Case study: Republic of Ireland

Electricity and gas smart metering customer behavior trials’ energy reports

Context
During the economic boom years and until the end of 2007, the Republic of Ireland had one of the highest growth rates in electricity demand among OECD countries, fuelled by a rapid increase in population and economic growth leading to talks of a looming energy crisis. However, due in part to the economic crisis whose effects started to be felt on electricity demand in 2008, and in part to new conventional and wind generation capacity and a new interconnector with Wales, Ireland’s generation-load balance seems secured for the coming years. The Republic of Ireland has just above two million residential customers and about 627,000 residential gas customers. A typical household customer uses 4,500 kWh of electricity and 13,800 kWh of gas per year. The Irish residential market has the particularity of being Europe's most active in terms of customer switching with a churn rate for electricity customers of over 11% and close to 17% for gas customers in 2012. This can be seen as the result of a strong will by the authorities to promote competition and reduce the dominance of the incumbent players, and also because of the fact that energy prices are among Western Europe's highest and have been increasing steadily in recent years. As an illustration, end-user electricity prices have increased by 10% and gas end-user prices by 21% between 2011 and 2012 (twice and three times the EU-15 average respectively). In 2012, a typical Irish household spent about 4.5% of its disposable income on electricity and 4% for gas. The CER published its decision on the national rollout of smart meters on July 4th 2012 based on the results of a large multi-purpose pilot that ended the previous year. The Irish mandate is one of the few in Europe to pro-actively ensure that household customers will also benefit from the smart metering technology. This is ensured by directly mandating energy suppliers to provide household customers with an advanced level of information on their energy consumption.

Objectives
Drawing from European legislative requirements, Ireland is one of the few countries in Europe to have mandated both electricity and gas smart meters and one of the fewer still to have mandated IHDs and consumption reports in order to give household customers ways to reap some of the associated benefits of smart meters such as reducing energy consumption and lower energy bills. In addition, insofar as energy reports encourage more energy efficient behavior, they are also seen as a tool to achieve Ireland's national target of 20% energy savings in 2020 relative to the 2001-05 average.

Case Study
Main characteristics
The CER established and oversaw the “Smart Metering Customer Behaviour Trials” (CBT trials) as part of the much larger smart metering technology trial which remains to date one of the largest and most comprehensive in Europe. It attempted among other things to measure the potential of energy consumption reports to change the behavior of electricity and gas consumers. The samples were designed to be representative of the Irish population. The electricity consumer pilot test period ran between January and December 2010 while the gas consumer pilot test period ran between June 2010 and May 2011. The electricity customer behavior trial comprised 3,296 residential participants who were assigned to one of four ToU tariff groups with increasing price differential and broken down into four different feedback channels:

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11 The CER (2012 b: 58) reports that electricity demand has cumulatively fallen by 8% over the last three years while margins at peak increased.
12 See annex 1 for a summary of EU regulations related to smart metering and smart billing.
13 Only Great Britain has mandated IHDs to be rolled out with electricity and gas smart meters.
14 An example for electricity and gas are provided in appendix 3
1. Bi-monthly bill with energy usage statement (consistent with their normal bill frequency);
2. Monthly bill with energy usage statement;
3. Bi-monthly bill with energy usage statement and IHD;
4. Bi-monthly bill with energy usage statement and overall load reduction goal incentive.

The gas customer behavior trial comprised 909 participants broken down into three different feedback channels.

As part of this analysis, we are interested in the impact of usage statements on energy consumption. Perhaps one flaw in the sample design was not to have a group on ToU tariffs only for electricity or seasonal tariffs only for gas without any additional feedback on their consumption than their usual bill. As a result, it is not possible to clearly separate the impact of the tariff’s structure from the impact of the usage statements on peak consumption. Although the difference in results between bi-monthly and monthly statements give an idea of it. The front page of the bill is similar to the existing supplier’s bill while the usage statement (on the back of the bill) constitutes the “smart” component. The electricity consumption report is composed of five elements. It provides a reminder of the structure and rates of the ToU tariffs (Figure 7), explains how to take advantage of the tariff structure (Figure 8) by, for instance, showing the cost of running certain appliances at different times during the day (Figure 9), explains how consumption evolved since the last bill and compares it to other participants in the pilot (Figure 10) and finally breaks down the weekly cost of electricity by day and rate (Figure 11). The focus of the usage statement is clearly both to shift usage to off-peak periods as well as reduce overall usage.

![Figure 7: Visual representation of the different time bands and time-of-day rates. (Source: CER 2011c)](image)

![Figure 8: Hints and tips to reduce electricity usage. (Source: CER 2011c)](image)
Figure 9: Cost of running appliances at different times of day. (Source: CER 2011c)

Figure 10: Historical usage since last bill and comparison with other participants. (Source: CER 2011c)

Figure 11: Breakdown of average weekly electricity cost per day and rate. (Source: CER 2011c)

The gas consumption report explains how consumption and average daily cost evolved since the last billing period and compares it to other participants in the pilot (Figure 12), provides hints and tips as to how to reduce usage adjusted to the season (Figure 13) and finally breaks down average daily usage into shorter periods and shows the associated cost (Figure 14).

<table>
<thead>
<tr>
<th>Averages</th>
<th>Date</th>
<th>Daily Use</th>
<th>Daily Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. this period</td>
<td>1st Apr - 1st Jun</td>
<td>15.770 kWh</td>
<td>€0.62</td>
</tr>
<tr>
<td>Avg. last period</td>
<td>3rd Feb - 1st Apr</td>
<td>41.440 kWh</td>
<td>€1.40</td>
</tr>
<tr>
<td>Day of most use</td>
<td>30th Apr</td>
<td>39.872 kWh</td>
<td>€1.48</td>
</tr>
</tbody>
</table>

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

Your usage explained

During the previous month you used 563.7 kWh. In the same period last year you used 706.1 kWh. Congratulations on reducing your gas usage.

Last bill period your gas usage decreased by 60.33%. Other customers’ average decrease was 53.15%. For advice on further reducing your usage try some of the energy tips on this bill.

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

Smart metering policies and smart billing rules

In Ireland, smart billing coincides with the deployment of smart meters. The Irish government, reflecting the EU’s view, sees smart metering as an important building block in enabling the smart grid and managing energy demand\(^\text{15}\). On July 4th 2012, the CER published its decision on the national rollout of electricity and gas smart metering. The deployment of smart meters led by DSOs will start in 2015 and is scheduled to take 4 years. Some key decisions related to smart billing outlined in the paper include:

- Rolling out electricity smart metering to all electricity residential consumers with \textit{half hourly intervals} for electricity consumption data;
- Rolling out gas smart metering to all gas residential consumers with \textit{half hourly intervals} for gas consumption data;
- Mandating the rollout of IHD devices showing cost and usage information

\(^{15}\) See Appendix 1 for a summary of EU regulations related to smart metering and smart billing.
to all energy consumers – the IHD will be capable of displaying information also for dual fuel consumers;

- Mandating energy usage statements containing detailed consumption and cost information to be provided by suppliers to their customers together with their electricity and gas bills;
- Consumers can give permission to other third parties to access their detailed historical consumption data.

At present, households in Ireland receive energy bills every two months. The CER has decided to leave billing and energy reports' frequency up to market forces. It also has yet to determine minimum content requirements for the consumption reports, noting that it will take into account forthcoming EU legislation regarding provision of energy information with billing during the design stage.

It is also interesting to note that the CER has the legal mandate to impose smart billing if it wishes to. Indeed, as part of the transposition of the Energy Services Directive (Directive 2006/32/EC) into Irish law, Statutory Instrument No. 542 of 2009, Part VI (Amendments to Electricity Regulation Act 1999) allows the Commission to place requirements on energy suppliers to:

(d) provide any or all of the following information in or with its bills, contracts, or other relevant communications, in a manner which, in the opinion of the Commission, is clear and understandable—

(i) current actual prices and actual consumption of energy,
(ii) a comparison of the final customer's current energy consumption with that customer's consumption for the same period in the previous year, in graphic form where the Commission considers it practicable,
(iii) a comparison of the final customer's energy use with the energy use of an average normalized or benchmarked final customer, or
(iv) sources of information on available energy efficiency improvement measures, comparative customer profiles or objective technical specifications for energy-using equipment, including contact information and website addresses.

Impact/Evaluation

Improvement in awareness of energy consumption

Awareness of energy consumption is often seen as the first steps towards initiating more energy efficient behavior. The CER attempted to measure improvements in participants' awareness and knowledge of their energy consumption through post pilot surveys. The results indicate that due to the trial 82% of participants made some change to the way they use electricity and 54% agreed that it succeeded in making them more aware of their usage. However, there was a lower level of success in terms of motivating or enabling change with 22% agreeing they now knew more about how to reduce usage and 24% stating that they were more interested in reducing their usage. The results also indicate that 86% of participants recalled receiving the energy usage statements and 87% made changes to the way they use gas. Finally the CER did not find evidence of secondary benefits in increased awareness of general energy efficiency or (unlike Opower) investment in energy efficiency enhancements for the home. This is perhaps due to the fact that the pilot did not last long enough.

Reduction in energy consumption

The following chapter presents the impact of the usage statements on households' electricity and gas consumption. The results of the CBT trials reviewed as part of this report are arguably among the most statistically robust of any such trial conducted internationally to date. During the design phase, the organizers made great efforts ensuring that the samples were large enough and representative of the general population so that the results are seen as reliable and in turn can be extrapolated at the national level. The outcome can therefore be seen as a very good indication of the impact of energy efficiency initiatives when they are scaled up in Ireland together with the smart metering infrastructure.
Table 3 shows the impact of usage statements when combined with ToU tariffs on participants' overall and peak time electricity consumption. Household customers who received the statement every other month reduced their overall usage by 1.1% while household customers who received the statement every month reduced it by 2.7%. In the same vein, they managed to reduce their consumption at peak hours by 6.9% when they received the statement every other month and by 8.4% when they received it each month. As explained earlier, it is hard to separate the impact of the ToU tariff structure from the impact of the statements on peak consumption reduction. However, the fact that households managed to reduce their consumption at peak times by an extra 1.5% when they received the statement monthly compared to when they received it bi-monthly can be seen as a result of receiving more frequent feedback information.

Table 3: Impact of energy usage statements on electricity consumption. (Source: CER 2011c)

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-monthly bill with energy usage statement</td>
<td>Overall consumption reduction: 1.1%; Peak consumption reduction: 6.9%</td>
</tr>
<tr>
<td>Monthly bill with energy usage statement</td>
<td>Overall consumption reduction: 2.7%; Peak consumption reduction: 8.4%</td>
</tr>
</tbody>
</table>

Table 4 shows the impact of the energy reports on household overall gas consumption. Household consumers who received the report monthly managed to reduce their usage by 2.8%, while households who received it bi-monthly managed to reduce it by 2.2%. The CER (2011d: 53) also notes that while the absolute impact (in kWh) is greater in the winter months, the impact in percent is greater during low usage months (summer months) as participants indicated in a follow up survey that they favor comfort in winter months and saw less scope for consumption reduction during that time of year.

Table 4: Impact of energy usage statements on household overall gas consumption. (Source: CER 2011d)

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-monthly bill with energy usage statement</td>
<td>2.2%</td>
</tr>
<tr>
<td>Monthly bill with energy usage statement</td>
<td>2.8%</td>
</tr>
</tbody>
</table>

As mentioned before, most experts agree that providing informative bills to households leads to energy consumption reduction at least in the short term, the important question being whether they are able to sustain savings over time. The CER examined the change in the impact of electricity usage statements between the first and second six months of the one-year-long trial. The results presented in Table 5 indicate an improvement over time for both overall and peak time consumption.

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16 ToU tariffs do not aim at reducing overall usage but rather shifting consumption from peak-hours to off-peak hours. A ToU pricing scheme can thus be seen as successful even if consumption remains unchanged as long as consumption at peak times is lower.
Table 5: Impact of energy usage statements on electricity consumption in the first and second 6 months of the trial. (Source: CER 2011c)

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>1st 6 months</th>
<th>2nd 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-monthly bill and energy usage statement</td>
<td>Overall: 0.8% Peak: 6.4%</td>
<td>Overall: 1.3% Peak: 7.5%</td>
</tr>
<tr>
<td>Monthly Bill, and energy usage statement</td>
<td>Overall: 2.6% Peak: 7.6%</td>
<td>Overall: 2.8% Peak: 9.2%</td>
</tr>
</tbody>
</table>

The CER looked at the trend in consumption reduction across periods of weeks over the lifetime of the trial. Results indicate that the initial impact of energy usage statements on overall energy consumption decreased incrementally for the first three to four months, at which point they began to stabilize and remained approximately at the same level until the end of the trial. The same analysis of peak time consumption seems to indicate that the impact in percent is lower during the "inner" winter months of November-February. (CER 2011c: 70-71.)

The Commission reported that the consumption level is the main explanatory variable of overall consumption reduction. Other explanatory variables such as the fact that households headed by individuals with greater educational achievement or "social grade" achieved higher levels of reduction than those with lower levels were also found to have an impact.

Very interesting from a social policy perspective is the fact that vulnerable customers17 and "fuel poor" customers also managed to reduce electricity consumption and lower their bills thereby improving welfare. Fuel poor customers benefited through reducing peak usage with overall usage almost unchanged.

The CER found that participants to the electricity CBT trials saved between €19 and €26 on their electricity bill or 3%-4% of a typical annual bill. Participants receiving bi-monthly energy statements are likely to have saved an amount towards the lower end of the bracket and participants receiving monthly energy statements likely to have saved an amount towards the middle18. Participants to the gas CBT who received the bi-monthly bill and energy usage statement were found to have saved about €13 (or about 2% of a typical annual bill) while participants CBT who received the monthly bill and energy usage statement were found to have saved about €16 (or about 3% of a typical annual bill).

The CER attempted to measure participants’ satisfaction with the different stimuli. The energy usage statements were rated as effective or very effective in helping to reduce usage by 79% of the participants with correspondingly high scores for comprehensibility. These scores were very similar for both the groups receiving a monthly bill and those receiving a bi-monthly bill. The participants’ assessment of the gas usage statement was good with 82% stating it was straightforward and

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17 Vulnerable participants were defined as participants who receive Free Electricity Allowances which includes both elderly, carers in receipt of specified allowances and individuals in receipt of specified invalidity or disablement benefits. They are therefore somewhat isolated from the impact of the tariffs as the allowance covers the cost of a portion of their energy costs.
18 The CER did not calculate the impact of the different stimuli on bills. These numbers therefore include the impact of IHDs which is ignored in the rest of the analysis. Participants receiving energy usage statements alone reduced consumption less than participants who were additionally provided with an IHD. Therefore, it is likely that the impact on the financial savings of the energy usage statements alone is less than the impact of the energy usage statements when accompanied by an IHD.
57% stating that it helped them reduce the amount they used. An interesting finding is that participants thought the effectiveness of the energy statements (both gas and electricity) over the period of the trial was decreasing. This last finding is coherent with different behavioral theories and has important implications for informative billing and also for feedback programs in general. A substantial body of literature has shown that behavior is often guided by habits. Darby (2006: 4) found that habits formed over a three-month period or longer are more likely to stick. Behaviors such as switching off the lights or turning off appliances for instance meet the three conditions identified by Jackson (2005) for the balance of the decision-making process to swing away from cognitive effort and towards automaticity: low degree of involvement, low perceived complexity and high degree of constraint. Thus, feedback programs should, rather than offering one static program for the entire duration of the pilot, bring participants through a cycle. For instance starting with simple feedback and suggest low-involvement behaviors to reduce usage (the "low hanging fruits") to help consumers achieve easy and visible reductions and then progress towards more sophisticated or constraining behaviors as participants have a made a habit out of and internalized previously promoted actions as part of a virtuous cycle. This approach is currently being put in practice as part of a pilot by Enel Distribuzione in Italy using an IHD to provide electricity consumption information to households\(^\text{19}\). At the beginning, participants will only be provided with the most basic feedback in order to attract their attention and help them develop the most basic habits. The software will be gradually upgraded to provide feedback and information of increased complexity.

Cost effectiveness

Based on the results of the CBT trials, the CER published a cost benefit analysis to assess the long-term costs and benefits to the market and the individual consumer of a national electricity and gas smart metering deployment under two scenarios:

- Bi-monthly billing. This option assumes a national rollout of smart meters, while retaining the current bi-monthly billing frequency. Under this scenario, the incremental cost relates to printing six additional color pages to be included with each bimonthly bill;
- Monthly billing. This option assumes a national rollout of smart meters, while increasing billing frequency to monthly. Under this scenario, the incremental cost relates to printing six additional bills per annum and 12 additional color pages for energy usage statements to be included with each monthly bill.

As part of this report we consider the estimated incremental cost for energy suppliers of sending energy usage statements together with the energy bills over and above the cost of the smart metering infrastructure and the billing frequency mandated under the two different scenarios. These numbers were based on data provided by energy suppliers and were used by the Commission to conduct the CBA. They are presented in the table below.

Table 6: Annual cost of printing and sending energy usage statements per customer. (Source: CER 2011a)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Electricity</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-monthly billing</td>
<td>€0.06</td>
<td>€0.10</td>
</tr>
<tr>
<td>Monthly billing</td>
<td>€0.12</td>
<td>€0.20</td>
</tr>
</tbody>
</table>

The numbers show to be rather negligible especially when put in perspective with the estimated cost for the combined roll out of electricity and gas smart meter of up to €1 billion which will be partly paid for by residential consumers themselves. The energy usage statement is likely to have an impact on the IT system cost to ensure it is able to provide customers with more detailed consumption and cost information. Nevertheless, the incremental cost of the IT system of sending energy

\(^{19}\) http://www.enel.it/it-IT/rete/smart_info/
usage statements together with the energy bills over and above the cost of the IT cost required anyway as part of the smart metering infrastructure upgrade is likely to be minimal and should not change the figures above by much.

Perspective

In its decision papers on smart metering (CER 2012a), the Commission mandated the full roll out of electricity and gas smart meters as well as the deployment of IHDs and energy usage statements to be sent together with the energy bills. The CER (2012a: 4) estimated the costs of deploying the electricity smart metering infrastructure to be between €600 and €800 million and the cost of deploying the gas smart metering infrastructure to be around €200 million. The cost of deployment will be partly shouldered by households and recovered by the utility through distribution tariffs. However, the Republic of Ireland is also one of the only European countries to have directly mandated the provision of more and better information about energy to all consumers. This will give households the possibility to better understand and control their energy usage and ultimately it will have a positive impact on their welfare and hence will directly and measurably benefit from the upgraded infrastructure. Based on the CBA, the cost of mandating different consumption feedback channels alone should not be seen as a hindrance by countries who are contemplating the deployment of smart meters. Indeed, the Commission estimates the cost of the IHD (plus the HAN component) to average €37.5 while the incremental annual cost of sending energy usage statements to amount to €0.06 per electricity customer and €0.10 per gas customer. This is to be compared with a cost ranging between €580 and €670 per customer for the deployment of the infrastructure\(^{20}\).

\(^{20}\) The cost per customer is calculated by dividing the total cost of the new infrastructure by the number of household and SME customers in 2012.