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Using Demand-Side Management to Support Electricity Grids

DSM University/Leonardo Energy Webinar
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The Regulatory Assistance Project

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Rescheduled Webinar on Energy Efficiency Obligation Schemes

- Apologies that the webinar “Best Practices in Designing and Implementing Energy Efficiency Obligation Schemes” scheduled for 9 April 2014 had to be postponed because of illness
- That webinar has now been rescheduled to 25 June 2014 at 14:00 CET
- Please go to the Leonardo Energy website to register for the rescheduled webinar:

www.leonardo-energy.org/webinar/best-practices-designing-and-implementing-energy-efficiency-obligation-schemes

About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raonline.org

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IEA DSM Programme



- The International Energy Agency DSM Programme is an international collaboration of 14 countries plus several international organisations working together to develop and promote opportunities for demand-side management (DSM)
- DSM offers solutions to problems such as load management, energy efficiency, strategic conservation and related activities
- The work of the IEA DSM Programme is organized through a series of research projects (known as Tasks) and reported in a number of publications
- The DSM University, supported by Leonardo Energy, provides access in a structured way to the knowledge developed during 20 years of experience in the IEA DSM Programme

IEA DSM Project on Network-Driven DSM (1)

- From 2004 to 2008, the IEA DSM Programme carried out a research project on network-driven demand-side management
- Seven countries participated in the project: Australia, France, India, New Zealand, Spain, South Africa and the United States
- Network-driven DSM is concerned with reducing demand on electricity networks (grids) in specific ways which maintain system reliability in the immediate term and over the longer term defer the need for network augmentation
- This project was the first broad and systematic investigation of the potential for DSM to cost-effectively support electricity networks

IEA DSM Project on Network-Driven DSM (2)

- Network-driven DSM measures include:
 - direct load control;
 - distributed generation, including standby generation and cogeneration;
 - demand response;
 - energy efficiency;
 - fuel substitution;
 - interruptible loads;
 - integrated DSM projects;
 - load shifting;
 - smart metering;
 - power factor correction; and
 - pricing initiatives, including time of use and demand-based tariffs

IEA DSM Project on Network-Driven DSM (3)

- The network-driven DSM project identified and developed a wide range of DSM measures that can:
 - relieve constraints on electricity distribution and/or transmission networks at lower costs than building ‘poles and wires’ solutions; and
 - provide operational support services for electricity networks, achieving peak load reductions with various response times

IEA DSM Project on Network-Driven DSM (4)

- The project comprised five linked investigations:
 - Worldwide Survey of Network-Driven DSM Projects
 - Assessment and Development of Network-Driven DSM Measures
 - Incorporation of DSM Measures into Network Planning
 - Evaluation and Acquisition of Network-Driven DSM Resources
 - Role of Load Control and Smart Metering in Achieving Network-related Objectives

Worldwide Survey of DSM Projects (1)

- In this investigation, 64 detailed case studies of network-driven DSM projects from 13 different countries around the world were researched and developed
- The survey focused on projects carried out between the early 1990s and 2008 in the seven countries participating in the project, but also included projects from other countries
- Detailed case studies of the projects were prepared and included in an online database
- These case studies provide detailed information about ways in which DSM measures can be used to relieve electricity network constraints and/or to provide network operational support services

Worldwide Survey of DSM Projects (2)

- The survey showed that network-driven DSM options can effectively:
 - achieve load reductions on electricity networks that can be targeted to relieve specific network constraints; and
 - provide a range of network operational services, including: reactive supply and voltage control, regulation and frequency response, energy imbalances, spinning reserves, supplemental reserves, and generator imbalances

Worldwide Survey of DSM Projects (3)

- Another important finding from the survey was that all types of DSM measures can be used to relieve network constraints and/or provide network operational services
- Whether a particular DSM measure is appropriate or cost-effective depends on the specific nature of the network problem being addressed and the availability and relative costs of DSM resources in that situation

Assessment and Development of DSM Measures (1)

- In this investigation, the 64 case studies from the worldwide survey were analysed to identify the categories of DSM measures that can be used to achieve network-related objectives
- The value propositions for these DSM measures were identified, including the specific network problems which each measure can successfully address
- In addition, the factors which result in a network-driven DSM measure being successful in cost-effectively achieving network-related objectives were determined

Assessment and Development of DSM Measures (2)

- The investigation concluded that the value to stakeholders of a network-driven DSM project varies depending on the perspectives of the stakeholders involved
- The value can even vary among similar stakeholders (e.g., customers located in network-constrained areas versus customers located outside these areas)
- The distribution of the benefits from network-driven DSM projects among many different stakeholders means that the project promoter is unlikely to capture all the benefits
- Other parties who have not contributed to the cost of implementing the project may well receive some of the benefits
- To provide value to the project promoter, the total benefits from a network-driven DSM project must be quite large and the promoter must capture a significant proportion of these benefits

Assessment and Development of DSM Measures (3)

- This investigation also identified a number of external and internal factors that may contribute to the success of network-driven DSM projects
- **External success factors** include: government policies, regulatory regime, market structure, commitment by project proponent, technology availability, commercial considerations, and public relations benefits
- **Internal success factors** include: project objectives, target market, DSM measures used, market barriers addressed, outreach and marketing, participation process, and customer service and delivery mechanisms

Assessment and Development of DSM Measures (4)

- Different network-driven DSM projects containing the same DSM measures (such as energy efficiency or load shifting or direct load control or pricing initiatives) tend to have a common set of factors that contribute to the projects' success
- The challenge in designing a successful network-driven DSM project is to clearly identify the success factors for each of the DSM measures included in the project and then concentrate on optimizing each of these factors

Incorporation of DSM into Network Planning (1)

- In this investigation, analyses were carried out of the interaction between network-driven DSM measures and the electricity market structures and regulatory regimes in each of the seven participating countries
- The network planning processes implemented in each participating country were also identified and characterised
- Options were then developed for modifying network planning processes to incorporate DSM measures as alternatives to network augmentation

Incorporation of DSM into Network Planning (2)

- Among the seven participating countries, planning processes for electricity transmission and distribution systems vary significantly
- Variation occurs particularly in relation to:
 - the types and functions of the various organisations involved
 - the detailed planning processes and methodologies used
 - the policy and regulatory regimes within which electricity network businesses operate
- However, there is sufficient commonality to identify key areas where changes could be made to enable increased use of DSM resources as alternatives to network augmentation and to support electricity networks

Incorporation of DSM into Network Planning (3)

- Three key areas were identified where changes could be made
- **Forecasting future electricity demand**
 - Forecasting methodologies frequently reduce global load forecasts by an assumed (usually small) amount to take account of the potential contribution by DSM towards supporting electricity networks
 - Forecasting methodologies for network planning should be modified to more accurately account for the potential contribution of DSM

Incorporation of DSM into Network Planning (4)

- **Developing options for relieving network constraints**
 - Network businesses should provide information and formal opportunities for third parties with expertise in DSM to participate in the development of options that use DSM resources to relieve network constraints
- **Establishing policy and regulatory regimes for network planning**
 - Governments and regulators should change policy and regulatory regimes to reduce the disincentives faced by network businesses that use DSM resources to support electricity networks
 - This could be done: 1) by providing policy and regulatory incentives to network businesses and 2) by imposing policy and regulatory obligations on network businesses

Evaluation and Acquisition of DSM Resources

- In this investigation, a survey of practices in the seven participating countries identified a range of processes for evaluating, acquiring and implementing DSM resources to provide support for electricity networks
- DSM resource acquisition processes typically include the following stages:
 - assess the need for DSM resources
 - identify and evaluate available DSM resources
 - contact potential providers of DSM resources
 - negotiate the provision of DSM resources
 - acquire and implement the DSM resources
- Best practices within each of these stages are tailored to the nature of each DSM resource and to the specific purpose for which the resource is required

Role of Load Control and Smart Metering (1)

- This investigation looked at the role of load control and smart metering in achieving network-related objectives
- A survey of load control and smart metering technologies was carried out, focussing on the functionalities and capabilities of load control and smart metering devices that can be used to achieve network-related objectives
- A database was established containing descriptions of 17 then available load control and smart metering technology products
- The load control and smart metering projects included in the case studies database were reviewed and new case studies carried out to identify the factors that contribute to making such projects effective
- Best practices in the use of load control and smart metering to achieve network-related objectives were identified

Role of Load Control and Smart Metering (2)

- Three ways were identified in which advanced metering and load control technology can be used to support electricity networks
- **First**, advanced meters enable the implementation of time-varying pricing which sends price signals to customers that reflect the underlying costs of generating, transporting and supplying electricity
- Price-based demand response programs can reduce or shape customer demand and particularly can reduce peak loads on the electricity network and therefore reduce the amount of investment required in network infrastructure

Role of Load Control and Smart Metering (3)

- **Second**, analysing data from advanced meters provides end-users with detailed information about the ways in which they use electricity and can enable businesses to identify and implement energy, cost and carbon savings
- Energy savings reduce the overall load on the electricity network, therefore contributing to supporting the network
- **Third**, load control technologies can be used to directly reduce peak loads on the electricity network by remotely switching appliances and equipment at customers' premises
- This is arguably the most effective mechanism for reducing peak loads since remote switching requires only one “set and forget” decision by end-use customers

Role of Load Control and Smart Metering (4)

Major Conclusions

- **Interval metering** is necessary to implement time-varying pricing
- **Interval metering** is *not* necessary to carry out load control functions – available technology can remotely switch loads without requiring connection to a meter
- **One-way communication** (not necessarily through a meter) is essential to carry out remote switching of loads
- **Two-way communication** is not essential to carry out remote switching of loads but it can provide valuable information to the program operator about the results of the switching
- **Metering** in some form is required for settlement of the financial transactions associated with load control programs

Conclusion

- The IEA DSM Programme project on network-driven DSM was the first broad and systematic investigation of the potential for DSM to cost-effectively support electricity networks
- There have been significant advances since 2008 in the use of DSM to support electricity networks, particularly in the technology that is now available
- However, the main findings and conclusions from the network-driven DSM project are still valid and the project reports and case studies of network-driven DSM projects continue to be sources of useful knowledge

Resources

- David Crossley email: dcrossley@raponline.org
- RAP website: www.raponline.org
- IEA DSM Programme website: www.ieadsm.org/
- Network-driven DSM project website :
www.ieadsm.org/ViewTask.aspx?ID=16&Task=15&Sort=0
- Publications from the network-driven DSM project:
www.ieadsm.org/ViewTask.aspx?ID=16&Task=15&Sort=0#ancPublications3
- Database of case studies of network-driven DSM projects:
www.ieadsm.org/TaskXVNetworkDrivenDSMCaseStudiesDatabase.aspx
- Database of load control and smart metering technology products:
www.ieadsm.org/TaskXVNetworkDrivenDSMLoadManagementDatabase.aspx