understand how to use the new technology

Key lessons learnt (to date):

- Design aspects relating to hierarchy of control logic need examining to maximise DNO DSM capability;
- While some households used the new storage heaters in the way they were designed, programming them to come on in accordance with their movements, others used them more like panel heaters, using the boost function as they required heat;
- More temperature sensors needed in hot water tanks;
- A standards paper will be drawn up for Shetland which will include minimum functionality and characteristics that equipment being installed on the island for Demand Side Management purposes should comply with.

Major barriers encountered (to date):

- Data retrieval from the heating systems was problematic and resulted in data on the behaviour of the storage heaters/hot water cylinders not being sent to the central data repository, and therefore lost;
- Engineers on site must be able to interrogate the system locally rather than relying on being relayed information from Glasgow

References:

Further information on this project can be found at:

UK 9. Sustainable Blacon

Description:
One hundred and fifty participants were recruited from Blacon, a suburban area outside Chester. They were split into three groups, ‘Active’, ‘Passive’ and ‘Control’. The ‘Active’ group were issued with an AlertMe™ system which allowed participants to monitor their electricity consumption using an online display. The system also allowed participants to control appliances remotely. The ‘Passive’ group were issued with Wattson™ meters which recorded electricity use at regular intervals and provided a real-time display of electricity consumption. The ‘Control’ group were not issued with any technological interventions. Participants in all three groups were requested to submit electricity and gas meter readings every month, and invited to educational meetings, consisting of eight sessions spaced throughout the year, some of which focused on energy use, but also on themes of interest to the participants such as water, waste and local food. Gas and electricity consumption data was requested from participants for the previous twelve months.

Customers involved:
One hundred and fifty customers were recruited from Blacon. Blacon is a mix of private homes and a substantial number of council-built properties. The formerly council owned properties are now run by a local housing association in partnership with the local council.

Technologies deployed:
Two technologies were employed as part of this trial, AlertMe™ and Wattson™. The Wattson™ device provided real time electricity consumption data as well as a record of electricity use over regular intervals. The AlertMe™ system is internet based, requiring the householder to log into the system for to access electricity consumption data. This system could also switch appliances on and off remotely.

Customer offerings:
No commercial offerings were available.

Customer engagement approach:
Participants were volunteers who responded to publicity circulated via Sustainable Blacon Ltd, existing community groups and leaflet drops. Rewards were offered for continued participation – a house energy efficiency make over worth between £300 and £2000 dependent on the householder’s level of engagement in the programme.

Smart metering:
Smart meters were not installed however an important aspect of the trial was investigating the benefit of In Home Display systems as an energy efficiency measure.

Tariff:
No tariff packages were involved in this trial
Remote / Automatic Control of Appliances:
No automatic control of appliances was included in this trial although the AlertMe™ system had the functionality to allow householders to remotely control their appliances.

Information and Data Sharing:
No information sharing was involved in this trial.

Advice / Customer Engagement:
Education sessions were held for trial participants. Some of the sessions focused on energy efficiency. A visit to a local energy efficient test house was organized. Other sessions were on subjects such as efficient water use, reducing waste and local food.

Results:
Based on those households that provided historical gas consumption information, the ‘Control’ group achieved the largest mean reduction in gas consumption. The ‘Passive’ group achieved the smallest mean reduction in gas consumption. The ‘Control’ and ‘Active’ groups contained a majority of houses that achieved a reduction in carbon emissions. The ‘passive’ group was equally divided between households that reduced and increase gas usage.

Of those households that provided historical electricity consumption data, 23 of the 43 reduced their consumption but consumption at the other 20 houses increased. While six of the eleven houses for which historical data was available in the ‘Control’ group reduced their electricity consumption, four of those that increased their consumption only did so by a small amount but one recorded a large increase. Amongst the ‘Passive’ group nine of the sixteen households for which historical data was available achieved a reduction. The increase of the other seven houses, some of which were large, outweighed any decrease. The number of houses that achieved a decrease in electricity consumption in the ‘Active’ group was equal to the number that increased their consumption but those who increased their consumption outweighed those who decreased their consumption.

Householders found the educational sessions useful and results suggest that the programme helped participants to reduce their energy consumption.

Feedback from the group issued Wattson™ devices was that 76% had found the device at least fairly easy to use. Households issued with an AlertMe™ system found it more difficult to use – only 41% found it at least fairly easy to use. 82% of households issued a Wattson™ device thought that it had helped them save electricity compared to 37% who were issued an AlertMe™ system.

Key lessons learnt (to date):
- The visual display unit (Wattson™) was useful prompt providing awareness of energy use;
- Householders reported that the Wattson™ helped them develop a better understanding of their households energy consumption, allowing them to discover which appliances caused a spike in their electricity consumption;
- Householders who received an AlertMe™ system failed to utilise it to its full potential particularly it’s control functions that allowed the remote control of appliances;
- The education programme was credited by participants for helping to instil good behaviour practises such as turning of lights or appliances when not in use.

Major barriers encountered (to date):
- Gathering historical data consumption data. Data was only collected for 46 households for gas and 43 households for electricity.
References:
Further information on this project can be found at: