SAVING ENERGY USING SMART METERING AND CONTROL

Richard Formby
EA Technology Limited
United Kingdom
Operating Agent IEA DSM Task XI

Energy plays a central role in everyday lives of residential and small business customers but its use impacts our environment and contributes to global warming. Many countries are concerned that liberalised markets may not deliver adequate peak electricity generation and network capacity in future. In this regard, smaller customer energy saving and behaviour change in response to financial and environmental stimuli can achieve energy savings, reduce peak demand and increase electricity supply security.

Many countries are concerned that liberalised markets may not deliver adequate peak electricity generation and network capacity. The domestic sector consumes between 20% and 40% of electricity in developed countries and is very attractive for energy saving. Customers can save energy by reducing use and shifting use from high to low demand times. Savings are achieved by increasing the propensity of customers to purchase energy efficient end uses, changing their behaviour to reduce thermostat settings, use hot water and lighting more wisely, reduce system losses and reserve generation and increase off peak space for wind generation.

Three mechanisms, by which smaller customers can save energy and assist system security are available for development.

- End Use Monitoring and Feedback (EUMF), where customers are presented with a breakdown of their individual end uses of electricity, its costs and environmental impacts. This requires a very smart meter and a customer display.
- Time of Use (TOU) and Dynamic TOU pricing, where customers are presented with different prices at different times and respond by shifting demand from high to low price periods. Time of Use pricing will only save energy if customers actually watch prices and change demand. This is unlikely for most customers. In order to be effective, remote/automatic switching of end uses will be necessary. This could be done without the requirement for a TOU meter. However, If customers are given the option to over ride the switching instructions, TOU metering will be needed to dissuade them from exercising that option.
- Demand Side Bidding (DSB), where customers participate in energy trading, by contracting and delivering specific demand changes in response to requests by System Operators or Suppliers. DSB will save energy in the same way as TOU pricing but again, it is the remote/automatic switching of demand which delivers the saving.

Validation of demand “available” and “ turned down” can be done using “ smart” metering or modelling methods.

IEA, DSM Task X1 has analysed work carried out and results of trials of EUMF, TOU pricing and DSB involving smaller customers in participating countries. It has also considered the impact that dynamic demand changes could have on profile settlements systems and methodologies for validating that participating customers have responded to requests for demand change. Analysis has also been carried out into end use demands which could respond to dynamic TOU pricing, aggregated and made available to System Operators as part of DSB processes.

Response modelling and communication and metering mechanisms, to enable payments to be made to customers participating in DSB, have been considered for each Demand Response (DR) delivery process.

Five reports have been completed:

Subtask 1 - Smaller Customer Energy Saving by End Use Monitoring and Feedback
Subtask 2 - Time of Use Pricing for Demand Management Delivery
Subtask 3 - Demand Side Bidding for Smaller Customers
Subtask 4 - The Impact of Dynamic Demand Changes on Profile Settlement Systems
Subtask 5 – Demand “available” and “turndown” Mechanisms for Market Bidding of Smaller Customer Demand

The study has quantified the potential of EUMF, TOU pricing and DSB mechanisms to deliver demand reductions and energy savings. It has also provided routes to dealing with dynamic profile changes in profile settlement systems and rewarding DSB participation.

Methods of applying EUMF as a cost effective and continuous methodology for motivating end use energy savings have been quantified for different levels of end use data disaggregation and presentation and levels of metering “Smartness”. Demand disaggregation methods have been reviewed including the use of “Very Smart Metering”. Face to face interviews between customers and energy advisors has been identified as being a very effective method for end use data disaggregation and motivator for customers. Monetary savings resulting from the application of EUMF to direct electric heating customers have been estimated to be worth approximately 100 Euro per year per customer.

Analysis has been carried out into potential smaller customer end use demands which could respond to dynamic TOU pricing and which could be aggregated and made available to System Operators as part of DSB processes. Successful participation by customers depends on the development of cost effective mechanisms for aggregating their demand and validating and rewarding those which actually deliver end use demand changes. “Smart” metering has a role to play in motivating these energy

saving mechanisms. The study showed that there is a role for smaller customers to bid demand to assist system operation, improve supply security and reduce supply costs. Savings in CO_2 will also be possible in some countries depending on the generation mix.

The study has estimated the financial viability of implementing different TOU pricing and DSB regimes by equating reliable and flexible demand shift with scheduled generation, transmission and distribution network construction costs. The financial benefits, available to motivate smaller customers to participate in TOU and pricing and DSB, are not large.

The study has concluded that there is a role for smaller customers to bid demand to assist system operation, improve supply security and reduce supply costs. It has also shown that unobtrusive as well as obtrusive management of end uses of energy may be possible in order to enable smaller customers to be “available” for automatic “turn down” of demand.

Dynamic TOU and Critical Peak pricing, if widely applied, will have an impact on profile settlements, used for Supplier settlements in competitive supply markets. If the profile settlement error becomes unacceptable, new, dynamic profiles could be developed to reduce it. This would be technically feasible by feeding the dynamic, demand control signals into the settlements process.

Task X1 has shown that validation requirements of DR, in order for it to be used as DSB, should not present fundamental barriers for smaller customers. In principle DR validation can be estimated based on sample group measurement, statistical modelling and Grid substation measurements of demand “ turndown” in response to DR motivator signals on specific days and at specific times. Various meter “smartness” levels have also been considered for this validation process.

The ESCO route to delivering smaller customer DR is considered very attractive in moving forward.

Motivating customers to buy energy efficient end uses and use them in a price flexible way to save energy and assist system security, is a difficult challenge. EUMF and TOU pricing have very important roles to play in this process.

End use, disaggregated, energy data statistics available in many countries for national populations should now be added to smaller customer energy bills to start the education process of making them more aware of end use costs and environmental impacts.