Case study on innovative smart billing for household consumers

Prepared by VaasaETT for the World Energy Council and ADEME
TABLE OF CONTENTS

Executive Summary ........................................................................................................... 5
Summary ............................................................................................................................ 7
Introduction ......................................................................................................................... 12
Key performance indicators .............................................................................................. 14
Case study: USA - California ............................................................................................ 16
Case study: Republic of Ireland .......................................................................................... 25
Case study: Sweden ............................................................................................................. 34
Case study: Australia - Victoria .......................................................................................... 39
Case study: UAE - Abu Dhabi ............................................................................................ 44
Case study: Chile ................................................................................................................ 47
Case study: South Africa .................................................................................................... 50
Case study: PRC - Hong Kong ........................................................................................... 53
References ......................................................................................................................... 55
Appendices ........................................................................................................................ 60

List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI</td>
<td>Advanced Metering Infrastructure</td>
</tr>
<tr>
<td>CBA</td>
<td>Cost Benefit Analysis</td>
</tr>
<tr>
<td>CBT</td>
<td>Customer Behavior Trials</td>
</tr>
<tr>
<td>CER</td>
<td>Commission for Energy Regulation (Ireland)</td>
</tr>
<tr>
<td>CPUC</td>
<td>California Public Utilities Commission</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>DEPI</td>
<td>Department of Environment and Primary Industries (Victoria – Australia)</td>
</tr>
<tr>
<td>HAN</td>
<td>Home Area Network</td>
</tr>
<tr>
<td>IHD</td>
<td>In home display</td>
</tr>
<tr>
<td>RSB</td>
<td>Regulation and Supervision Bureau (Abu Dhabi)</td>
</tr>
<tr>
<td>ToU</td>
<td>Time-of-use</td>
</tr>
</tbody>
</table>
# TABLE OF FIGURES

Figure 1: Normative comparison in Opower’s home energy reports ........................................... 17
Figure 2: Actionable insights in Opower’s home energy reports ............................................. 18
Figure 3: Results of actions displayed in Opower’s home energy reports .............................. 19
Figure 4: Trend in annual program savings - September 2009 - August 2010 ....................... 22
Figure 5: Electricity savings by income bracket ......................................................................... 23
Figure 6: Electricity savings by age ............................................................................................. 23
Figure 7: Visual representation of the different time bands and time-of-day rates ................... 26
Figure 8: Hints and tips to reduce electricity usage ................................................................. 26
Figure 9: Cost of running appliances at different times of day .............................................. 27
Figure 10: Historical usage since last bill and comparison with other participants ............. 27
Figure 11: Breakdown of average weekly electricity cost per day and rate ......................... 27
Figure 12: Historical usage since last bill and comparison with other participants .............. 28
Figure 13: Hints and tips to reduce gas usage adjusted to the season .................................... 28
Figure 14: Breakdown of average gas daily usage and average daily cost ............................ 28
Figure 15: Breakdown of electricity bill into its different components ................................. 35
Figure 16: Historical monthly consumption for the last 13 months ..................................... 36
Figure 17: Average quarterly electricity usage and associated GHG emissions .................. 40
Figure 18: Benchmarking information on electricity usage .................................................... 40
Figure 19: Normative consumption feedback ......................................................................... 45
Figure 20: Amount of electricity subsidy ............................................................................... 45
Figure 21: Historical monthly consumption for the last 13 months ..................................... 48
Figure 22: Energy saving tips and advice included on the reverse ....................................... 48
Figure 23: Historical monthly consumption for the last 13 months ..................................... 51
Figure 24: Maximum power demand over past 13 months .................................................. 51
Figure 25: Historical monthly consumption for the last 13 months ..................................... 53
Figure 26: Use of bills to communicate with customers ........................................................... 54
Executive Summary

This report assesses and provides ex post evaluations of eight best practice examples of informative energy bills\(^1\) from diverse geographies, representing a mix of developed and developing counties. The different cases are analyzed according to a set of key performance indicators that cover various stakeholders. The analysis also focuses on related supporting policies such as energy efficiency measures, smart meter regulations and advanced metering infrastructure deployment in each market. Based on the findings, the report draws recommendations as to how countries with different profiles and goals could implement and benefit from smart billing.

Residential consumers account for an important share of most country's energy consumption. In addition, residential consumption is bound to keep increasing in the near future while energy prices are soaring well beyond inflation in many parts of the world. Engaging households is therefore essential and inevitable if environmental and energy efficiency targets are to be met and also for affordability and social justice reasons. Nevertheless, households are often perceived as a very difficult target group for energy efficiency programs due to their high number, their diversity, their low level of consumption when taken individually and because they often see energy as a low interest and low involvement product.

The first step towards creating more sustainable behaviors is often to raise awareness of consumption. Regulators and policy makers seeking to do so often consider drafting rules supporting the provision of households with feedback on energy consumption as well as information about how to reduce it. Utilities in competitive markets see feedback programs as a way to differentiate their offering, move competition away from prices only and establish a trust-based relationship for the sale of additional future revenue generating services to customers. Information on energy consumption is typically conveyed to household consumers through in-house and ambient displays, web portals, mobile phone applications and smart bills.

Enhancing bills can be seen as an efficient way to reach an entire consumer base leading to a greater aggregated effect on a country's energy consumption. Indeed, simple, low cost solutions which can be provided to all may provide a higher aggregated result than higher cost solutions provided to only a few. Furthermore, consumers are likely to be most aware of their consumption and the associated cost and most receptive to conservation messages when they receive their utility bill, which make them a logical place to insert energy efficiency advice. Finally, although of course smart bills can be only as good as the data that is available, they can be implemented without major investments in electricity and gas metering systems which makes them relevant for countries at different stages of development.

The main findings stemming from the analysis of the different case studies are:

- Smart bills can be a cost-efficient and effective way to engage an entire customer base, promote energy efficiency and foster conservation behavior. In the case studies reviewed as part of this report, smart bills were responsible for reducing household electricity consumption by between 1.1% and 2.7% and gas consumption by between 2.2% and 2.8% while at the same time proving cost-effective compared to other feedback and energy efficiency programs;
- A few simple features have been shown to greatly improve traditional bills and provide useful actionable insight to household consumers;

---

\(^1\) Please note that the terms "smart bills", "enhanced bills" and "informative bills" are used interchangeably throughout this report.
• Smart metering will not necessarily result in smart billing or any other feedback programs unless supported by adequate regulation as shown in the case of Sweden;

• Although quality and insight are greatly improved by the data granularity enabled by advanced metering infrastructure systems, enhanced bills can also be implemented with traditional meter data as shown by the case studies in Chile, Abu Dhabi (UAE); South Africa and Hong Kong (China);

• Smart bills and other feedback programs increase customer acceptance of other energy efficiency programs such as ToU tariffs or smart meter roll out since feedback programs enable them to benefit. The case of Victoria (Australia) is a good counter example;

• Smart bills are most effective when they are part of a comprehensive education and feedback package. Pre-offering education in order to engage consumers at an early stage, mixed feedback channels to reach all members of the household as well as people with different cultures or interests and appealing and intuitive feedback devices have all shown to lead to greater acceptance and impact of feedback programs;

• The most advanced and arguably the best cases of smart bills are to be found in countries with both enhancing technology and supporting regulation. California and Ireland are inspiring examples.

The following policy recommendations can be drawn from the research:

• Accurate billing frequency should be monthly whenever feasible in order to increase awareness of energy consumption and enable consumers to better link the results of their behavior with their energy consumption and expenditures;

• Although the specific design of the bills should be left to market forces and allow for innovation and creativity, some building blocks of smart billing have proven effective and should be made mandatory. These elements include: (i) normative energy use comparison, (ii) tips and advice as how to reduce energy usage or power demand (iii) tips and advice as to how to benefit from ToU or other types of dynamic tariffs if applicable, (iv) historical consumption data in order to track progress, (v) in case energy is subsidized real cost and real bill size should there be no State subsidy should be mentioned, (vi) indicate the different elements of the bill and who is responsible (retailer, DSO, State) and finally (vii) show pollutant emission associated with billed energy consumption;

And;

• Numerous countries are upgrading or contemplate upgrading their metering systems at massive costs which one way or another will fall on end-users. Many countries facing increasingly difficult-to-manage spikes in electricity consumption rightly see dynamic prices as one possible solution and are trying to promote them to residential consumer. Nevertheless, smart meters alone do not bring about consumption reductions and mandatory dynamic tariffs can have a disproportionate negative impact on people who have no choice but to remain at home all day or have little or no energy to shift. End consumers need to be informed about the workings and advantages of dynamic tariffs and how to best benefit from them. This does not come naturally. Supporting regulation should ensure that feedback and education requirements (for instance through smart billing but also through other more dynamic and interactive channels if deemed cost-effective) be an integral part of any smart meter or residential dynamic pricing policy package to ensure that all consumers are able to benefit financially and otherwise.
This report assesses eight best practice examples of informative energy bills from diverse geographies, representing a mix of developed and developing counties. The different cases are analyzed according to a set of key performance indicators that cover various stakeholders. The analysis also focuses on related supporting policies such as energy efficiency measures, smart meter regulations and advanced metering infrastructure deployment in each market.

Households are often perceived as a very difficult target group for energy efficiency programs due to their diversity and because they often see energy as a low interest and low involvement product. However, addressing residential electricity consumption is essential and inevitable if environmental and energy efficiency targets are to be met and also for affordability and social justice reasons. Households account for about 30% of the European Union’s final electricity consumption and between 20% and 39% in the markets reviewed as part of this report. Globally, residential consumption is expected to increase steadily in the foreseeable future as living standards of millions of households improve in the emerging world and households in developed countries keep acquiring new electricity consuming appliances. What is more, a recent study showed that residential energy prices have increased substantially between 2009 and 2012 in the countries worst affected by the economic crisis in Europe2. (Dromacque and Bogacka 2013.) Soaring prices are not confined to Europe however; the South African power utility Eskom for instance has applied to more than double the price of its electricity over the next five years after an increase of 180% over the past six years; prices in Victoria (Australia) have increased by 36% since 2008 and by 75% in Chile since 2006.

Regulators and policy makers seeking to address these issues often consider providing households with feedback on energy consumption as well as information about how to reduce it. Awareness is indeed considered an important first step towards creating more sustainable behaviors by making energy visible and ultimately reducing usage. Utilities in competitive markets see feedback programs as a way to differentiate their offering, move competition away from prices only establishing a trust-based relationship for the sale of additional future revenue generating services and of course gain or retain customers. Information on energy consumption is typically conveyed to household consumers through in-house and ambient displays, web portals, mobile phone applications and smart bills. The additional information that “smarten” traditional energy bills can be displayed on the invoice itself or take the form of a standalone usage or consumption report sent together with the traditional invoice.

Most residential consumers in Europe receive estimated bills which are adjusted for the time of year and the household's average consumption. Typically, these are sent three to four times a year. The difference between the estimated average consumption and the actual usage is made up at the end of the billing period or when a customer changes electricity supplier. They therefore do not accurately reflect the actual usage for a given period and leave consumers little room to track changes in their behavior. Smart bills on the other hand invoice for the actual consumption and provide additional information seeking to initiate more sustainable and efficient behaviors. Informative bills can be sent as frequently as once per month and have several advantages over other feedback channels. Indeed, every customer receives and most will at least glance at their bill3. In addition, to this day and though this is changing in some markets, the vast majority of customers' only contact with their utility is through their bill. Furthermore, consumers are likely to be most aware of their consumption and the associated cost and most receptive to conservation messages when they receive their utility bill, which makes them a logical place to insert energy efficiency advice. Energy bills therefore seem like a

---

2 Between 2009 and 2012, end user residential electricity prices have increased by 34% in Spain, 31% in Portugal, 14% in Greece and 13% in Italy while end user residential gas prices increased by 89% in Greece, 43% in Portugal, 27% in Spain and 38% in Italy over the same period.

3 The exceptions could be customers who pay by direct debit or via the internet and pre-payment customers.
sensible channel to promote energy conservation to most household and thus maximize the aggregated impact on national consumption.

The eight best practice examples in this report were selected due to the intrinsic quality of the programs themselves and their impact on the different stakeholders but also due to the surrounding supporting policies and the lessons to be learnt from their implementation.

**The impact of smart billing programs from the perspective of different stakeholders:**

- **Improvement in awareness of energy consumption and fostering electricity conservation behavior.**

  The case studies reviewed indicate that smart bills improve customers’ awareness of their energy usage and initiate conservation behavior. In the USA, Opower (2013) who designed the consumption reports analyzed as part of the Californian case study (SMUD) found that 83% of customers remembered receiving the reports, 73% read them thoroughly and 74% acted upon them. Regarding the large trials in Ireland, 82% of participants made some changes to the way they use electricity and 54% agreed that it succeeded in making them more aware of their electricity usage. The results for gas indicate that 86% of participants recalled receiving the usage statements and 87% made changes to the way they use gas. Finally in Sweden, where monthly billing based on actual consumption has been mandatory since July 2009, consumers are slightly more aware of their electricity consumption than in many other European countries. (European Commission 2010: 17.)

- **Reduction in energy consumption**

  In the cases reviewed as part of this project, Californian utility SMUD reported that 30 months after the first energy usage statements were sent, electricity savings averaged 2.6% for high consumption households who received the report monthly and 1.5% for lower consumption households who received the report quarterly. In Ireland, participants who received the energy usage statement every other month together with their energy bills reduced their overall usage by 1.1% while household customers who received the statement every month reduced it by 2.7%. Gas consumers receiving similar energy usage statements monthly managed to reduce their usage by 2.8%, while households who received it bi-monthly managed to reduce it by 2.2%. Although primarily used as a tool to reduce overall electricity consumption, the results of the large Irish pilots show that smart bills can also be an efficient vessel to help households on static Time-of-Use tariffs (ToU) shift consumption away from high priced high consumption periods. Participants indeed managed to reduce their consumption at peak hours by 6.9% when the statement was sent every other month and by 8.4%
when it was sent each month. Interestingly, both case studies indicate that results are sustained over time and that low income and vulnerable households also benefit from enhanced information on their energy consumption.

- Reduction in energy bills

The Irish regulator calculated the impact of ToU electricity tariffs coupled with energy usage statements on households’ bills. Participants to the feedback and ToU tariff trials in Ireland saved between €19 and €26 on their electricity bill or 3%-4% of a typical annual bill and between €13 and €16 (2%-3% of a typical annual bill) on their gas bill.

- Aggregated impact on national energy consumption

A study has recently been published by the Environmental Defense Fund reviewing the results of 12 smart bill programs at 11 different utilities in the US (similar to the energy usage statements sent by SMUD). The study encompassed 771,000 households from various geographies with different climates, market structures, consumption patterns, etc. Davis (2011: 2) found that "reducing residential electricity usage across the United States by 1.8% [the average result] would save over 26,000 GWh of electricity, reduce greenhouse gas emissions by roughly 8.9 million metric tons of carbon dioxide per year – equal to the emissions from three 500-MW coal-fired power plants – and save households just over $3 billion dollars per year on their electric bills."

- Cost effectiveness

A study by Allcott & Mullainathan (2010) based on undisclosed data by Opower found that an Opower-like program such as the one reviewed in the Californian case study costs an electric utility 7.48 USD per household per year or 2.5 cents per kWh saved, which compares well with other energy efficiency programs with costs ranging from 1.6 to 6.4 c/kWh saved. (cf. Friedrich et al.: 2009, Arimura et al.: 2009.) In its cost benefit analysis (CBA) on the deployment of smart meters together with In-House Displays (IHDs) and energy usage statements to all household customers, the Irish regulator estimates the cost of the IHD (plus the home area network component) to average €37.5 and the incremental annual cost of sending energy usage statements to amount to only €0.06 per electricity customer and €0.10 per gas customer to be put in perspective with a cost ranging from €580 to €670 per customer for the deployment of the advanced metering infrastructure (AMI).

- Improvement in customer relationship and increased customer acceptance of other energy efficiency programs

---

4 It is interesting to note that energy efficiency measures generally appear to be cheaper than renewable energy sources. Borenstein (2012: 71) summarizes levelized cost estimates for wind and solar generation taken from various recent papers. The cost per kWh are typically higher than that of energy efficiency programs.
In competitive markets, utilities who offer households solutions to manage consumption and reduce energy expenditure should see some soft benefits. They should indeed be better placed to stop consumers from switching to another retailer and also attract new ones. In non-competitive markets, the industry’s image may improve. There is also some evidence of a “halo effect”; in that utilities may be able to capitalize on customers’ newly built sense of empowerment and trust towards the utility. Opower (2013) indicates that utilities who send its home energy reports enjoy a customer satisfaction rate of 86% versus 81% for other utilities, and that customers exposed to its programs are more likely to get involved in other utility offerings and programs. In a similar fashion, energy usage statements seem to be valued by household consumers. In Ireland, 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 57% stating that it helped them reduce the amount they used.

The main findings stemming from the analysis of the different case studies:

- Smart bills can be a cost-efficient and effective way to engage an entire customer base, promote energy efficiency and foster conservation behavior. In the case studies reviewed as part of this report, smart bills were responsible for reducing household electricity consumption by between 1.1% and 2.7% and gas consumption by between 2.2% and 2.8% while at the same time proving cost-effective compared to other feedback and energy efficiency programs;
- A few simple features have been shown to greatly improve traditional bills and provide useful actionable insight to household consumers;
- Smart metering will not necessarily result in smart billing or any other feedback programs unless supported by adequate regulation as shown in the case of Sweden;
- Although quality and insight are greatly improved by the data granularity enabled by advanced metering infrastructure systems, enhanced bills can also be implemented with traditional meter data as shown by the case studies in Chile, Abu Dhabi (UAE); South Africa and Hong Kong (China);
- Smart bills and other feedback programs increase customer acceptance of other energy efficiency programs such as ToU tariffs or smart meter roll out since feedback programs enable them to benefit. The case of Victoria (Australia) is a good counter example;
- Smart bills are most effective when they are part of a comprehensive education and feedback package. Pre-offering education in order to engage consumers at an early stage, mixed feedback channels to reach all members of the household as well as people with different cultures or interests and appealing and intuitive feedback devices have all shown to lead to greater acceptance and impact of feedback programs;
- The most advanced and arguably the best cases of smart bills are to be found in countries with both enhancing technology and supporting regulation. California and Ireland are inspiring examples.

The following policy recommendations can be drawn from the research:

- Accurate billing frequency should be monthly whenever feasible in order to increase awareness of energy consumption and enable consumers to better link the results of their behavior with their energy consumption and expenditures;
• Although the specific design of the bills should be left to market forces and allow for innovation and creativity, some building blocks of smart billing have proven effective and should be made mandatory. These elements include: (i) normative energy use comparison, (ii) tips and advice as to how to reduce energy usage or power demand (iii) tips and advice as to how to benefit from ToU or other types of dynamic tariffs if applicable, (iv) historical consumption data in order to track progress, (v) in case energy is subsidized real cost and real bill size should there be no State subsidy should be mentioned, (vi) indicate the different elements of the bill and who is responsible (retailer, DSO, State) and finally (vii) show pollutant emission associated with billed energy consumption;

And;

• Numerous countries are upgrading or contemplate upgrading their metering systems at massive costs which one way or another will fall on end-users. Many countries facing increasingly difficult-to-manage spikes in electricity consumption rightly see dynamic prices as one possible solution and are trying to promote them to residential consumer. Nevertheless, smart meters alone do not bring about consumption reductions and mandatory dynamic tariffs can have a disproportionate negative impact on people who have no choice but to remain at home all day or have little or no energy to shift. End consumers need to be informed about the workings and advantages of dynamic tariffs and how to best benefit from them. This does not come naturally. Supporting regulation should ensure that feedback and education requirements (for instance through smart billing but also possibly through other more dynamic and interactive channels if deemed cost-effective) be an integral part of any smart meter or residential dynamic pricing policy package to ensure that all consumers are able to benefit financially and otherwise.
Introduction

International energy landscapes are changing rapidly and profoundly. Once regarded as cheap commodities, electricity and gas were not seen as a matter of interest for households and not much effort was made to reduce usage. However, with energy prices soaring well beyond inflation in many parts of the world, improved awareness of how energy consumption is linked to pollution, scarce or insufficient generation capacity in many countries and supported by regulation and enabling recent technology, a wide range of stakeholders now seek to provide households with consumption feedback to help them manage and ultimately reduce their energy usage and expenses. In some cases, the push comes from regulatory bodies. For example, Ireland's Commission for Energy Regulation (CER) has recently mandated that smart meters be rolled out together with energy usage statements (containing detailed consumption and cost information) to be provided by suppliers to their customers with their electricity and gas bills. In other cases, the push is triggered by market forces as retailers in markets opened to competition consider providing feedback on energy consumption as well as tips and advice as to how to reduce usage and bills as a way to retain and gain residential customers and establish a trust-based relationship for the sale of additional future revenue generating services. Western Massachusetts Electric Company in the US, British Gas in Britain and Energy Australia in Australia are good cases in point.

The traditional role of feedback in demand response programs is to make energy visible and to make the consumption of energy visible, thus expanding on residential consumers’ knowledge of the use and quantity of energy that actually circulates in the household. Common channels through which information on energy consumption is conveyed to household consumers are in-house and ambient displays, web portals, mobile phone applications and smart bills. Taken individually, all these channels have inherent advantages and disadvantages. They also have different purposes, and different members of the same household may prefer different channels. To support this point, research has shown that the programs with the greater impact on energy consumption therefore take a holistic approach to feedback. (cf. Stromback, Dromacque and Yassin: 2011, Lewis, Dromacque, Brennan: 2012.) IHDs act as constant reminders of energy usage. The information they display reaches every member of the household and enables them to link their actions to energy consumption in close-to-real-time. However, the technology can be seen as too costly to be mandated by regulators or given free of charge by retailers. Ambient displays also act as constant reminders of energy usage and reach the entire household but the type of information they are able to convey is limited. Web portals are relatively cheap to develop, can be personalized and provide consumption feedback in close-to-real-time. However, they have major drawbacks. They only reach the account owner whereas every member of the household uses energy, requires the user to actively log in and have so far not been very successful at attracting consumers (anecdotal figures from suppliers in the Nordic region show a typical uptake rate of 2-5%). Smart bills are sent at intervals that can vary from monthly to quarterly, and therefore they do not act as constant reminders of energy consumption as there is a delay between consumers' actions and awareness of the consequences of these actions. However, enhancing bills can be seen as a cost effective way to reach an entire consumer base leading to a greater aggregated effect on a country's energy consumption. Indeed, simple, low cost solutions which can be provided to all consumers may provide a higher aggregated result than higher cost solutions.

As an illustration, South African power utility Eskom has applied to more than double the price of its electricity over the next five years and electricity prices have increased substantially in countries worst affected by the economic crisis between 2009 and 2012 (+34% in Spain, +31% in Portugal, +14% in Greece, +13% in Italy, +9% in Ireland).

See appendix 10 for a detailed description of IHDs and web portals.
provided to only a few. In addition, they do not necessarily require major investments in electricity and gas metering systems, although of course these smart bills can be only as good as the data that is available. Basic forms can nonetheless be implemented by countries at different stages of development provided supportive regulations are in place. For these reasons, smart billing is the focus of this report.

Based on a review of 23 pilots, smart billing has the potential to reduce electricity by close to 6% (Stromback et al. 2011) although the outcome can vary significantly. In her literature review, Darby (2006) found results of smart billing pilots ranging from 0 to 12%. It is therefore important to learn from the experience of countries that have implemented or are implementing smart billing in order to better understand:

- The common features of smart bills that seem to be most efficient;
- The costs and benefits from the customers’ and utilities' perspectives;
- Customers’ drivers (what matters to them, their needs, what they would like from an energy company and an energy offering); and,
- The supporting regulation that countries need to put in place to optimize the impact of smart bills in accordance with countries’ problems at hand and circumstances.

Electricity and gas are not ordinary goods. Access to energy is vital; it allows households to stay warm, heat water, light their homes, cook etc. Energy shortages and lack of energy have been shown to hamper economic and social development. (UNDP 2011.) Many fast growing economies face electricity shortages and cannot build generation fast enough to keep up with economic growth and/or surging population7. Special attention will therefore be given to suggesting different approaches for developing countries to implement smart billing.

---

7 India, South Africa and Brazil are good cases in point. In 2012, 620 million Indians were left without power for several hours in, by far, the world's biggest blackout. Brazil suffered from an energy crisis in 2001 and South Africa in 2008 leading to power rationing and having had a negative impact on economic growth.
This chapter describes the key performance indicators used to assess the impact of smart billing programs on the different stakeholders.

**Improvement in awareness of energy consumption**

Electricity and gas consumption are often invisible by-products of habitual activities which do not require any deliberate actions by household members. As a result, "most people have only a vague idea of how much energy they are using for different purposes and what sort of difference they could make by changing day-to-day behaviour or investing in efficiency measures." (Darby 2006:3). As an illustration, the European Commission (2010: 16) found that less than half of European households know how much electricity they consume and state "the use of estimated consumption – in the majority of Member States estimated consumption is the dominant method [...] – clearly reduces consumers’ awareness of the volume of electricity consumed. This is worrying since such awareness is essential to reducing energy consumption to reach climate objectives and because lack of it hampers informed consumer choice." Thus, creating awareness of one’s energy consumption is often the first step towards more sustainable behaviors. It is indeed easy to imagine that consumers are most aware of their energy consumption and of the associated cost when they receive their utility bill, which makes them a logical place to insert energy efficiency advice.

**Reduction in energy consumption**

Feedback on energy consumption can influence the behavior of residential consumers and lead to a conserving behavioral effect. (cf. Darby 2006, Stromback et al 2011 and EPRI 2012.). Looking more specifically at 23 smart billing pilot projects, Stromback et al (2011) found that participants reduced electricity consumption by close to 6% on average. In her literature review, Darby (2006) found results ranging from 0 to 12%. Davis (2011) analyzed the impact of consumption reports on the electricity consumption of 771,000 households in the USA and found usage to have decreased by about 2% as a result.

**Reduction in energy bills**

The costly deployment of AMI systems financed at least in part by end-users is often justified on the ground that they will enable residential customers to better manage their energy expenses by, for instance, providing them with more frequent and granular consumption feedback. This is all the more important considering soaring energy prices in many parts of the world and sluggish economic growth in the West which force the issue of energy affordability back into the center stage each time a major price increase is announced by utilities or governments. Pre and post pilot surveys found that the most common stated goal of participants to take part in energy efficiency programs is to lower their energy bills. A recent survey of over 10,000 electricity customers in 19 countries found that 91% of respondents said that the opportunity to reduce their electricity bill is the most important factor that would encourage them to adopt an electricity management program. (Accenture 2012: 51.) This is also the main argument of retailers promoting their feedback programs.
When comparing different channels to provide consumption feedback to households, smart bills intuitively seem to be a cost effective way to reach an entire customer base. Every customer receives and most will at least glance at his or her energy invoice. In addition, to this day and though this is changing, the vast majority of customers' only contact with their utility is through their bill. Feedback channels are not mutually exclusive and we do not advocate an “either or” approach. Indeed, a variety of feedback channels and content have proven to work best in pilots as different feedback channels and messages have different purposes and reach different members of the household. However, policy makers should realize that simple, low cost solutions which can be provided to all consumers may provide a higher aggregated result than higher cost solutions provided to only a few. As an illustration, web portals require users to actively log in and have so far not been very successful at attracting consumers. Although hard to come by, anecdotal figures from suppliers in the Nordic region indicate a typical uptake rate of 2-5%. Mandating IHDs to all consumers on the other hand might be deemed too costly (especially considering that these will need to be replaced every few years).

IHDs have shown to have a bigger impact on energy consumption than indirect feedback such as smart bills. A recent review of pilots by Stromback et al (2011) found that providing participants with feedback on their electricity consumption through IHDs led to reduction in electricity consumption on average 2% higher than when provided through enhanced billing. The difference in results is often attributed to the fact that direct feedback enables participants to link their actions to their energy usage in close-to-real-time thereby initiating a virtuous cycle of learning. Again, we do not advocate an “either or” approach when it comes to feedback channels for the reasons mentioned above however, regulators and utilities should account for the cost efficiency of the different solutions as well. An approach suggested by different authors is to look at the “cost of saved energy”, in other words the cost of the solution divided by the amount of kWh saved.

While they suffer from a rather poor image in Europe (cf. European Commission: 2012) and indeed in other parts of the world, energy providers are in contradiction also widely seen by households as one of the most trusted parties to inform them about their consumption and actions to take in order to reduce it. (Accenture 2011: 13-14.) Utilities who offer solutions to manage consumption, lower customers' carbon footprint and reduce energy expenditure should see some soft benefits. In competitive markets, they should be better placed to stop consumers from switching to another retailer or indeed attract new ones. In non-competitive markets, the industry's image may improve. There is also some evidence of a “halo effect”; in that utilities may be able to capitalize on customers' newly built sense of empowerment and trust towards the utility.
Case study: USA - California

Sacramento Municipal Utilities District (SMUD) home energy reports

Context
California experimented with a rather brief and highly unsuccessful attempt to deregulate its electricity market that started in 1996 with the passage of Assembly Bill 1890 and ended with the well documented electricity crisis of 2000 and 2001. Attempts at deregulation were therefore called off, and the sector moved back to a system of vertically integrated utilities with three - Pacific Gas & Electric, San Diego Gas & Electric and Southern California Edison - who serve 80% of Californians, regulated by the California Public Utilities Commission (CPUC). California is the most populous state in the USA and counts about 13 million residential customers. A typical household uses 6,800 kWh of electricity per year; one of the lowest levels of consumption in the country, albeit rather high by international standards. Californian residential electricity prices have increased by 30% since 2003 and are traditionally among the country's highest. In 2012, they stood at about 35% above the national average. A typical Californian household currently spends about 3% of its disposable income on electricity. California is also seen as a frontrunner when it comes to energy efficiency and electricity demand management. As such, it has developed arguably one of the world's most comprehensive set of policies aimed at managing energy consumption.

Objectives
A thorough investigation into the causes of the crisis and how it could have been averted is beyond the scope of this report; however a consensus has formed that two important aggravating factors were a shortage of generation capacity and the lack of demand response to mitigate peak demand. Again last year, statewide annual electricity sales amounted to 259 TWh while net generation was only about 201 TWh. In addition, weather related peaks due to the massive use of air conditioning on hot summer days sometimes lead to network failures. As a result, California is the largest electricity importer in the USA and security of supply ranks high on the authorities’ agenda. The State has established energy efficiency as its highest priority energy resource for procurement of new resources. Key legislation that established this priority are Assembly Bill 1890 (1996) and Assembly 995 (2000). Under this legislation, California has established a “loading order” that calls for first pursing all cost-effective efficiency resources, then using cost-effective renewable resources, and only after that using conventional energy sources to meet new load. Enabling smart billing through different pieces of regulation and through supporting technologies to help residential customers build awareness and reduce electricity consumption is part of the State’s strategy to improve security of supply.

Case Study
Main characteristics
SMUD, together with Opower, offers an information program to help customers manage their electricity consumption by providing reports comparing their usage to that of other similar households. In this study, we look at the impact of the energy reports on electricity consumption of 35,000 randomly assigned participants 30 months after the first reports were sent out in April 2008. Larger users with consumption of over 8,000 kWh per year receive the report once a month while other users receive it once every three months. The energy reports provide customers with normative energy use comparisons with that of their neighbors (Figure 1), suggest actions that they can take in order to reduce their usage (Figure 2), and shows them the results of those actions over time (Figure 3). It is believed that there is a social driver at work in the presentation of energy

* An example is given in appendix 2.
use in this comparative fashion. If households learn they use more energy than their neighbors, it is assumed they will be motivated to reduce consumption and possibly do more than their neighbors. Tips and advice on how to do just that are also conveniently shown on the report. In addition, they are often tailored to the customer’s circumstances. For instance customers with electric heating receive information on how to reduce the consumption of electric heaters, and the potential impact of the various proposed actions quantified. Consumption reports do not give negative feedback but only ways to improve if consumption is higher than peers.

Figure 1: Normative comparison in Opower’s home energy reports. (Source: Opower 2013)

Figure 1 shows an example of how the participant household’s consumption level compares to that of its “Efficient Neighbors”. In general, one hundred geographically-proximate households with similar characteristics are used to form the comparison group. A household’s characteristics include, for example, house size and heating type.
Figure 2: Actionable insights in Opower's home energy reports. (Source: Opower 2013)
Supporting Policies

Smart metering policies

In California smart metering is part of an integrated set of policies to help manage electricity consumption as a direct method of improving security of supply for the State. A conclusion was reached after the California electricity crisis that another aggravating factor (linked to the lack of capacity) was the lack of demand response to mitigate peak consumption. The CPUC began a rulemaking in June 2002 which it concluded in November 2005 with the aim of “developing demand response as a resource to enhance electric system reliability, reduce power purchase and individual consumer costs, and protect the environment. The desired outcome of this effort was that a broad spectrum of demand response programmes and tariff options would be available to customers who make their demand-responsive resources available to the electric system”. Subsequently the CPUC and the utilities have developed an integrated package of smart metering plus demand response measures of direct load control and time differentiated pricing tariffs.

On 19 February 2004, the CPUC established six minimum functionality requirements for smart metering, while three are of particular interest for smart billing:

- Collection of usage data at a level of detail (interval data) that supports customer understanding of hourly usage patterns and how those usage patterns relate to energy costs;
- Customer access to personal energy usage data with sufficient flexibility to ensure that changes in customer preference of access frequency do not result in additional AMI system hardware costs;
- Compatibility with applications that utilize collected data to provide customer education and energy management information, customized billing, and support improved complaint resolution and consumption, tier alert notifications, rate option calculator, real time data transmission, and third party services.

---

[Decision 05-11-009 November 18, 2005, Order Instituting Rulemaking on policies and practices for advanced metering, demand response, and dynamic pricing, Rulemaking 02-06-001, http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/51376.htm]
The CPUC also requires that any meter deployed as part of a Utility AMI project include a universal, nonproprietary local area network to wide area network bi-directional interface.

All of the CPUC’s regulated utilities as well as other utilities in the State have already, or are in the process of, deploying smart meters to their residential customers.

Billing rules effectively mandate smart billing. On 28 July 2011, the CPUC voted unanimously to adopt a comprehensive set of rules to ensure that consumers can access the detailed energy usage data gathered by their smart meter. This decision applies to the three large investor-owned utilities, and contains the following requirements:

**Web presentment.** Utilities must provide via their websites the following information, updated daily: detailed energy usage, bill-to-date, month-end bill forecast, and projected month-end energy price. (Californians pay higher prices as they use more energy, progressing through up to five pricing “tiers”).

**Tier alerts.** When customers move from one price tier to the next, the utilities are to provide notifications “via e-mail, text message, tweet, chat, or some other form of rapid communication.” PG&E already does this for its smart meter customers.

**Rate option calculator.** Though few customers are aware of it, all residents and businesses served by California’s three largest utilities have the option of switching to a ToU rate. The newly required calculator, which will appear on these utilities’ websites, should help consumers understand whether they would save money by switching to a ToU rate. This tool would use an individual customer’s data automatically from the utility.

**Real-time data.** The smart meters installed by these three utilities all contain a radio that uses the ZigBee standard for transmitting data to homes and businesses. This is called the Home Area Network interface. So far this interface has not been turned on. Today’s CPUC decision requires these utilities to file plans that “include an initial phase with a rollout that enables a minimum of 5,000 HAN-enabled devices to be directly connected with smart meters, as envisioned in the decisions approving the deployment of [Advanced Metering Infrastructure] — even if full functionality and rollout to all customers awaits resolution of technology and standard issues.”

**Third-party data services.** Consumers will be able to authorize third parties to receive their backhauled smart meter data directly from the utility (as opposed to data that comes directly from the meter), to support services such as energy efficiency, demand response, energy advice, and more. The three major utilities will submit to the CPUC applications with specific plans, including which standards they will use — probably the Open Automated Data Exchange (OpenADE) standard in final development by NIST’s Smart Grid Interoperability Panel and the North American Energy Standards Board. Importantly, the CPUC found: “The utilities, however, will bear no new liability for the actions of third parties which acquire information via this [mechanism].”

Since revenue and profits are traditionally linked to the quantity of electricity and gas sold, helping customers reduce consumption does not seem like a natural strategy for Utilities. “Decoupling” breaks this link by providing stable revenue for Utilities regardless of sales volume. Since they are protected if their sales decline due to improved energy efficiency. Proponents of decoupling contend that Utilities are more likely to invest in this resource, or may be less likely to resist

---

deployment of otherwise economically beneficial measures. California first introduced decoupling for gas Utilities in 1978 (Decision 88835). By 1982, similar mechanisms were in place for the three electric IOUs. The measure was cancelled during the liberalization period. In 2001, the Legislature passed Section 739.10, which required that the CPUC resume decoupling. Currently, the revenue decoupling program is combined with performance incentives for meeting or exceeding energy efficiency targets. Revenue requirements are adjusted for customer growth, productivity, weather, and inflation on an annual basis with rate cases every three or four years, varying by Utility.

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. Opower (2013) reports that 83% of customers remember receiving its home energy reports, 73% read it thoroughly and 74% act upon it.

**Reduction in energy consumption**

As part of this report, we look at the impact of SMUD's Home Energy Reports on household's electricity consumption 30 months after the first exemplars were sent out in April 2008. This constitutes, to the best of our knowledge, one of the longest running experiments of this type anywhere. The duration of most similar programs is typically between three months and one year. The results below therefore allow us to measure the long term effects of smart bills on electricity conservation and whether their impact lasts or fades away. Table 1 reports the average results in terms of electricity conservation for the 35,000 households who receive the reports compared to a control group. It shows that over the 30-month period, savings averaged about 2.6% for high consumption households who receive the report monthly (households who use more than 8,000 kWh of electricity per year) and about 1.5% for low consumption households who receive the report quarterly.

Table 1: Impact of the home energy reports after 30 months. (Source: Navigant Consulting 2011)

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Reports (High Usage Customers)</td>
<td>2.6%</td>
</tr>
<tr>
<td>Quarterly Reports (Low Usage Customers)</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

One of the common questions about the impact of behavioral interventions to reduce energy usage is whether the impact fades away as people's interest diminishes and they revert to their old habits. The length of the SMUD program allows us to look into this matter. Table 2 shows the results in terms of electricity conservation for the first and second year of the program. For larger users average percent savings in program year 2 are higher than in year 1 - 2.89% compared to 2.37%, which is a 22% increase in savings in the second year. The increase is statistically significant. For smaller users, average percentage savings in program year 2 are higher than in year 1 - 1.70% compared to 1.25%, which represents a 36% increase in savings.
Table 2: Impact of the home energy reports after 1 and 2 years into the program. (Source: Navigant Consulting 2011)

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Reports (High Usage Customers)</td>
<td>2.37%</td>
<td>2.89%</td>
</tr>
<tr>
<td>Quarterly Reports (Low Usage Customers)</td>
<td>1.25%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

Figure 1 presents the trends in annual program savings for larger users (HC) and smaller users (LC) over months 6-29 of the program. When adjusted for seasonal fluctuations by setting heating and cooling degree days at their annual averages, the graphs show that for HC households, program savings appear to have remained constant on an annual basis after an initial ramp-up period of about 10-12 months. The long run annual savings seem to be approximately 2.9% per year. For LC households, program savings continue to trend upward after 29 months.

Figure 4: Trend in annual program savings - September 2009 - August 2010. (Source: Navigant Consulting 2011)
Opower reports some interesting findings that go against conventional wisdom. Figure 5 shows that electricity savings are comparable across income brackets while Figure 6 shows that electricity savings are consistent regardless of the participants' age.

**Figure 5: Electricity savings by income bracket. (Source: Opower 2013)**

**Figure 6: Electricity savings by age. (Source: Opower 2013)**

The findings reported in this section contradict many of the oft heard criticisms of behavioral energy efficiency programs, such as the fact that savings do not persist past the first few months and that energy savings are harder to achieve for senior citizens and households in lower income brackets.

Opower (2013) indicates on its website that utilities who send its home energy reports enjoy a customer satisfaction rate of 86% versus 81% for other utilities, and that customers exposed to its programs are more likely to get involved in other utility offerings and programs.

**Improvement in customer relationship**

**Cost effectiveness**

A study by Allcott & Mullainathan (2010) based on undisclosed data by Opower found that an Opower-like program costs an electric utility 7.48 USD per household per year or 2.5 cents per kWh saved, which compares well with other energy efficiency programs with costs anywhere between 1.6 and 6.4 c/kWh saved. (cf. Friedrich et al.: 2009, Arimura et al.: 2009.)
In the case of California, the introduction of home energy reports by several Utilities is clearly a result of clever regulation. However, even in other markets with different circumstances, where for instance the regulation is less supportive or in fully deregulated markets, Utilities may still want to adopt smart bills as a way to gain or retain residential customers. A study has recently been published by the Environmental Defense Fund reviewing the results of 12 Opower program deployments at 11 different Utilities in the US and encompassing 750,000 households from various geographies with different climates, market structures, consumption patterns, etc. Davis (2011) finds that the reports are shown to reduce energy demand by 1.8% on average, with the effectiveness of individual programs ranging from 0.9% to 2.9%. The author (2011: 2) extrapolates these results and concludes that "reducing residential electricity usage across the United States by 1.8% would save over 26,000 GWh of electricity, reduce greenhouse gas emissions by roughly 8.9 million metric tons of carbon dioxide per year – equal to the emissions from three 500-MW coal-fired power plants – and save households just over $3 billion dollars per year on their electric bills." The case of Opower's home energy reports is a very good example of how complex and frequently low interest energy consumption data can be crunched and turned into meaningful, insightful and useful information for households if coupled with a customer oriented approach. However, such a level of insight is only possible thanks to AMIs and the fact that forward looking regulation in California allows innovative third parties to access meter data and forces Utilities to provide households with information and tools to manage their consumption.
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:

---

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](source: CER 2011c)

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

![Figure 8](source: CER 2011c)

**Figure 8:** Hints and tips to reduce electricity usage. (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).

### Your general usage and costs

<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 is used to calculate the costs in that period. Please refer to your bills for further information.

### Your usage explained

During the previous month you used 563.7 kWh. In the same period last year you used 706.117 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?
Figure 12: Historical usage since last bill and comparison with other participants. (Source: CER 2011d)

Handy tips to reduce your energy use

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

Figure 13: Hints and tips to reduce gas usage adjusted to the season. (Source: CER 2011d)

Figure 14: Breakdown of average gas daily usage and average daily cost. (Source: CER 2011d)

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.

---

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 customers\(^\text{17}\) 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 middle\(^\text{18}\). 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

---

\(^{17}\) 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. 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>
<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/reti/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 infrastructure20.

---

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.
Case study: Sweden

E.on Sverige's residential electricity bill

Context

Sweden was one of the first countries in Europe to complete the deployment of smart electricity meters to household consumers. In 2003, the Swedish government required accurate monthly invoices based upon actual meter readings for all residential customers beginning July 1st, 2009. The legislation was in response to widespread dissatisfaction among residential consumers due to inaccurate invoices, data errors during switching and the long settlement periods (sometimes up to two years) which meant that some customers received very large invoices and sometimes had difficulty paying. In 2003, when the proposition was adopted, a survey of customer satisfaction found that the three largest electricity suppliers (E.On, Fortum and Vattenfall) were more unpopular than the tax office and customs (Svenskt Kvalitetsindex.) The only group which was close to being as unpopular was the police and even they scored higher than Fortum and E.On. Therefore, the aim of the Swedish government at the time was to be seen addressing these issues. The legislation did not specifically require smart meters to be rolled out, but set out to address citizen's dissatisfaction with the electricity industry. However, without any clear requirements from the regulator, unbundled network companies responsible for the roll out only sought to comply with the regulation while improving their own operations. They therefore did not pay much attention to the new capabilities offered by more advanced meters in terms for instance of being able to provide more frequent feedback to consumers, enabling more sophisticated dynamic pricing schemes and accommodating more intermittent generation. As a result, many of the meters deployed are not capable of supporting energy efficiency programs, nor is the national data handling and communication system capable of handling the necessary levels of granularity required for the most effective pricing or feedback programs. This greatly limits customer engagement and thus their ability to benefit from the smart metering infrastructure all the while bearing the cost (€200 per household). This is all the more unfortunate given that Sweden has arguably significant potential for energy efficiency. Average consumption at 9,000 kWh a year is amongst Europe's highest and around half of its 4.5 million electricity customers have electric heating and typically use about 20,000 kWh a year\(^{21}\). In addition, the cost of electricity is a concern for Swedish households during the long winter as a result of monthly billing based on actual consumption. Typical households spend about 4% of their disposable income on electricity and households with electric heating about 17%. In addition, electricity prices have increased by 21% between 2009 and 2012. The high share of electricity in household budgets, and especially those with electric heating, is one of the reasons why Sweden consistently has one of Europe's highest customer switching rates at around 10% per year. (Lewis, Brennan and Dromacque 2012.)

Objectives

Sweden did not mandate smart meters but only monthly meter readings in order to address customer dissatisfaction with the electricity industry. Proposition 2002/03:85\(^22\) stated:

- "In order to facilitate supplier changes and give electricity customers a more direct connection between consumption and billing, the government has passed a decision to introduce monthly metering of electricity usage among all electricity customers by 1 July 2009."

---

\(^{21}\) Electric heaters are large sources of load but also provide great sources of flexibility.

\(^{22}\) http://data.riksdagen.se/dokument/GQ0385
Some of the key objectives were:

- To provide all consumers with accurate monthly invoices rather than estimated invoices;
- To further competition within the electricity market by supplying all end consumers with accurate monthly invoices, rather than estimated bills, in the hopes that this would increase awareness of electricity costs and encourage consumers to switch away from expensive retailers;
- To give electricity customers a more direct connection between consumption and cost in order to encourage behavioral change and increased energy efficiency.

Case Study

Main characteristics

Below is an example of electricity bills sent by E.On Sverige to residential customers from its distribution area who have not switched to another supplier. The bill is shown in appendix 4 in its entirety. The front page of the bill states in a transparent manner not only the total amount to be paid, but also which amount is due to the DSO and which amount is due to the retailer. The back of the bill constitutes the enhanced component and contains two interesting elements. As shown by Figure 15, the electricity bill is broken down into each of its different components (retailer’s standing fees, DSO’s standing fees, transmission, distribution, energy, electricity tax and VAT) and shows which amount goes to the different parties (retailer, DSO or state through taxes).

![Figure 15: Breakdown of electricity bill into its different components. (Source: E.On Sverige 2013)](image)

The back of the bill also shows historical consumption levels over the past year (Figure 16).

---

23 E.On is one of the “big 3” with Vattenfall and Fortum who together share about half of the Swedish electricity retail market.
Supporting Policies

Smart metering policies

Sweden did not mandate smart meters but only monthly meter readings in order to address customer dissatisfaction with the electricity industry. Thus, the legislation did not specify any minimum requirements for meters although it was anticipated at the time that the most cost effective way to comply for the industry would be to upgrade the metering infrastructure. Proposition 2002/03:85\(^4\) stated:

- “In order to facilitate supplier changes and give electricity customers a more direct connection between consumption and billing, the government has passed a decision to introduce monthly metering of electricity usage among all electricity customers by 1 July 2009. Within the given timeframe, the network companies are free to decide the pace of implementation. The cost of the reform is estimated at around SEK 10 billion (€ 1.1 billion) and will be paid for by the end consumers.”

The possibility to use smart meters as a building block for a smarter electricity grid was overlooked. Measurements are delayed and real-time information is not transmitted to customers. As a result, the installed smart meters should already be replaced as the technology is not suited to next-generation smart grid technology. Furthermore, people regularly protest at the high electricity bills during the winter. The government has launched an investigation into the cost of upgrading the smart metering system and data handling capabilities in order to enable in-home displays and dynamic pricing programs for residential consumers. At the time this report was written, this was still under debate.

Billing rules

There are a few legal requirements on the Swedish electricity market regarding the invoice as it is seen as a component for competition. However, the network company is required to give the consumers’ meter readings. The meter readings include the following data:

- Meter readings at each month;
- Yearly consumption;
- Consumption per month (in kWh) for the last 13 months.

Another relevant aspect from the Swedish market can be the access of monthly and hourly meter readings. The consumer has the right to monthly meter readings and from 1\(^{st}\) October 2012 the consumer can, without any charge, sign contracts based on hourly consumption.

In Sweden, as in the other Nordic countries, customers who leave their incumbent supplier start receiving two bills; one from their network company related to distribution and transmission charges and one from their new supplier related to

\(^4\) http://data.riksdagen.se/dokument/GQ0385
the supply of electricity. The group of Nordic energy regulators (NordREG) sees
the separate billing regime as confusing for consumers and as a hindrance to
competition. NordREG (2012) recommends the introduction of mandatory
combined billing performed by the supplier as early as 2015 as the Nordic
countries work towards creating a common retail electricity market.

**Impact/Evaluation**

**Improvement in awareness of energy consumption**

The average Swedish consumer seems to be slightly more aware of their electricity
consumption than in many other European countries (European Commission 2010: 17). This is perhaps due to the cold winters, high average level of consumption and monthly bills based on actual consumption. It is therefore complicated to isolate the impact of accurate monthly billing on awareness and consumption since it has not been quantified. The current bills, however, give little information to consumers as to what is actually consuming electricity in their homes nor how they could reduce usage. Consumers are likely to be most aware of their consumption and the associated cost and most receptive to suggestions as to how to reduce both when they receive their utility bills which makes them a logical place to insert energy efficiency advice. Further, the granularity of consumption data (monthly versus daily in the CER pilot) may not be enough to create more energy efficient behaviors. Information on personal consumption will not work without a motivation to conserve, which may be provided by other instruments like financial incentives, goal setting, or personal commitment. On the other hand, feedback will not work if households have no idea what they can do about their consumption.

**Improved transparency**

The energy industry is hardly known for its transparency. Most consumers are not aware that their electricity and gas prices are made up of different elements, that some of these are regulated or set by the government (taxes) while some others (in deregulated markets) are left to market forces, and finally that the amount is divided between the different actors. In many countries (Great Britain, Romania, France etc), electricity and gas bills do not contain any precise breakdown information relating to the different elements besides VAT. Utilities in these markets do not see the need for the inclusion of such detailed information with the bills of residential customers. It means that retailers can hide relatively high margins or inefficiencies without much notice. This can been seen as a double-edged sword, since it also means that retailers in deregulated markets are often wrongly blamed for increasing prices even when the increases are due to components of the price which are out of their control. A study of residential energy prices in Europe by Dromacque et al. (2013) found that the energy price component (including retail margins) represent a mere 43% of the total electricity cost and 53% of the total gas cost. The same study found that over the past four years the regulated components of the bill increased the most. Although the current separate billing system is deemed confusing by many including NordREG, Sweden's highly transparent bills makes it possible for residential customers to know exactly what they are paying and to whom, which then makes it possible to voice their concerns or complaints to the responsible entity. Interestingly, Great Britain has arguably Europe's least transparent energy prices while at the same time the British energy industry faces some of the loudest critics from media and consumer groups.

**Perspective**

Swedish residential customers have received monthly bills based on actual consumption since July 2009. The current advantages for households are better oversight of their energy consumption due to accurate monthly invoices and improved switching times and data handling processes. In that regard, the regulation was successful in that it did what it set out to do. However, the light touch regulatory approach chosen by the Swedish government has not been successful at exploiting the potential of smart meters as building blocks of smarter energy networks and brought comparatively low levels of service improvement,
notably in terms of enhancing bills\textsuperscript{25}. The accurate monthly bills are also in some ways a burden for consumers as well as a benefit. Indeed, electricity costs used to be averaged out over the course of the year. This lowered consumer awareness of how their actions influenced their costs, but it also protected them from extremely high bills during the cold winter months. On top of this, no real-time consumption information has been provided to help consumers control these costs, resulting in shock electricity bills for some with electric heating. It points to the need for mandated feedback and customer education requirements as an integral part of any smart meter policy and regulatory package.

\textsuperscript{25} Utilities are developing websites where customers will be able to view their consumption information either from the previous month or perhaps the previous day. Uptake rate figures are not available.
Case study: Australia - Victoria

Origin Energy's residential electricity bill

Context

Victoria is the second largest electricity market in Australia with 2.3 million residential electricity customers. It also can be recognized for having one of the world's most active markets in terms of customer switching. (Lewis et al 2012.) The government of Victoria led the way to competition and privatization and retailers are now free to offer any form of pricing structure they wish. Electricity prices in Australia, once low by international standards, have increased substantially over the past few years (+36% over the past 5 years in Victoria). They are now higher than in many Western European countries. Typical Victorian household consumption is not especially high at 4,000 kWh a year, but the State experiences short periods of very high electricity demand and the top 1,000 MW of demand occurs for less than 2% of the year26. In its latest forecasting report, the Australian Energy Market Operator (2012) forecasts summer peak demand to keep growing at a rate of up to 3.4% a year over the next 10 years. In an attempt to shave peak demand, the Victorian Department of Environment and Primary Industries (DEPI) decided in 2007 to roll out smart meters and ToU tariffs to all customers by the end of 2013, without IHDs however. Following this decision, Victorian households and consumer associations started complaining about the inflated electricity bills to pay for the meters without being accompanied by any means to track and manage electricity consumption even though it was one of the main arguments to support the roll-out. The final blow to mandatory ToU tariffs was when the University St Vincent de Paul of Melbourne (Jonshton 2009) published a report showing that vulnerable consumers such as elderly, long-term unemployed and people with disabilities will be disproportionately disadvantaged by the new pricing plan due to potential difficulties in shifting their energy use to off-peak periods. In the face of the popular backlash that ensued, the Victorian government announced in March 2010 a moratorium on mandatory ToU tariffs (still in place at the time of writing) while the installation of smart meters across Victoria continues in accordance with legislative requirements.

Case Study

Main characteristics

The most interesting parts of electricity bills sent by Origin Energy to residential customers are presented below. Origin Energy is Victoria's largest retailer with a market share of 24%. Energy bills in Victoria are sent quarterly and this is expected to remain unchanged once the smart meters are deployed. The bill reviewed here is shown in appendix 5 in its entirety. Figure 17 shows the average quarterly consumption and associated GHG emissions during the billing period and how they compare to the previous year.

---

The bill also contains information which compares the use of electricity at the residential customer's place with the average use of electricity at similar places.

**Figure 18: Benchmarking information on electricity usage. (Source: Origin Energy 2013)**

**Supporting Policies**

**Smart metering policies**

Victorian policy makers view smart metering as a building block of an integrated set of policies to manage electricity consumption at peak times, thereby enabling more dynamic price signals and load automation. Peak demand is primarily driven by the increased use of air-conditioning on very hot days leading to two issues. Firstly, there is the issue of a potential inability of the supply system to meet extremes of peak demand without significant new investment in the electricity supply system, and secondly, there is a cost factor; supply costs escalate exponentially on days of extreme peak demand because of the low utilization of the assets to cover the short duration peaks. The result is a phenomenon of cross subsidy from electricity customers who do not use air conditioning to those who do. In February 2006, the Council Of Australian Governments agreed to improve price signals for energy customers and investors, and committed to “the progressive national roll out of 'smart' electricity meters from 2007 to allow the introduction of time of day pricing and to allow users to better manage their demand for peak power”. (Decision 2.2.)

In August 2006, Victorian legislation was passed to give the relevant Minister the
power to make Orders in connection with the state-wide rollout of 2.4m smart meters to be led by DSOs. These powers have been exercised to commence the rollout at the end of 2008 and to be completed by the end of 2013. In October 2007, the DEPI specified the minimal requirements for the installed meters in the State. These requirements include:

- Remotely measured half-hourly consumption with the capability of being read at least once every 24 hours;
- Controlled load or dedicated circuit management (storage hot water)
- Remotely measured separate exports and imports of energy
- Remote setting of times for controlled load switching
- Supply capacity control for entire customer’s load
- Measured power factor
- “Open” ZigBee interface to home area network
- Control of “other load” (e.g. air conditioner at time of summer peak)

**Billing rules**

Victoria’s Energy Retail Code (Draft Version 11) lists the information to be shown on energy bills. Some of these provide interesting additional information to consumers, including:

- Average daily consumption during the billing period for each tariff component;
- If a bill was issued by the same retailer for the corresponding billing period during the previous year, average daily consumption during that previous billing period;
- Details of consumption for each billing period over the past 12 months or, in the case of customers with a smart meter, consumption for each monthly period over the past 12 months;
- Reference to the availability of government funded energy charge rebate, concession or relief schemes;
- Benchmarking information which compares the use of electricity at the residential customer's place of supply; the average use of electricity at similar places of supply; and, assesses whether the use of electricity at the residential customer's place of supply is above, equal or below the average use at similar places of supply;
- Greenhouse gas emissions associated with the amount of electricity to which the bill relates;
- Greenhouse gases (GHG) emissions associated with the amount of electricity to which each previous bill related within the past 12 months;
- The website address: www.climatechange.vic.gov.au where customers can find examples of actions they can take to reduce energy use and emissions.

**Impact/Evaluation**

**Improvement in awareness of energy consumption**

Victoria faces times of acute system stress on hot summer days and decided to act upon it by mandating dynamic tariffs and load automation with the objective of reducing electricity consumption at peak times. Providing consumption feedback to consumers to help them manage their overall electricity consumption was at first overlooked and is now being brought back into the picture. However, smart billing is not being actively promoted by the government. Current energy bills have the advantage of helping consumers link electricity consumption with GHG emissions and provide guidelines as to what households their size typically consume. However, their impact on overall consumption has not yet been measured and is likely to be negligible since bills are only sent every quarter. In addition, the current

bills give little information to consumers as to what is actually consuming electricity in their homes nor how they could reduce usage. However, consumers are likely to be most aware of their consumption and the associated cost and most receptive to suggestions as to how to reduce both when they receive their utility bills which makes them a logical place to insert energy efficiency advice.

Australia's electricity systems face extreme and ever increasing peak demand on hot summer days including all the associated risks and inefficiencies this entails. Policy makers have set out to address these issues by giving residential consumers price signals and the possibility to automate some home appliances such as water boilers and air conditioners. While the solutions to the problems at hand make sense, and the needed technology was given careful consideration, successful demand response programs also require consumer engagement and acceptance as well as a careful assessment of the impact on consumer welfare, or in other words adequate surrounding regulations. Indeed, smart meters alone do not bring about consumption reductions and ToU tariffs can have a negative impact on people who are forced to stay home all day. Consumers need to be informed about the workings and advantages of dynamic tariffs and how to best benefit from them. This does not come naturally, however. Only then the benefits of dynamic tariffs for all parties will be achieved. A review of dynamic pricing pilots by Stromback et al. found that participant education clearly determines the success of ToU pricing programs (2011: 39). Participants of ToU pilots who did not receive any educational materials did not manage to lower their overall electricity consumption. To the contrary, participants who did receive educational material managed to reduce overall electricity consumption and reduced peak consumption by an additional 50%. It is interesting to note that even in pilots only 57% of participants in ToU trials were properly educated on how to best benefit from the new pricing structure. This illustrates how much the industry tends to overestimate consumers' understanding of more sophisticated tariff structures as well as knowledge of their own consumption without support. In Victoria, the popular backlash against mandatory ToU arose due to the fact that household consumers were not provided with the tools (IHDS, smart bills, web portals) that would have enabled them to take advantage of the new tariffs while footing the ballooning bill for the metering system upgrade. Consequently, the government abandoned its plan to make ToU tariffs mandatory. Although it greatly impacts the original business case, it is not necessarily a bad outcome since the backlash forced both the electricity industry and the public authorities to give consumers a more prominent place in the program. Optional ToU tariffs do not mean that people will not choose them; it means that the industry and public authorities will have to explain and convince the population of their benefits. Opt-in dynamic pricing coupled with feedback and automation can help some consumers to lower energy usage and bills as well as help protect the environment while not negatively impacting other consumers who would otherwise not benefit. The DEPI recently commissioned a series of studies published in 2011 and 2012 to assess among other things the impact of dynamic pricing on vulnerable households and how to minimize possible welfare losses. From a voluntary perspective, several distributors and retailers have created or are trialing web portals which provide access to smart meter data. In addition, the Victorian government decided in 2012 to subsidize IHDS through its Energy Saver Incentive program which offers discounts and special offers on selected energy saving products and appliances. Finally, some retailers such as AGL and EnergyAustralia are starting to partner with third parties to offer enhanced bills and consumption reports in an attempt to

---

28 Johnston (2009) found that dynamic pricing system could increase power bills by up to $300 a year for low-income families which represents a 30% jump on their average annual power bills.

29 International experience proves that customers are interested in dynamic tariffs when given the choice. 370,000 French EDF consumers are on a voluntary ToU / CPP tariff called Tempo. Arizona Public Service has enrolled 51% of its customers on a voluntary ToU rate, PG&E (California) has enrolled 80,000 customers on CPP, etc

retain or gain new consumers.
Case study: UAE - Abu Dhabi

Al Ain Distribution Company's newly introduced electricity bill

Context

The emirate of Abu Dhabi is a relatively small electricity market with only 220,000 household customers. Nonetheless, several features make it a uniquely interesting and challenging case when it comes to promoting energy conservation and awareness of consumption. This mostly stems from the fact that end-user electricity prices are heavily subsidized by the government which in effect eliminates any financial incentive for households to reduce usage. For example, in 2011, nationals paid only 16% of the real cost of electricity while expatriates paid less than half that cost. Typically, inhabitants of Abu Dhabi spend only around 0.5% of their annual disposable income to pay for electricity despite having one the world's highest consumption levels. Partly as a consequence of having access to virtually free electricity, Emiratis' average consumption stands at 71,000 kWh per year (ten times the world average) while foreign households consume a third of this bringing the national average to 41,000 kWh. In addition, the emirate is experiencing rampant growth in peak electricity demand. The Water and Electricity Authority (ADWEC) forecasts that peak demand will keep increasing by 11% each year until 2015 and between 7% and 8% over the period 2015-2020; on par with Abu Dhabi's fast growing population. The government is well aware of the issues arising from overconsumption. While it refutes plans to phase out the subsidy, the public authorities and the energy industry are trying to find solutions to curb excess electricity consumption. Although the authorities have not mandated smart meters for residential customers, Abu Dhabi's two distribution companies, Abu Dhabi Distribution Company and Al Ain Distribution Company (each act as the sole distributor and supplier of electricity and water in their respective areas) are deploying them actively. Smart meters potentially enable dynamic tariffs, real-time feedback on consumption and direct load control of certain appliances. Research forecasts that the smart meter market value in the UAE will grow from USD 26.0 million in 2012 to USD 86.6 million in 2017. (ZPryme research and consulting, 2013.) In addition Powerwise, an energy management agency, was launched in 2011 under the direction of the Regulation and Supervision Bureau (RSB) with the task of raising awareness of energy consumption and promoting electricity conservation among the population. The office is currently conducting several trials and information campaigns targeting household consumers.

Objectives

High energy consumption comes at a cost. Apart from the strain on state finances arising from the provision of subsidized electricity, growing peak demand necessitates added power generation capacity, requiring expensive new power plants. A revamp of the old electricity bill to help residential customers become aware of the real cost of electricity, build awareness of electricity consumption and promote a sustainable use of it is part of the authorities' strategy to reduce over consumption.

Case Study

Main characteristics

The RSB introduced a revamped electricity bill in March 2012 based on traditional meter data to be sent by the two distribution companies to their residential

---

31 The hot and arid climate and the very high standards of living of most of the population are also partly responsible for the high consumption.
32 The statistics office, SCAD, reports that the population of Abu Dhabi is growing at an average of 7.7% per year, considered among the highest population growth rates in the world.
33 According to the International Energy Agency's World Energy Outlook 2011, the UAE spent about USD 5.5 billion or over 1.8% of GDP to subsidize electricity in 2010.
customers on a monthly basis. The bill is shown in Appendix 6 in its entirety. Innovative features of the new bill include normative consumption feedback and the amount of electricity subsidy for the bill. Normative feedback allows customers to realize how much electricity they are expected to use for their property type, and how much above or below this guideline they are. Consumption bands are divided into "Ideal average" and "Above ideal-average" and are based on annual averages for each property type (see Figure 19).

![Figure 19: Normative consumption feedback. (Source: Al Ain Distribution Company 2013)](image)

The second innovatory feature of the new bill is that it clearly states the actual cost of electricity as well as the portion of this paid by the government through the subsidy (see Figure 20).

![Figure 20: Amount of electricity subsidy. (Source: Al Ain Distribution Company 2013)](image)

Supporting policies

Billing rules

The RSB mandated some elements of smart billing. Since March 2012, all electricity customers receive utility bills showing the government subsidy and benchmarking information on their consumption.

Impact/Evaluation

Improvement in awareness of energy consumption and cost

The RSB unveiled a new utility bill showing the real cost of electricity excluding the State subsidy as well as benchmarking information on household usage. Normative feedback is based solely on the property type (villa or flat). Additional criteria which do not require smart meter data such as property size or number of occupants could make the consumption target more precise and hence more relevant to households. The roll out of the new bill started only at the beginning of March 2012 and no ex post evaluation of their impact on consumption has yet been performed. The enhanced bill is a positive, if modest, step towards more sustainable consumption patterns. However, the impact on consumer behavior of the new bill even if coupled with broader education and information campaigns is likely to be minimal. Indeed, inhabitants of the Emirate spend a negligible proportion of their annual disposable income on electricity despite having one of the highest consumption levels in the world. This is due to the heavy State electricity subsidy which in effect diminishes any financial incentives for already wealthy households to conserve electricity. This will make changing attitudes towards energy difficult. Indeed, as shown by a recent survey of over 10,000 electricity customers in 19 countries, 91% of respondents said that the opportunity to reduce their electricity bill is the most important factor that would encourage them to adopt an electricity management program, ahead of decreasing their
personal impact on the environment (69%) and knowing that they are one of the highest electricity users in their peer group (16%). (Accenture 2012: 51.)

**Perspective**

Universal energy subsidies are widely seen to encourage excess consumption, to be an inefficient use of public funds and to be one of the main barriers to energy efficiency and to the introduction of renewable energy sources. Several studies argue for a gradual phase-out of inefficient energy subsidies which for example do not specifically target the needy or hamper investments in energy efficiency measures. (cf. IEA 2011, IEA, OPEC, OECD and World Bank 2011.) Nevertheless, a phase out of the subsidy in Abu Dhabi is currently not on the authorities’ agenda. In the meantime, Powerwise, the newly launched energy management agency is running numerous initiatives that attempt to change household behavior and curb excess consumption through education and information campaigns. The new bill is one of these initiatives and constitutes a first modest step in the right direction. However, in a country where the concept of electricity conservation is new and where households will have no financial incentive to reduce usage in the foreseeable future, the authorities and the industry will have to prove very creative to convince them to change their consumption habits. Technology can provide a solution, however. As AMI systems are rapidly being rolled out in Abu Dhabi and elsewhere in the UAE, the utilities and the regulatory authorities should consider their potential for demand side management (DSM) at an early stage. Indeed, AMI systems enable the introduction of dynamic pricing, the access to real-time consumption data for both utilities and consumers and finally allow for remote load control of household appliances such as air conditioning. However, AMI systems are at the moment being deployed without mandate or minimum requirements. The risk is therefore that the potential of smart meters to manage electricity consumption might be overlooked and an opportunity to mitigate excessive electricity consumption missed. This would be very unfortunate in a booming country with such a pressing need for demand response and no real financial constraints.

---

34 47% of residential consumption is used for space cooling.
Case study: Chile

Chilectra’s residential electricity bill

Context

Chile is the first of the South American countries to reach developed status and to have joined the OECD, a club of mostly rich countries. It has quietly been addressing poverty over the past few decades to bring it to the lowest levels in all of Latin and South America. (OECD 2012: 5.) Chile grew at a rate of 5.4% between 1986 and 2010 and is expected to keep growing at a healthy rate in the coming years. This can partly be explained by favorable developments in trade (copper represents 60% of exports) whose proceeds were spent soundly. Energy consumption is projected to grow at a rate of 6-7% annually between 2012 and 2020. (Ministry of Energy 2012: 8.) Because Chile has limited sources of fossil fuels itself, it heavily depends on imports to power its economy. This mainly comes in the form of gas from Argentina, where prices have increased over the past few years leading to increasing marginal costs of electricity. The roughly 5.1 million households in Chile have a relatively low average annual electricity consumption of 2,400 kWh. Regardless, Chileans have been plagued with steadily increasing electricity prices in the past decade (+75% over the past six years alone for households) and spend a rather high share of their annual disposable income to pay for electricity (6% in 2011). The government is attempting to tackle the issue of energy security and has to that effect specifically designated energy efficiency as part of its national energy strategy for the horizon 2030. Distributed generation, smart grids and smart metering technologies focusing on net metering are clearly identified as part of this strategy and a roadmap for their implementation is currently under discussion.

Objectives

Decree N° 327 - Article 127 passed in 1997 lists the information that must be shown on the bill, however none qualify as elements of smart bills. Chilectra voluntarily decided to add “smart” features to residential electricity bills as part of its strategy to maintain or improve customer satisfaction at a time of soaring prices by helping them manage electricity costs.

Case Study

Main characteristics

Below are shown the most interesting abstracts of the electricity bill sent by Chilectra to its residential customers. “Smart” features include graphical representations of the past year’s comparison of monthly consumption (see Figure 21) and tips and advice on how to reduce usage on the reverse page of the bill (see Figure 22).

---

35 http://ciperchile.cl/pdfs/04-2013/chilquinta/DOC5_DS327.pdf
36 Largest Chilean distribution company with approximately 1.6 million customers serving the capital city Santiago and its vicinities
37 The bill is shown in appendix 7 in its entirety.
Supporting policies

Smart metering policies

There is currently no regulatory mandate to install residential smart meters in Chile. Smart meters potentially enable provision of timely consumption data to consumers. Nevertheless, the development of distributed generation, smart grids and smart metering technologies focusing on net metering are parts of the government's energy strategy as clearly stated by the Ministry of Energy in the National Energy Strategy 2012-2030 document (2012: 34). In addition, regulation has recently been introduced that can be seen as precursors or complementary to smart meters:

- Congress approved a law in March 2012 allowing distributed generation up to 100 kW and mandating net-metering for residential customers;
- ToU rates must be offered to residential customers since 2008.

Impact/Evaluation

Improvement in customer relationship

Chilectra constitutes a good example of a utility who decided to go further than just complying with elementary billing rules. It voluntarily enriches household customers’ electricity bills with additional information about their consumption and how to manage it. This case study shows that company policy can in some cases compensate for light regulation even without retail competition. Although we are not aware of any ex post evaluation of the bill, it is likely that providing tips and

---

38 The text reads “I have a brilliant idea! The best idea is to care about the environment! Find more information on reverse.”
advice as to how to reduce usage and an easy way to track consumption is seen positively by customers, especially at a time of soaring end-user prices. Nevertheless, there is currently a debate in Chile following customer complaints' on the understandability of the different charges. The authorities and the utilities are therefore discussing the best way to reach a balance between price transparency and understandability of the bill. The Swedish case study could provide some ideas.

The Chilean electric sector is very dynamic and in the last decades the yearly national consumption growth rate has been around 6%. As Chile imports most of the fossil fuel it needs to generate power, the government is well aware of the challenges arising from increasing energy consumption on its energy security. It has specifically designated energy efficiency as part of its national energy strategy for the horizon 2030 with distributed generation, smart metering technologies focusing on net metering and smart grids seen as part of the solution. Utilities are already trialing residential AMI systems and feedback programs in several pilots around the country39. The details of a smart grid roadmap are currently being discussed and decisions likely to be taken in the coming years. The regulatory authorities should ensure that minimum requirements and billing rules allow for households to have access to their consumption data. This would provide ways that allow them to better understand and reduce their usage and bills so as to ensure that they not only bear the costs of the investment but are also able to benefit financially and otherwise.

39 Chilectra is currently running a project with 100 households where smart meters were installed. As part of this pilot the utility is sending personalized printed consumption reports showing households' consumption levels and patterns in comparison to their neighbors' as well as tips to reduce usage. The impact has not yet been calculated but feedback from customers has been very positive so far. A dedicated web portal is to be developed this year as a next stage in the pilot.
**Eskom’s residential electricity bill**

**Context**

South Africa suffered from acute power shortages between 2006 and 2008 despite worrying forecasts made in the late 1990s that the country was going to run out of capacity by 2007. Because of a successful electrification program and healthy economic growth, power demand was catching up fast with a capacity that had not increased much since the 1980s. However, Eskom who supplies 95% of South Africa’s electricity, was not allowed to invest as much as it would have wanted in new generation as the government wanted to bring in private power producers but failed to create an adequate regulatory framework for them to come in. The power shortages had a measurable impact on the economy and triggered downward revisions of GDP growth forecasts for the following years. In 2006, the financial losses due to power supply rationing for the mining industry was estimated at between R200 and R250 million a day. Furthermore, many SMEs which did not have the capital to install generators were forced to shut down and several large scale investments were postponed or cancelled due to the lack of reliable sources of power. Over the following years, Eskom and the government responded by investing in capacity expansion and also by launching numerous and comprehensive DSM initiatives aimed at every consumer segments. With regards to residential consumers, the government has recently settled on a non-binding national energy saving target of 10% per household. Despite it all, the country is still operating with margins well below the internationally recommended minimum of 15% and cannot cope with maintenance or breakdowns of power stations. Today load shedding agreements with large industrial users (e.g. aluminum smelters, gold and platinum mines, etc...) are widely implemented to give the grid additional breathing space and avoid power outages. Double digit electricity tariff increases have become common since 2008 as the massive investments in boosting power generation are passed on to residential customers. Each of the tariff revisions between 2008 and 2012 saw prices jump by over 25% (well above inflation). Sharp price increases will continue as Eskom has applied to more than double the price of its electricity by 2018. The 75% of electrified households' budgets have been and will again be greatly impacted by the price hikes.

**Objectives**

Due to unsubstantial capacity margins and the occurrence of brown or black outs, informing households about their maximum power demand is more important in South Africa than in many other countries.

**Case Study**

**Main characteristics**

The progressive features of the electricity bills sent by Eskom to its residential customers are shown below. These include historical comparisons of monthly consumption over the past year (see Figure 23) and maximum power demand over the past year (see Figure 24).

---

40 7% of national GDP at the time and 18.4% taking into account the indirect multiplier effects
41 A list of initiatives can be found at: <http://www.eskomidm.co.za>
42 Eskom reports in various “system status bulletins” updates that capacity margin was 0.9% on July 16th 2012, 1.3% on May 21st, 2012, etc...
43 Eskom (2012: 3) reports 45.75 hours of SAIDI for the year to March 2012.
44 The bill in its entirety is shown in Appendix 8.
Impact/Evaluation

Smart billing is not actively promoted by the government nor used by the different utilities as a tool to help consumers use electricity more efficiently. Current bills give information on both electricity consumption and maximum power demand which reflects the country's issues with tight capacity margins. Although South African households are more knowledgeable about the challenges related to peak time electricity consumption than in most countries, the impact of the bill on peak power demand is likely to be negligible. Indeed, the current bills give no information to consumers as to what is actually consuming electricity in their homes or how they could reduce usage as such information campaigns are being promoted through other channels.

Perspective

Between 2006 and 2008, electricity black outs had a sizeable negative impact on the economy of South Africa. It is still being felt today through exponential tariff increases and the occurrence of power shortages. The authorities and the main utility Eskom are tackling the seemingly insurmountable issue in a sensible manner. Firstly, heavy investments in the supply side are finally taking place. Secondly, numerous DSM initiatives have been launched. Today, even though capacity margins are still insufficient, there are few countries in the world with as many comprehensive DSM programs as South Africa. Perhaps surprisingly, smart billing is not one of them. Although 3.9 million customers have prepaid meters (Eskom 2013) sometimes as a solution to avoid having to deal with billing errors, a majority of them are still low-usage customers. Therefore, enhanced bills could still be used to engage large users who have the highest potential for load shifting\(^4\) and energy conservation. Although the grid is already relatively "smart", AMI systems, which are also seen by the authorities of many countries as a way to manage residential demand more efficiently, are not yet mandated in South Africa. As is often the case, utilities are taking the lead. Johannesburg's CityPower is

---

\(^4\) Eskom reports that 50% of an average household's energy usage in a month is taken by geysers and pool pumps.
planning on deploying smart meters to large residential customers. Nevertheless, the main stated goals are not related to energy efficiency but to reduce electricity theft and billing errors. As paramount as these goals are, the risk is to overlook the potential of AMI systems to benefit both the electricity network through remote load control of non-essential large appliances as well as consumers through the provision of consumption feedback which would in turn enable them to reduce their increasing energy expenditures.

46 The City of Johannesburg plans a mass rollout of smart meters to businesses and households consuming above 1,000 kWh of electricity a month and move them to ToU tariffs. Energy regulator NERSA allowed City Power to mark up their tariff increase by 1% to fund smart metering.
CPL Hong Kong’s residential electricity bill

Context

Hong Kong has two electric utilities that hold a monopoly in their respective areas. CLP Power Hong Kong Limited (CLP) and Hong Kong Electric Company Limited (HEC) serve the city’s 2.7 million residential customers. These residential customers annually consume 3,800 kWh on average and total residential consumption is a 26% share of total national electricity consumption. Hong Kong has one of the most reliable electricity supply systems in the world with adequate reserve capacity. There are regular talks about breaking the duopoly and opening the electricity market to competition. These talks have become relatively more common after a row over tariff increases last year (+5.9% in 2013 compared to 2012). The government is obliged to inform the two companies no later than 2016 if it intends to open up the market from 2018. In the meantime, a “Scheme of Control Agreement” was signed between the two utilities and the government in January 2008. It created financial incentives to support initiatives in the fields of energy conservation. Various energy audit, education and awareness campaigns were recently launched as utilities want to be seen as proactive. There is currently no regulatory mandate to install smart meters but utilities are conducting trials.

Objectives

Smart billing is not mandated by the government. CLP voluntarily enhanced residential electricity bills as part of its strategy to maintain or improve customer satisfaction at a time of increasing prices and talks of market liberalization by helping them manage electricity expenditures.

Case Study

Main characteristics

CLP is Hong Kong’s largest electric utility supplying 75% of the city’s circa 2.7 million residential customers. Bills are sent bi-monthly and based on accurate meter readings. Since 1998, CLP has provided customers with bar charts of their past electricity consumption on their electricity bills (as shown by Figure 25).

Starting from 1 June 2012, customers are also able to benchmark their consumption with the average consumption of CLP customers as well as the CO2 emitted per unit of electricity.

Figure 25: Historical monthly consumption for the last 13 months. (Source: CPL Hong

---


49 The entire bill is shown in appendix 9.
Interestingly, CLP Hong Kong also uses the bill as a support to communicate directly with their customers as shown by Figure 26.

Message for Customer

In response to customers’ feedback, we have highlighted the amount payable and the due date.
To encourage customers to pay bills timely, 3 Timely Payment Lucky Draws would be held from April to December.
For details, please visit our Customer Service Centers or website: www.clpgroup.com.
Testing of Messages - 5 lines

Figure 26: Use of bills to communicate with customers. (CPL Hong Kong 2013)

**Impact/Evaluation**

Smart billing is not mandated by the government however CLP voluntarily decided to enhance residential electricity bills. Although this is a positive step, this remains only for informative purposes and the impact of the bill on consumption is likely to be small. Indeed, the current bills give no information to consumers as to what is actually consuming electricity in their homes or how they could reduce usage. Information campaigns are done separately from the billing. However, consumers are likely to be most aware of their consumption and the associated cost and most receptive to suggestions as to how to reduce both when they receive their utility bills, which make them a logical place to insert energy efficiency advice.

**Perspective**

The city of Hong Kong has a rather healthy residential electricity market. Household consumption is on par with most Western European countries and much lower than North America’s. Capacity margins at peak times seem secured. However, increasing electricity prices face public discontentment and both authorities and utilities want to be seen as tackling the problem. The “Scheme of Control Agreement” signed between the government of Hong Kong and its main utilities has enabled the launch of many interesting initiatives since it was signed in 2008 (the agreement does not influence smart billing). Utilities in Hong Kong are also starting to trial AMI systems with their household consumers50. Although a decision regarding a mandatory roll out of smart meters is not on the agenda, the authorities should ensure that when a decision is made, minimum requirements and billing rules allow for households to benefit financially and otherwise.

---

50 CLP will start an AMI pilot scheme in the third quarter of the year designed to provide 3,000 residential customers with timely, detailed information on their energy usage and tips to optimize consumption.


Department of Communications, Energy and Natural Resources (2013). National Energy Efficiency Action Plan to 2020. Available online at:


Electrical and Mechanical Services Department (2012). Hong Kong Energy End-use data 2012.


Statistics South Africa (2005). Natural resource accounts - Energy accounts for South Africa


U.S. Energy Information Administration (2012). Retail sales of electricity and Number of Retail Customers by State by Sector.

ZPryme research and consulting (2013). UAE Smart Grid market vision.
APPENDIX 1
EU wide enabling and supporting policies

EU's Third Energy Package

The EU’s "Third Energy Package" came into force on 9 September 2009. The package contains provisions regarding intelligent metering systems with the aim of helping to increase individual consumer information and awareness of energy consumption:

Electricity - Directive 2009/72/EC (Annex 1)

- [Member States shall ensure that consumers] are properly informed of actual electricity consumption and costs frequently enough to enable them to regulate their electricity consumption”

- “Member States shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the electricity supply market.”

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


- [Member States shall ensure that consumers] are properly informed of actual gas consumption and costs frequently enough to enable them to regulate their own gas consumption.

- Member States shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the gas supply market.

EU's Energy Efficiency Directive

On 25 October 2012, the EU adopted the Directive 2012/27/EU on energy efficiency. Article 10 stipulates that billing should be:

- Accurate and based on actual consumption and that final customers have the possibility of easy access to complementary information on historical consumption allowing detailed self-checks.
APPENDIX 2

USA – California: Example of Opower’s paper-based home energy report. (Source: Opower 2013)
APPENDIX 3

Ireland: Example of paper-based home electricity usage report used in the Irish Customer Behaviour Trials. (Source: CER 2011)
Ireland: Example of paper-based home gas usage report used in the Irish Customer Behaviour Trials. (Source: CER 2011)
APPENDIX 4

Sweden: Example of electricity bills sent by E.On Sverige to residential customers from its distribution area who have not switched away to another supplier. (Source: E.On Sverige 2013)

Specifikation
APPENDIX 5

Australia – Victoria: Example of electricity bills sent by Origin Energy to residential customers. (Source: Origin Energy 2013)

Recto
## Payments Received - Thank You

<table>
<thead>
<tr>
<th>Date</th>
<th>PAY Date Account</th>
<th>$ XXXX.XX</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 May 12</td>
<td>66</td>
<td>XXXX.XX</td>
</tr>
<tr>
<td>Total Payments Received</td>
<td>$ XXXX.XX</td>
<td></td>
</tr>
</tbody>
</table>

## Electricity Usage and Service Calculation

<table>
<thead>
<tr>
<th>Description</th>
<th>Billing Period: 21 Aug 12 to 21 May 12</th>
<th>General Purpose TOU (D)/(C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Reading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous Reading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usage kWh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total kWh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Property</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub Total Electricity Charges</td>
<td>$ XXXX.XX</td>
<td></td>
</tr>
<tr>
<td>GST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Electricity Charges</td>
<td>$ XXXX.XX</td>
<td></td>
</tr>
</tbody>
</table>

## How you Compare

<table>
<thead>
<tr>
<th>Season</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>9.3kWh</td>
<td>11.4kWh</td>
<td>14.6kWh</td>
<td>16.7kWh</td>
</tr>
<tr>
<td>Winter</td>
<td>12.4kWh</td>
<td>14.9kWh</td>
<td>17.4kWh</td>
<td>19.5kWh</td>
</tr>
</tbody>
</table>

## Moving Address

For a quick and simple way to disconnect your current electricity and/or gas, please:

- Log into your online account at originenergy.com.au/myaccount
- Go to “Manage” then “Manage Account”
- Click on “Stop your supply”

## Contacting us

For any questions or complaints relating to your account:

- Go to originenergy.com.au/myaccount
- Write us at
  Origin Energy Customer Contact Centre, GPO Box 1370, Adelaide, SA 5001
  Telephone: 1300 262 654
  Email: enquiry@originenergy.com.au

## Important Information

- Hot Water Replacement: 24 hour hotline call 1300 791 4488
- Solar Home Products & Solar Billing: 1300 791 4488
- Energy Usage
- Energy Efficiency
- Energy Efficiency Certification

## How to pay your account

- Direct Debit Register online at originenergy.com.au/myaccount
- Phone 1300 791 4488 between 8am to 9pm, Monday to Friday, 8am to 5pm, Saturday
- Pay by Visa or MasterCard online (24 hour, payment limit apply)
- Pay by PayDirect - Online, telephone or at any Post Office
- Pay Direct Debit - Call 1300 791 4488

## Payment Slip

<table>
<thead>
<tr>
<th>Date</th>
<th>$ XXXX.XX</th>
</tr>
</thead>
<tbody>
<tr>
<td>06 Jun 12</td>
<td>$ XXXX.XX</td>
</tr>
</tbody>
</table>

---

66
APPENDIX 6

UAE – Abu Dhabi: Example of electricity bills sent by Abu Dhabi’s two distribution companies to residential customers. (Source: Al Ain Distribution Company 2013)
APPENDIX 7

Chile: Example of electricity bills sent by Chillectra to residential customers (Source: Chillectra 2013)
APPENDIX 8

South Africa: Example of electricity bills sent by Eskom to residential customers. (Source: Eskom 2013)
APPENDIX 9

Hong Kong: Example of electricity bill sent by CLP Power Hong Kong Limited to residential customers (Source: CLP 2013)

[Image of an electricity bill]

Message for Customer

In response to customer’s feedback, we have highlighted the amount payable and the due date.

To encourage customers to pay bills timely, 3 Timely Payment Lucky Draws would be held from April to December. For details, please visit our Customer Service Centers or website: www.clp.com.hk. Testing of Messages – 5 times.

Payments included up to 30.09.2007

Account number: 85181-73169-9

Total Amount Due: $177.64

07/09/2007

[Barcode image]
APPENDIX 10

In-house displays (IHD) are displays which hang on the wall or sit on a counter and provide close to real time information about household electricity consumption. They also provide a variety of other data. For example the display provided in the "Electricity Smart Metering Customer Behaviour Trials" allows people to set daily budgets for how much they want to spend, informs them of their success, what the current price of electricity is and provides information on how much they have spent so far this month.

IHDs provide households with real-time and historical information on their electricity usage and costs. Additional feedback content that are sometimes offered on the IHD are peer comparisons (showing the consumption rate of neighbors or consumers with similar conditions) and appliance specific consumption (breaking down the energy usage of individual appliances in the home).

The home screen for the dynamic display unit is the key screen that the customer always sees when the device is switched on, while further information can be gained if desired through navigating to other screens.

Ambient displays differ from IHDs in that they do not provide specific consumption information but rather signal to the customer messages about their general level of consumption and/or a change in electricity prices. Many ambient displays have the attributes of being attractive and intuitive which adds to their customer acceptance potential. An example of this is the Energy Orb sold by PG&E in the USA. Originally designed to track stock market prices, the Energy Orb can also be programmed to change from green to yellow to red depending on the current electricity price.

Websites offer an alternative way to provide the consumer with information about their electricity consumption. Websites are chosen as a means of providing feedback because they are relatively cheap. They rely on smart meters to collect the necessary consumption data and therefore the granularity of data provided to consumers depends largely on how often the meters are read or how often the information is transferred from the meter to the utility (or retailer).
APPENDIX 11

Overview of markets reviewed

### Number of Residential Electricity Customers

<table>
<thead>
<tr>
<th>Country</th>
<th>Customers (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA - California</td>
<td>13</td>
</tr>
<tr>
<td>South Africa</td>
<td>9.2</td>
</tr>
<tr>
<td>Chile</td>
<td>5.1</td>
</tr>
<tr>
<td>Sweden</td>
<td>4.5</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>2.7</td>
</tr>
<tr>
<td>Australia - Victoria</td>
<td>2.3</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>2</td>
</tr>
<tr>
<td>UAE - Abu Dhabi</td>
<td>0.2</td>
</tr>
</tbody>
</table>

### Average Residential Electricity Consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Consumption (kWh per annum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAE - Abu Dhabi</td>
<td>41,000</td>
</tr>
<tr>
<td>Sweden (with electric heating)</td>
<td>20,000</td>
</tr>
<tr>
<td>USA - California</td>
<td>6,800</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>4,500</td>
</tr>
<tr>
<td>South Africa</td>
<td>4,030</td>
</tr>
<tr>
<td>Australia - Victoria</td>
<td>4,000</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>3,800</td>
</tr>
<tr>
<td>Chile</td>
<td>2,400</td>
</tr>
</tbody>
</table>

### Residential Consumption as a Share of National Electricity Consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Consumption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAE - Abu Dhabi</td>
<td>39</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>37</td>
</tr>
<tr>
<td>USA - California</td>
<td>35</td>
</tr>
<tr>
<td>Australia -Victoria</td>
<td>34</td>
</tr>
<tr>
<td>Sweden</td>
<td>26</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>24</td>
</tr>
<tr>
<td>Chile</td>
<td>20</td>
</tr>
<tr>
<td>South Africa</td>
<td>16</td>
</tr>
</tbody>
</table>