DSM Spotlight

The Newsletter of the International Energy Agency Demand-Side Management Programme December 2010

iea dsm energy efficiency

new work

Smart Grids and Demand Side Management

Smart meters and smart grids are emerging as an answer for curbing and managing electricity use. Recognizing what smart grids hold for the future and what still is not known about their use and impact, the IEA DSM Programme is initiating several projects in this area over the next year. The first of these projects are highlighted below.

DSM's Role In Delivering Effective Smart Grids

A paradigm shift is occurring in how the balance between electricity supply and demand is managed—a optimising the use of renewables with varying output or minimising the need for investment in new network assets, generation or peaking generation plants. As a result, the Smart Grid concept has emerged as a key solution, and work is underway on the technical aspects of Smart Grids and how they can be implemented. An area that has received little attention is the demand side or consumer, and therefore the IEA DSM Programme will begin work in this area in 2011.

One of the new DSM Tasks will work to ensure that the demand side is willing and able to contribute towards the successful implementation of Smart Grids. To achieve this goal, a number of key issues need to be understood. For example, the role of regulation is an important factor in the successful implementation of Smart Grids as it directly impacts the opportunities for demand side initiatives to be developed.

This project will focus on exploring issues such as:

Awareness – There is little evidence to demonstrate consumer perception and understanding of their role in delivering successful Smart Grids. For example, much emphasis is being placed on the development of smart appliances that can be automatically or remotely controlled. However, little is known about consumer attitudes to such appliances and how they will be used in practice. Will smart appliances be able to

continued on page 2

NOTE FROM THE CHAIRMAN

Nudge and Be Nudged

For decades we have argued the economic benefits of energy efficiency as the driving force for implementation. We have thoroughly learnt the language of economists and are professional in any debate on cost-efficiency. But, we may still have missed a point?

It is with some surprise to read the October 18th issue of the *Wall Street Journal* and find the headline "It isn't financial incentives. It isn't more information. It's guilt." This is a hard message to hear for us who have bet the house on financial incentives and information!

The article builds to quite some extent on the research and results published in a book called *Nudge* by Richard Thaler and Cass Sunstein. In this book, the authors provide a scientific background and some interesting examples that show the importance of framing offers in a way most likely to lead a customer to accept. They call it Choice Architecture.

So indeed it might be about guilt, but basically it is about how we humans observe new messages. Money matters, but sometimes not enough. And indeed information is important, but even more important is how it is transmitted.

Nudges are important to move us forward. And, the IEA DSM Programme is trying some of its own nudging in *Task XX, Branding Energy Efficiency Services.*

How to sell DSM with success.

Hans Nilsson
IEA DSM Chairman

PARTICIPATING COUNTRIES

Australia
Austria
Belgium
Canada
Denmark
Finland
France
Greece
India
Italy
Japan
South Korea
Netherlands
New Zealand
Norway
Spain
Sweden
Switzerland
United Kingdom
United States

deliver the expected level of demand response? For example, insulation has been seen as the 'lynch pin' of delivering energy savings within the residential sectors. However, experience has shown that the actual savings have been less than expected. Could the same also be true for smart appliances?

Perception – Consumers may have some awareness of the costs associated with Smart Grids, for example in relation to the roll out of smart meters, they may not be fully aware of the benefits they offer, both to individuals and society. For example, a Time of Use Tariff provides a powerful message to consumers about the value of shifting electricity consumption from one part of the day (e.g., the peak) to another. However, such tariffs could be perceived as simply 'punishing' those consumers who have high consumption during the peak. If such perceptions prevail, there will be little motivation for consumers to voluntarily switch to such tariffs, or for Energy Suppliers to offer them for fear of alienating their consumers.

Data privacy – There is growing evidence that consumers are concerned with data privacy issues, in particular, concerns have been raised about the way electricity utilities could use the information they collect on electricity consumption patterns and habits. Customer reluctance over the use of data collected through smart meters could prove a major obstacle to ensuring that Smart Grids fulfil their potential.

To define the scope and work of this project, a Task Definition Meeting will be held in early 2011. If you would like to learn more about the project, please contact the project coordinator, Linda Hull of EA Technology, United Kingdom, Linda.Hull@eatechnology.com

Time of Use Tariffs and Smart Grids

Real costs of electric power show a marked variability from day to day and from hour to hour. In particular, the costs increase as the demand approaches the upper limit of the generation capacity.

Yet, consumers very seldom pay tariffs directly related to actual energy prices since suppliers seem to prefer basing their rates on flat and not variable costs. Unfortunately, this approach does not allow consumers to respond to economic incentives when critical conditions occur in the system. Conversely, tariff plans where price depends on the time of use (TOU) are set to encourage a collaborative response to the demand.

The most common type of TOU rates are "two-part" rates, these rates charge customers a higher "on-peak" price than the standard flat utility rate during daytime hours, and a lower "off-peak" price during night time hours and weekends. Some utilities offer a "three-part" TOU rate, in which both the on-peak and off-peak periods are shorter than the typical two-part TOU rate periods, and also include a "shoulder" period between the on-peak and off-peak hours, during which time prices are between the on-peak and off-peak prices

In Italy, a time-of-use tariff at two-part rate periods was introduced in July 2010 as a standard tariff for residential users. The scheme of this tariff is outlined below:

- "on-peak" price: from 8am to 7pm working days: the so called F1 time-band
- "off-peak" price, which results from the concurrence of the so called F2 and F3 time-bands

F2 time band	F3 time-band
from 7 am to 8 am: working days **from 7 pm to 11 pm: working days** **from 7 am to 11 pm: Saturday**	**from 0 am to 7 am: working days and Saturday** **from 11 pm to 12 pm: working days and Saturday** **from 0 am to 12 pm: Sunday and Holiday**

The implementation rules are expected to be fully working in 2011 after some expected adjustments as more smart meters are installed and experience is gained. As of now, approximately 35 million smart meters have been installed.

This scheme will be implemented using smart meters, 35 million of which have already been installed. The meters can store consumer data in 15-minute intervals and accommodate 8 rate periods.

The Italian Regulatory Authority for Electricity and Gas (AEEG) is in charge of monitoring the implementation of this tariff policy, defining prices and systematically checking the effectiveness in load shifting. To do this AEEG has entrusted RSE to support them in the national project on residential loads and demand, which is underway.

The monitoring period for the two-rate tariff is 2010-2012 and includes two main activities.

Activity 1 – A panel of monthly consumers randomly selected from 28,000 household users.

Data are supplied by the various DSO's and include conditions before and after the tariff was set. A first assessment will be performed on the actual load shifting, operating effectiveness of the adopted tariff scheme, and advantages of the specifically adopted smart meter technology. The geographical distribution of the smart meters sample throughout Italy is shown in Figure 1. And, some preliminary results are shown in Figure 2.

continued on page 3

Smart Grids *from page 2*

Activity 2 – A panel of a select sample of 1,000 household users.
This panel is completely handled by RSE and is based on interviews performed by a market research organization every 3 months. The objective is to gather data relevant to the installed the electric appliances and the electricity consumption behaviors of the users. The relevant load curves are to be supplied by the DSO's on a daily base. The goals are the same as in Activity 1, but will produce data in greater details.

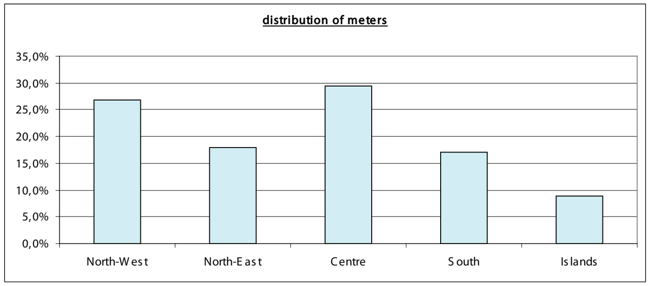

Figure 1. Smart Meter Distribution in Italy.

Tariff policies based on TOU pricing are considered powerful 'tools' to motivate consumer behavior changes. Answers to questions such as these will help to better under DSM, TOU and Smart Grids:

- How will customers respond when TOU tariffs are mandatory?
- What is the potential impact on low-income households?
- What is the outcome on retailers obliged to make a TOU tariff available to consumers?

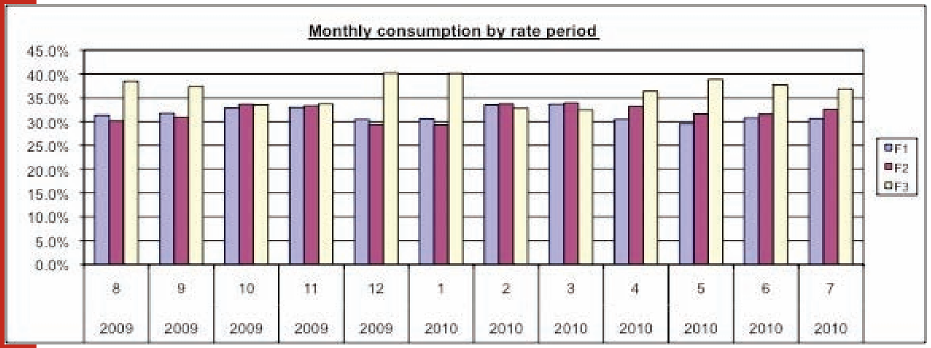

Figure 2. Breakdown of Electricity Consumption by Rate Period.

The IEA DSM Programme plans to include the work being done in Italy in its Smart Grid project, and Italy has kindly offered to share its vast database and studies. This contribution could potentially be part of a subtask devoted to a survey of smart metering experiences in participating countries and assessment studies on their effectiveness. If you would like to learn more, please contact Antonio Capozza of RSE, Italy, Antonio.Capozza@rse-web.it or Simone Maggiore of RSE, Italy Simone.Maggiore@rse-web.it

new work

Demand Response Services – A Job for ESCOs?

Demand Response (DR) can be defined as "changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized." (U.S. Department of Energy).

Dynamic pricing of electricity (and other network bound final energy sources) as well as carbon pricing will play an increasing important role in smarter grids, increased security of supply, and a decarbonized electricity system.

The question is can ESCOs be a driver and player in DR services? To answer this, the IEA DSM Programme is initiating new work to identify business cases for additional revenue streams for ESCOs by tapping into the added value of dynamic pricing of electricity, efficiency and CO2-reduction. Within the existing regulatory environment participants will examine:

- DR wholesale markets, products and players in participating countries electricity markets
- DR market sectors and potentials
- DR business cases: multiple revenues and life cycle cost of DR measures (case studies)
- Analyses of transaction cost to implement DR measures
- Integration of DR business cases into energy service models (based on case studies)

This proposed work will build on the existing resources of other IEA DSM Tasks as well as national and international work such as EU-DEEP and KONDEA of Austria. Its structure will be either a new IEA DSM Task or added work to the current *DSM Task XVI, Competitive Energy Services.*

To define the scope and work of this project, a Task Definition Meeting will be held in the second quarter of 2011. If you would like to learn more about the project, please contact the project coordinator, Jan Bleyl of Grazer Energieagentur GmbH, Austria, bleyl@grazer-ea.at.

case study

End User Flexibility by Efficient Use of Information and Communication Technologies - Norway

This is the seventh article in a series highlighting the case studies of DSM Task XV, Network Driven DSM. *This Task demonstrated that DSM can be successfully used to support electricity networks in two main ways 1) by relieving constraints on distribution and/or transmission networks at lower costs than building 'poles and wires' solutions, and 2) by providing services for electricity network system operators, achieving peak load reductions with various response times for network operational support.*

Introduction

A large-scale pilot project involving 10,984 customers, mainly residential, was carried out by two network operators and six technology vendors in Norway between 2001 and 2004. In the Nordic power market, the bid curves in the day ahead market (Elspot) were rather steep in the higher price ranges, which meant that price elasticity was very low. The tight peak power balance, periods with shortage of energy, and the low investment in new production capacity focused attention towards increased price elasticity on the demand side. The purpose of this pilot project was to investigate manual and automatic demand response to prices in the day ahead market.

Description of the Project

As shown in Figure 1, the project included:

- two way communication to customers using radio, PLC, GSM, GPRS and PSTN;
- automated meter reading with hourly readings; and
- a separate channel for direct load control of water heaters.

In Norway, the electricity industry has been unbundled and has separate network service providers and energy retailers supplying end use customers. As a result, customers' electricity bills contain four main components based on:

- network tariff
- retail energy tariff
- value added tax (VAT)
- government charges

The residential customers involved in this pilot project were offered a specially designed time of use (TOU) network tariff. This tariff consisted of three components:

- fixed component
- component for network losses
- energy-related component that was only activated during peak periods

The TOU network tariff had a two-level rate structure as shown in Figure 2. The rates were:

- peak price of about NOK 0.88 (excluding VAT) during peak load periods (defined as 7 to 11 am and 4 to 8 pm on working days from November to April); and
- off- peak price of NOK 0.02 (excluding VAT) in all other hours of working days, weekends and holidays.

The 44:1 differential between the peak and off-peak network tariff was very large. However, when the retail energy tariff, VAT and government charges components were added to the customers' electricity bills, this differential was reduced to about 3:1.

In addition, the energy retailers in the area offered customer contracts based on the spot prices in the electricity market on an hourly basis.

continued on page 5

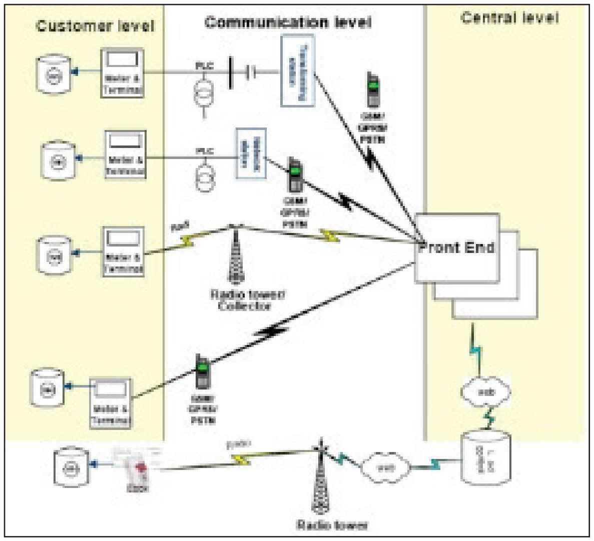

Figure 1. Information and Communication Technologies Used in the Pilot Project.

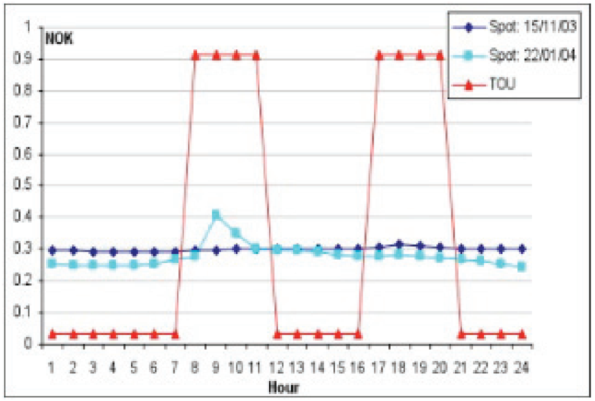

Figure 2. Tariffs Used in the Project

Case Study *from page 4*

One of the retailers also offered an hourly spot price in combination with remote controlled automatic disconnection (load control) of water heaters in the periods from 9 to 11 am and 5 to 7 pm on weekdays. The energy spot price was expected to be high during these periods. Load control of water heaters was available to 50% of the customers in the pilot project.

Load control operated through a separate channel to automated meter reading and required an agreement with the network operator to carry out the remote load control in the specified periods. Load control was implemented for short test periods of between two and three days several weeks apart.

The two network operators offered slightly different load control options as shown in Figures 4 and 5.

Water heaters were switched off as follows:

- Buskerud Kraftnett AS: during the hour with the highest energy spot price plus the hour before or after;
- Skagerak Energi Nett AS: during two hours in the peak load periods when the energy spot price reached a predefined limit.

In the case of Skagerak, the energy spot price limit was initially set at 0.0625 NOK/kWh. However, spot prices during the test period were low with little volatility. In the last months of the pilot project, the spot price limit was removed and the water heaters were disconnected for two hours every morning and evening, when the spot prices were highest.

Table 1. Average Load Reductions per Household

Option	Buskerud Kraftnett AS	Skagerak Energi Nett AS
TOU network tariff	~0.18 kWh/h	~0.18 kWh/h
Hourly spot price for energy	~0.6 kWh/h	~ 0.4 kWh/h
Direct load control of water heaters	~0.5 kWh/h	~0.57 kWh/h
TOU network tariff plus hourly spot price for energy (no load control)	~1 kWh/h	~0.3 kWh/h

Therefore, there were five possible tariff options from which customers in the pilot project could choose:

- TOU network tariff and standard-offer energy tariff; or
- TOU network tariff and spot price energy tariff; or
- TOU network tariff, spot price energy tariff and direct load control of water heaters; or
- standard-offer network tariff and spot price energy tariff; or
- standard-offer network tariff, spot price energy tariff and direct load control of water heaters.

Results

The main test period was from November 2003 to March 2004. During this period, the average load reductions per household achieved through the various options are shown in Table 1.

Detailed results are shown in the following Figures.

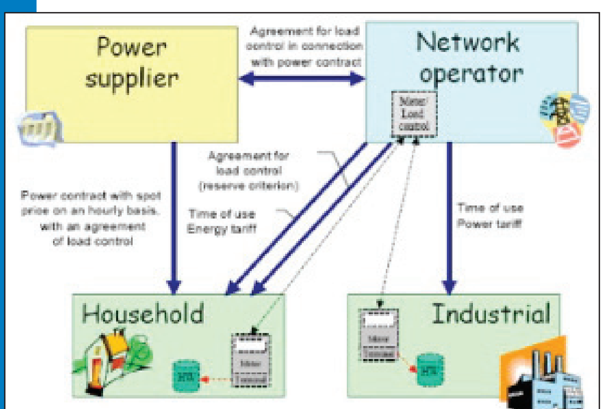

Figure 4. Tariff and Load Control Arrangements for Buskerud Kraftnett AS

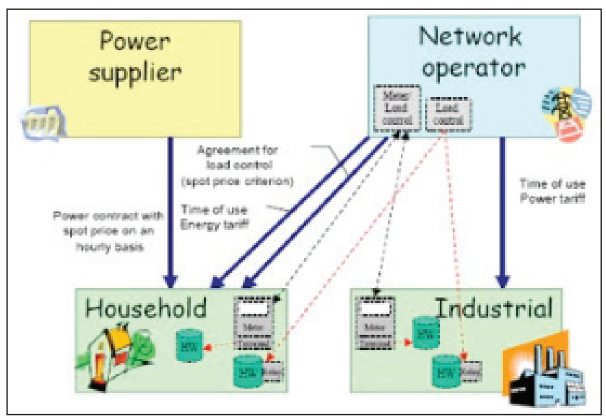

Figure 5. Tariff and Load Control Arrangements for Skagerak Energi Nett AS

continued on page 6

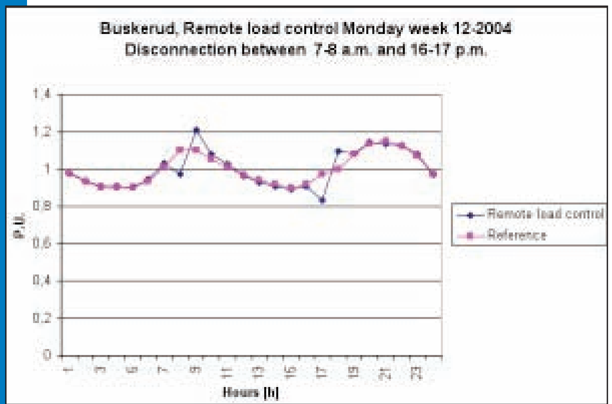

Figure 6. Results for Load Control

In Figure 6, the results are for residential customers with both TOU network tariff and spot price energy tariff and load control. The reference curve is based on consumption by similar customers in the same period and the same location. Compared with the reference group, electricity use by the load control group is reduced during the two peak load periods. The reduction is 12% in the morning and 14% in the afternoon. The number of customers was 1,230.

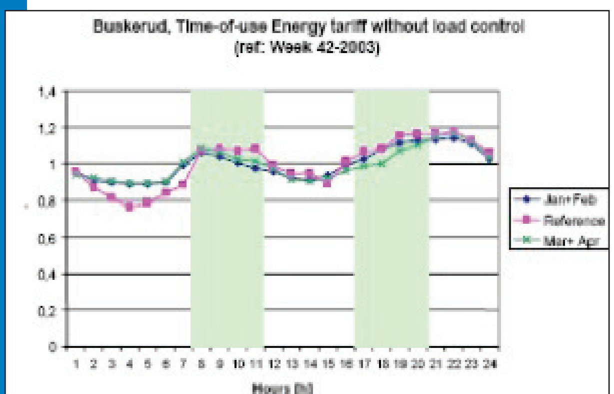

Figure 7. Results for TOU Network Tariff Without Load Control

In Figure 7, the results are for residential customers with TOU network tariff and standard-offer energy tariff with no load control. Compared with the reference group, electricity use by the TOU network tariff group is reduced during the two peak load periods. The reduction is 10% in the morning and 7% in the afternoon. The number of customers was 39.

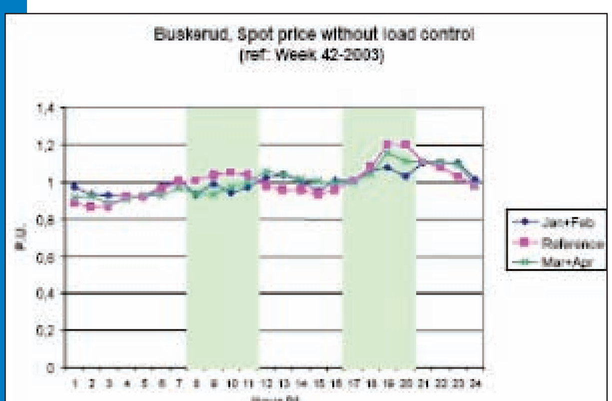

Figure 8. Results for Spot Price Energy Tariff Without Load Control

In Figure 8, the results are for residential customers with standard-offer network tariff and spot price energy tariff with no load control. Compared with the reference group, electricity use by the spot price energy tariff group is reduced during the two peak load periods. The reduction is 15% in the morning and 22% in the afternoon. The number of customers was 17.

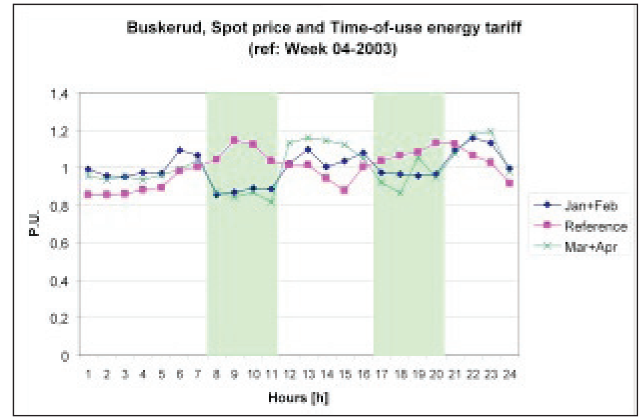

Figure 9. Results for TOU Network Tariff and Spot Price Energy Tariff Without Load Control

In Figure 9, the results are for residential customers with TOU network tariff and spot price energy tariff with no load control. Compared with the reference group, electricity use by the TOU network tariff/spot price energy tariff group is considerably reduced during the two peak load periods. The reduction is 35% in the morning and 31% in the afternoon. Number of customers was 6.

In summary, the largest response was achieved for the households with both the TOU network tariff and the hourly energy spot price and no direct load control of water heaters. However, only a very small number of customers (6 out of 10,894) chose this option and it is possible that these were households with an interest in the issue and the willingness and ability to modify their energy-using behaviour.

For those customers who were offered remote controlled automatic disconnection of water heaters, the average load reduction from water heaters was estimated to be about 0.5 kWh/h during peak periods.

continued on page 7

Case Study *from page 6*

The load curves for the customers with direct load control showed some increases in load towards the end of peak periods. This increased load was probably caused by the simultaneous reconnection of the water heaters with a loss of diversity in the water heater load as a result.

In addition, the decision to disconnect the water heaters to coincide with the two most expensive hours for the energy spot price meant that the water heater reconnection took place when the TOU network price was still high and remained high for the first hour after reconnection.

Conclusion

In this pilot project, a large experimental area with installed technology for automatic meter reading and remote load control was established. The average reduction in electrical consumption per household was 0.5 kWh/h. Taking network losses into account, this is equivalent to 0.6 kWh/h in reduced electricity generation.

Assuming there are 2 million household customers in Norway, and 50% of these install technology for remote load control, the estimated potential for peak load reduction through remote load control in the residential sector in Norway would be 600 MW (an average of 0.3 kWh/h per customer).

The data from the pilot project enabled an estimate of the average annual cost to achieve peak load reduction in the residential sector across Norway of NOK 680/customer/year ÷ 0.3 kWh/h/customer = NOK 2,260/kW.

This estimate was from a pilot project with many technological and organisational challenges. It was expected that lessons learned from the pilot project would make it possible to improve this figure considerably in future projects.

This article was contributed by David Crossley of Energy Future Australia Pty. Ltd. For more information on this case study and others, visit Task XV, Network Driven DSM at http://www.ieadsm.org/ViewTask.aspx?ID=17&Task=15&Sort=1.

www.ieadsm.org

Visit the DSM Programme's website for easy access to reports, news and contact information.

The DSM Spotlight is published several times a year to keep readers abreast of recent results of the IEA Demand-Side Management Programme and of related DSM issues. IEA DSM, also known as the IEA Implementing Agreement on Demand Side Management, functions within a framework created by the International Energy Agency (IEA).

Views, findings and publications produced by IEA DSM do not necessarily represent the views or policies of the IEA Secretariat or of the IEA's individual member countries.

For more information on the Programme, its work and contact addresses, please visit our website at **www.ieadsm.org**

No. 39, December 2010

Editor: Pamela Murphy
KMGroup, USA