

DSM Spotlight

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

July 2009



XIX

DSM for Small Consumers

In many developed countries, the consumption of domestic and small commercial consumers can account for as much as 50% of the country's total electricity demand. Unlike large industry however, this demand is spread over many thousands or millions of sites. The potential for small consumers to participate in demand side programmes was identified in the work of *IEA DSM Task XI, Time of Use Pricing and Energy Use for Demand Market Delivery*. However DSM Task XI also recognised that, given how relatively small the consumption of each of these consumers can be and how disparate the group is, the challenge is often in demonstrating the business case to target this group of consumers for demand side programmes. It is this challenge that *IEA DSM Task XIX Micro Demand Response and Energy Saving* plans to address.

To develop this business case, DSM Task XIX participants are considering what loads within a small site could be targeted, how these can be targeted, and what are the associated costs. This information is then being set against the market dynamics of the participating countries to assess the benefits of different types of demand response and energy saving programme. This information will then be used to examine the different possibilities that might work in any given country, dependent on its regulatory framework, common customer loads and how demand response and energy saving programmes have been embraced by energy consumers.

NEW PARTICIPANTS WELCOME

Join other experts to:

- Understand the advantages and disadvantages of TOU pricing, Demand Response (DR) and demand disaggregation and feedback for residential and SME customers in competitive energy markets
- Gain an independent view of technology and benefits available for TOU pricing and demand disaggregation
- Quantify the value and technologies for end use monitoring and feedback, Time of Use Pricing and DR to customers and its potential for achieving DSM objectives

- Develop national policies to encourage time of use metering, pricing and demand disaggregation within competitive energy markets
- Understand the role of demand side participation in energy markets through the use of DSB/DR programmes and mechanisms
- Quantify the need for time of use metering or developed profile metering in order to validate DSB/DR implementation
- Quantify infrastructure needs for alternative load control options and savings calculations
- Understand the contribution that Dynamic DR can have on the improving the utilization of wind generation capacity.

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

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case study

ETSA Utilities Air Conditioner Direct Load Control Program Australia

This article is the second in a series highlighting the case studies of IEA DSM Task XV, Network Driven DSM. The work in 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.

Program Background

ETSA Utilities is the sole distributor of electricity in the State of South Australia, serving over 800,000 customers with a distribution network covering 178,000 square kilometres. In September 2003, the electricity industry regulator, the Essential Services Commission of South Australia (ESCOSA), established processes that required ETSA Utilities to publish information regarding forecast network limitations or constraints, and to seek proposals for non-network alternatives to address such constraints, including demand side management.

These processes were to address a significant barrier to the successful take-up of DSM opportunities – the lack of publicly available information regarding network limitations that might be addressed through DSM. ESCOSA's intention was for DSM providers to be able to assess opportunities and make bids to ETSA Utilities on the basis of the information provided.

Existing electricity industry regulation controlled the average revenue (\$/MWh) that ETSA Utilities could earn in a year. This provided an incentive to ETSA Utilities to maximise energy sales, and conversely penalized the utility if sales were below forecast levels, for example, if there was a greater than expected impact of DSM measures.

To reduce this disincentive to implement DSM, ESCOSA incorporated a correction factor designed to reduce the financial risks faced by ETSA Utilities because of variations in forecast sales. This factor was more directly relevant to the application of energy efficiency measures than to the reduction of peak demand, but could be relevant to peak reduction measures that also reduced energy sales (e.g., installation of more efficient reverse cycle air conditioners). In addition, ESCOSA approved AUD 20.4 million (December 2004 values) as operating expenditure over the 2005-2010 regulatory period for ETSA Utilities to trial specified network DSM measures that may reduce the requirement for peak-

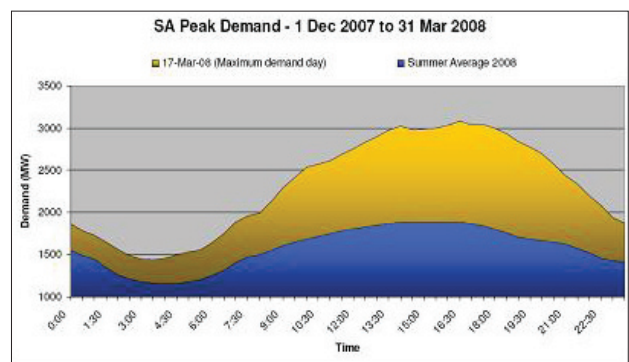
driven network expansion. The DSM measures mandated by ESCOSA were:

- power factor correction;
- direct load control;
- voluntary and limitable load control;
- standby generation;
- critical peak pricing; and
- aggregation of demand reductions.

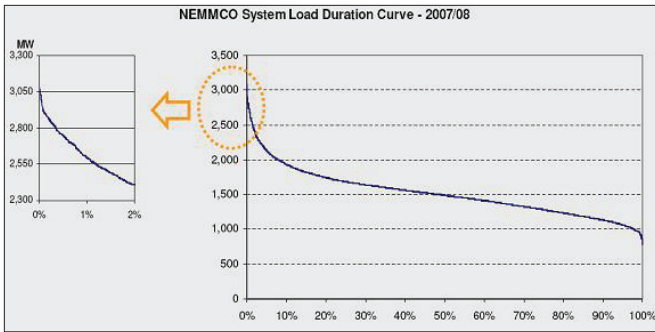
Program Drivers

South Australia has a very peaky electricity demand profile. Figure 1 shows the electricity demand profile on the ETSA Utilities network on 17th March 2008, the last day of Adelaide's record 15 day heat wave with temperatures consistently above 35°C, when demand peaked at just over 3,000 MW. In Figure 1, this peak day load profile is compared with the average daily load profile for the 2008 summer. Figure 2 shows that 20% of the capacity of the distribution system in South Australia is used for 2% of the time during the year.

The major contribution to the peak is from the residential sector, particularly air conditioning use on hot days. ETSA Utilities estimates that peak demand on hot days, primarily



► Figure 1. Peak Day Load Profile for the ETSA Utilities System, 17 March 2008, Compared with Summer Average Load Profile



► **Figure 2. Load Duration Curve for the ETSA Utilities System, 2007/08**

due to air-conditioning load, is about 1,000 MW higher than average daily peak demand over the summer.

DLC Pilot Program

To implement the ESCOSA-funded DSM program, ETSA Utilities identified a range of possible projects within each of the program’s approved categories of DSM measures. The DLC Pilot Program was a three-phase project.

DLC Phase I

Phase I was carried out during the summer of 2005/06 to determine customer perception of change in comfort levels resulting from the remote management of domestic air conditioners. The trial involved 20 residential customers in the Adelaide metropolitan area and customers were paid an incentive of AUD 100 to participate. The customers were recruited by demographic, geographic area and equipment type. During the trial customers were able to contact a named ETSA staff person to provide feedback and to report adverse impact or problems. After the trial customers were de-briefed on the results of the trial and their perceptions were recorded.

DLC Phase II

Phase II was implemented during the summers of 2006/07 and 2007/08. This project covered the larger metropolitan area of Adelaide and included two substations that, without initiatives to reduce peak demand, would reach capacity by 2011. A target load reduction of 2.2 MVA was set for the



► **Figure 3. Saab Systems “Peak Breaker” Direct Load Control Device Used in the ETSA Utilities Air Conditioner DLC Phase II Project**

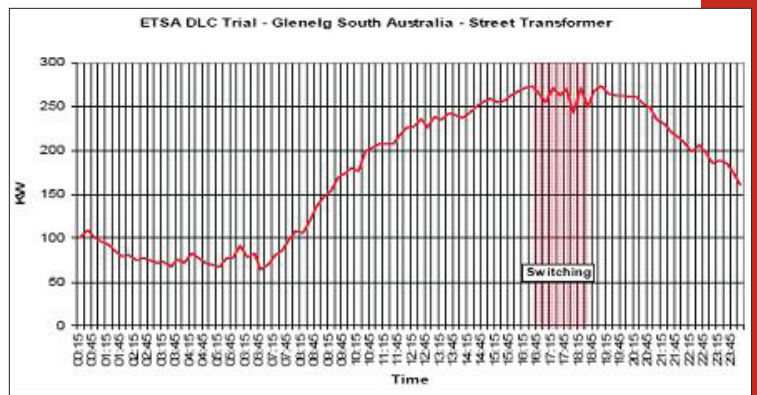
pilot program. The program kicked-off with the education campaign, “Beat the Peak”. Approximately 4,000 residential customers expressed interest in participating in DLC Phase II from which ETSA Utilities identified about 1,700 residential air conditioners and 700 commercial air conditioners suitable for the program.

To monitor demand impacts during the project, ETSA Utilities installed metering equipment in some customer premises, as well as on ten 11 kV feeders and 86 street transformers.

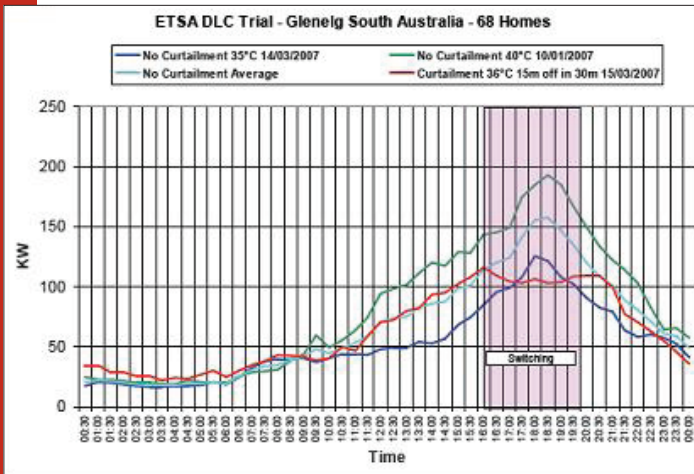
For DLC Phase II, ETSA Utilities, in conjunction with the Adelaide-based Saab Systems Pty Ltd, developed a small DLC device (the “Peak Breaker”) to be attached to the external compressor of air conditioners (see Figure 3). This device required only a simple installation procedure lasting up to 30 minutes with no internal access to premises needed.

Site level monitoring with interval meters was carried out during peak demand days at 90 randomly selected sites, with the remaining sites being monitored at the street transformer level. Monitoring also occurred through the SCADA system operated by ETSA Utilities to demonstrate the impact at the 66 kV sub-transmission system at times of peak demand. In addition, the distribution transformers and 11 kV substation feeders were equipped with metering equipment with remote communications capability allowing interval data to be collected as required.

One important operational conclusion from DLC Phase II was that effective load reductions requires a random overlapping switching protocol. Simultaneous switching early in the switching period caused a ‘sawtooth’ effect on the demand profile (see Figure 4) with repetitions of a majority of the load switching early in the switching period and little load switching later. This ‘sawtooth’ effect negated any



► **Figure 4. An Example of the “Sawtooth” Effect from the ETSA Utilities Air Conditioner DLC Phase II Project**



► Figure 5. Load Reductions Achieved in the ETSA Utilities Air Conditioner DLC Phase II Project

peak reduction. Randomised switching of individual loads required monitoring to ensure that the managed load was evenly distributed throughout the entire switching period. A process of reassigning the DLC units into distinct controllable segments, so as to overcome the ‘sawtooth’ effect, allowed the load to be more evenly switched during each control event.

DLC Phase III

This phase drew on the findings from Phase II. For this project, there were 935 installations in the homes and commercial premises of volunteers in Adelaide suburbs and South Australian country locations. The Peak Breaker device was improved and adapted to over 50 different types of air conditioners. ETSA Utilities provided a comprehensive 24-hour support service and developed a sophisticated digital control system that allows tailored switching on an individual customer level.

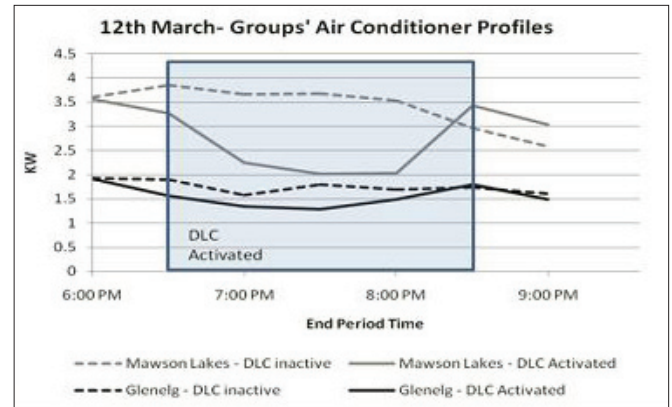
Results

DLC Phase I

The results of DLC Phase I showed that the external control of air conditioners significantly reduced the electricity demand of the sample customers, and that no reduction in thermal comfort level accompanied the reduced demand. The approximate load reduction resulting from cycling of compressors in the initial trial was 5 kW in a total demand of about 30 kW, ie a reduction of about 17%. Customers reported no reduction in their thermal comfort levels, with several commenting that they noticed no difference at all.

DLC Phase II

Figure 5 demonstrates the impacts on peak demand resulting from the cycling of air conditioners in a group of 68 premises in Glenelg, an inner suburb of Adelaide located on the coast. The figure shows the aggregate load



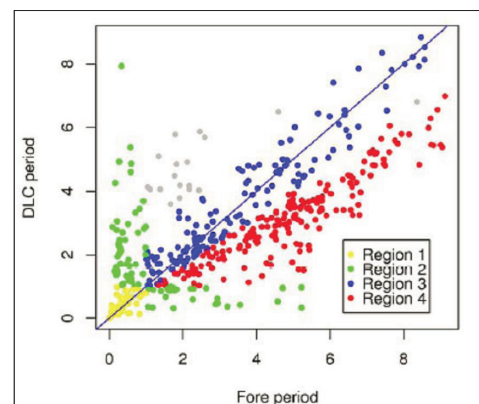
► Figure 6. Load Reductions Achieved by Separate Groups of Participants in the ETSA Utilities Air Conditioner DLC Phase III Project

profile, with no load curtailment, for days with maximum temperatures of 35 degrees and 40 degrees Celsius, and the average profile for those two days.

Figure 5 also shows the profile for a day with maximum temperature of 36 degrees Celsius in which the air conditioner at each premises was cycled between 4pm and 7.30pm. A significant reduction in peak demand was achieved for this day, equivalent to about 40 kW, in comparison with the average peak demand of the two days for which there was no air conditioner cycling.

DLC Phase III

Figure 6 illustrates the impact of a DLC event on separate groups of participants in Glenelg and Mawson Lakes, an outer suburb of Adelaide. It can be clearly seen that DLC has an impact under all circumstances but that its impact was more pronounced in Mawson Lakes than in Glenelg because of housing composition, mix and diversity and distance from the coast. Another important feature highlighted by Figure 6 is that because Mawson Lakes is a newer suburb with homogeneity of housing style and reliance on air



► Figure 7. Demand (kW) for DLC Activated Households Before and During a DLC Event in the ETSA Utilities Air Conditioner DLC Phase III Project

conditioning, a larger quantity of load reduction can be achieved there during a DLC event than in more established suburbs such as Glenelg.

Statistical analysis of the Phase III results show that the households participating in the trial can be divided into four categories illustrated by the four regions in Figure 7.

Region 1

These are households with low demand in both periods. It is reasonable to infer that no significant air conditioner usage occurred in these households and that a DLC event did not reduce load.

Region 2

These are households with low demand in one of the two periods. This could happen if, for example, the air conditioner was off during the “fore period” and on during the DLC period.

Region 3

These are households where the demand was high and differed little between the two periods. It is reasonable to infer that for these households there was a significant source of load not controlled by DLC.

Region 4

These are households where the demand was high in

both periods but significantly lower during the DLC period. It is reasonable to infer that these were the households in which DLC had the intended effect.

The interpretation of the demand patterns suggests that the impact of a DLC event is likely to be lower than its theoretical maximum (e.g., 50% for a 15 minutes off, 15 minutes on switching protocol) because not all houses will be using their air conditioners during a DLC event.

Overall Project Effectiveness

The trial is continuing and with each summer more information is gathered about the effectiveness of direct load control of air conditioners in reducing peak load on the ETSA Utilities network. Eventually, sufficient information may be obtained to enable ETSA Utilities to routinely implement large scale direct load control programs as an alternative to augmenting the network to cope with peak loads.

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

DSM for Small Consumers from page 1

The different models for the delivery of DR and energy saving programmes are also being considered. For some of the participating countries, a utility-led approach may be the most appropriate. For others, there may be a new business opportunity to be developed that uses an Energy Services Company (ESCO) to aggregate interested consumers irrespective of their energy supplier and to offer the reduced load back to the market, the system operator or the supplier.

DSM Task XIX began in January 2009 and is due to run until April 2010. It is currently collating information from the participating countries to form the basis of its first report, “Micro Demand Response and Energy Saving Products – Definition of the Requirements, and the Options for Effective Delivery.” The information in this report will then be used to examine the possibilities and supporting business cases.

To learn more about DSM Task XIX visit <http://www.ieadsm.org/ViewTask.aspx?ID=16&Task=19&Sort=0> or contact the Task Operating Agent, Linda Hull, Linda.Hull@eatechnology.com.

XVII

Integration of Demand Side Management, Distributed Generation, Renewable Energy Sources and Energy Storages

Participants in Task XVII are collaborating to optimize the integration of flexible demand (Demand Response and Demand Side Management) with distributed generation, energy storages, and smart grids. The objective is to increase the value of Demand Response, Demand Side Management and Distributed Generation and decrease problems caused by intermittent distributed generation (primarily from renewable energy sources) in the physical electricity systems and at the electricity market. To do this, the participants will provide integration-based solutions and examples of successful best practices.

NEW PARTICIPANTS WELCOME

Join other experts to:

Participants will receive and share updated information on the development and penetration of new technologies in consumption, generation and energy storage at customers' premises in different countries.

Analyze the effects of new technologies on power systems and stakeholders overall and by country.

Analyze the flexibilities provided by new end-uses (e.g., electric vehicles and heat pumps) and energy storages in the context of increasing the amount of uncontrollable generation in power systems -- how much and how this flexibility can compensate the problems caused by the uncontrollability in the generation.

To begin, the participants conducted a scoping study to collect information from other relevant IEA Programmes, participating countries, workshops, and other sources (e.g., research programs, field experience). This phase, with input from Austria, Finland, Italy, Korea, Netherlands, Spain and USA, concluded in November 2008 with a state-of-the-art report and a proposal for the next phase of work.

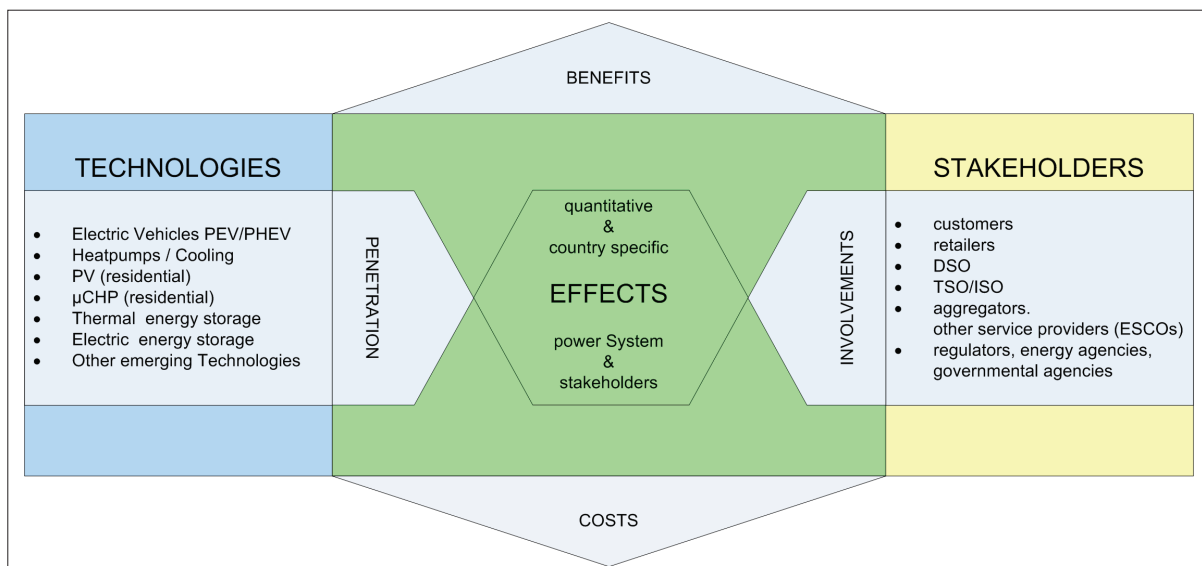
Completed Work

Phase I concluded with a 2-volume synthesis report, <http://ieadsm.org/Publications.aspx?ID=18>, and two public workshops, <http://ieadsm.org/ViewTask.aspx?ID=16&Task=17&Sort=0>. In addition over 50 case studies were collected and categorized for use by the participants.

Conclusions from Phase I were that with increased penetration of DG and developments in technology and the market will lead to:

- new roles for stakeholders, new business environments, and demand for new tools,
- rapid development of metering and ICT technologies, and
- development of new products, services and pricing policies which can activate the more deep participation of final consumers in the market.

Successful integration means that different technologies in the supply and demand sides as well as in ICT are developed to the level where their integration is feasible both technically and economically and that regulation, policy and market provide the successful framework for the integration.



Summary of the Status of Integration

Early: R&D

Young: Pilots / Field tests

Existing: Available, at least one vendor; early adopters involved

Mature: Widespread commercial

New Work

This phase of the work will focus on assessing the effects of emerging DER technologies in different stakeholder groups and within the electricity system. The emerging DER technologies that will be examined are plug-in electric and hybrid electric vehicles (PEV/PHEV), different types of heat pumps for heating and cooling, photovoltaic at customer premises, micro-CHP at customer premises, energy storages (thermal/electricity) in the connection of previous technologies, and other technologies seen feasible in 10 – 20 years, especially by 2020.

The work is divided into four Subtasks:

- Subtask 5: Assessment of technologies and their penetration in participating countries
- Subtask 6: Stakeholders involved in the penetration and effects on the stakeholders
- Subtask 7: Assessment of the quantitative effects on the power systems and stakeholders
- Subtask 8: Conclusions and recommendations

The figure on page 6 describes the concept of this new work.

This 2-year phase of the work will begin in September 2009. Participating countries include Austria, Finland, France, Netherlands and Spain. New participants are welcome.

For more information contact the Operating Agent, Mr. Seppo Kärkkäinen of VTT in Finland, Seppo.karkkainen@vtt.fi (after September 1, 2009: seppo.karkkainen@kotikone.fi)

Electricity Supply	Fossil fuel based technologies	<ul style="list-style-type: none"> ▪ fuel cells ▪ micro CHP ▪ conventional CHP 	Young Existing Mature	
	Renewables	<ul style="list-style-type: none"> ▪ wind ▪ photovoltaics ▪ small hydro ▪ waves, tidal ▪ biomass 	Mature Existing/Mature Mature Young/Mature Young/Mature	
	Renewable production forecasting		Young/Existing	
	Electrical energy storage	<ul style="list-style-type: none"> ▪ energy management ▪ bridging power ▪ power quality 	Young/Mature Existing/Mature Early/Existing	
	Economic dispatch, SCUC software		Mature	
	Resource planning techniques, tools		Mature	
	Real-time grid operation tools		Mature	
	Electricity demand	Many DSM techniques		Mature
		Automated DR devices		Young
		Pricing granularity (smart rates)	<ul style="list-style-type: none"> ▪ Small customers ▪ Large customers 	Early Existing
Consumer response and production			Early	
Communication, control and monitoring		Communication networks		Mature
	High-speed digital monitoring	<ul style="list-style-type: none"> ▪ Generation ▪ Transmission (EU) ▪ Transmission (USA) ▪ Distribution 	Mature Mature Young Early	
	Smart meters deployment		Young/Existing	
	Cyber-security		Young/Existing	
	Interoperability		Existing	
	Functional Automation/Monitoring	<ul style="list-style-type: none"> ▪ for large assets ▪ for DER 	Mature Young	
	Intelligence/Smart behaviour		Young	
	User/primary process feedback		Young/Existing	
	Intelligent agents and distributed controllers		Young	
	Communication semantic and content		Young/Existing	
	Integration analytics	Modelling electricity system impacts		Young/Existing
Understanding relative costs and benefits			Existing	
Controlling and coordinating parts			Young	
Good, real data			Early / Young	
Regulation, policy and business	How to capture benefits			
	Incentives and subsidies			
	How to pay for everything			
	Taxation			
	Aggregator business		Young/Existing	

note from the chairman

Timing is Never Right

"In good times we do not have the time and in bad times we do not have the money." This is a typical attitude in Industry when energy efficiency measures are discussed. And indeed, it is true. Energy efficiency measures seldom do come naturally and seldom are delivered over the counter. To add to this problem, there are several ways to save kilowatt hours and hence choices to be made. Energy efficiency therefore requires time to consider and to prepare for, which makes the decision process difficult and easily postponed for another day – when there is more time! This is why the large scale deployment of energy efficiency in the DSM-format is so important. The first steps are to facilitate the choices for the user/customer, to make the conditions (cost/benefit) transparent, and to make the timing to be NOW!

All of the IEA DSM Programme Tasks are designed to make energy efficiency a natural commodity. In particular, this is the case in our current work - *Task XVI, Competitive Energy Services; Task XIX, Micro Demand Response and Energy*

Saving; and Task XX, Branding of Energy Efficiency. For those interested in participating, we can inform you that the time to do so is also now as they are still in their start-up period.

In the larger perspective with the ongoing economic crisis, it would make a lot of sense to undertake more energy efficiency measures now, both to prepare industry to be in better shape for the future and to make use of the spare and therefore cheaper capacity in the efficiency business. It seems, however, as if quite a few are holding their breath as they wait for the outcome of the COP15 meeting in Copenhagen later this year. They should remember that the brain needs oxygen and it would be better to breathe the fresh air of energy efficiency when it is cheap.



Hans Nilsson
DSM Chairman

www.ieadsm.org

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

The screenshot shows the IEA DSM website homepage. At the top, there is a search bar and navigation links for 'Member Login' and 'New Visitor Registration'. Below this is a horizontal menu with 'Home', 'News', 'About Us', 'Participation', and 'Contact Us'. A secondary menu includes 'Tasks and Projects', 'Publications', 'Workshops', 'Links', and 'Awards'. The main content area features a 'Welcome' message, a 'Latest News' section with a 'New Task!' announcement, a 'Latest Report' section with a 'NEW REPORT!' announcement, and a 'Latest Newsletter' section with an 'Issue 31 - June 2008' announcement. The website design is clean and professional, with a blue and white color scheme.

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

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