INTERNATIONAL ENERGY AGENCY

IMPLEMENTING AGREEMENT ON TECHNOLOGIES AND PROGRAMMES FOR DEMAND SIDE MANAGEMENT

Task XV: Network-Driven DSM

Final Task Management Report – Original Work Plan

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Prepared for
IEA DSM PROGRAMME

11 June 2007

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EXECUTIVE SUMMARY

Network-driven DSM comprises demand-side measures used to relieve network constraints and/or to provide services for electricity network system operators. In Task XV, network-driven DSM was defined as follows:

> *Network-driven demand-side management is concerned with reducing demand on the electricity network in specific ways which maintain system reliability in the immediate term and over the longer term defer the need for network augmentation.*

Task XV identified the following two prime objectives for network-driven DSM:

- to relieve constraints on distribution and/or transmission networks at lower costs than building 'poles and wires' solutions; and/or
- to provide services for electricity network system operators, achieving peak load reductions with various response times for network operational support.

The following network-driven DSM measures were considered in Task XV:

- distributed generation, including standby generation and cogeneration;
- energy efficiency;
- fuel substitution;
- load management, including interruptible loads, direct load control, and demand response;
- power factor correction;
- pricing initiatives, including time of use and demand-based tariffs.

Task XV comprised five subtasks:

- Subtask 1: Worldwide Survey of Network-Driven DSM Projects;
- Subtask 2: Assessment and Development of Network-Driven DSM Measures;
- Subtask 3: Incorporation of DSM measures into network planning;
- Subtask 4: Evaluation and Acquisition of Network-Driven DSM Resources; and
- Subtask 5: Communication of Information about Network-Driven DSM.

In Subtask 1, the worldwide survey identified 45 network-driven DSM projects undertaken over about the last 10 years. Detailed case studies of the projects were prepared and included in an on-line case study database. The survey showed that all types of demand DSM measures can be used to relieve network constraints and/or provide network operational services. However, whether a particular DSM measures is appropriate and/or cost effective in a particular situation will depend on the specific nature of the network problem being addressed and the availability and relative costs of demand-side resources in that situation.

Subtask 2 concluded that the value of a network-driven DSM project varies among categories of stakeholders and may even vary among individual stakeholders (eg customers located in network-constrained areas vs customers located outside these areas). The distribution of the benefits from network-driven DSM projects among many different stakeholders means that the project proponent is unlikely to capture all the benefits from such a project; other parties who have not contributed to the cost of implementing the project may well receive some of the benefits. To provide significant value to the project proponent, the total benefits from a network-driven DSM project must be quite large and the proponent must be able capture a significant proportion of these benefits.

Subtask 3 identified four key areas in which changes could be made to enable increased use of demand-side resources as alternatives to network augmentation and to support electricity networks:

- forecasting future electricity demand;
- communicating information about network constraints;
- developing options for relieving network constraints; and
- establishing policy and regulatory regimes for network planning.

Subtask 4 identified a range of processes for evaluating, acquiring and implementing DSM resources to provide support for electricity networks. Good DSM resource acquisition processes include the following stages:

- assessing the need for DSM resources;
- identifying and evaluating available DSM resources;
- contacting potential providers of DSM resources;
- negotiating the provision of DSM resources; and
- acquiring and implementing the DSM resources.

Through participating in Task XV, country Experts and representatives were able to:

- understand the advantages and disadvantages of network-driven DSM measures as alternatives to network augmentation;
- gain information about network-driven DSM measures currently in use in other countries and about the relative effectiveness of these measures;
- understand the factors which lead to a network-driven DSM measure being effective;
- participate in further developing network-driven DSM measures so that they will be successful in cost-effectively relieving network constraints;
- identify modifications which can be made to existing network planning processes to incorporate network-driven DSM measures as alternatives to network augmentation;
- understand the interaction between network-driven DSM and the operation of competitive electricity markets;
- participate in developing business models, rules and procedures to achieve the successful implementation of network-DSM measures under different electricity market structures and regulatory regimes.

1. INTRODUCTION

This is the final report to the Executive Committee of the IEA DSM Programme under the original Work Plan for Task XV: "Network-Driven DSM". At the time of writing, a proposal for the extension of the Task is being submitted for consideration by the Executive Committee. This report does not cover the scope of work proposed under the extension.

At its meeting in April 2004, the Executive Committee approved the initiation of Task XV and nominated Dr David Crossley as the Operating Agent. At its meeting in October 2004, the Executive Committee declared Task XV to be 'in force' from 18 October 2004 and to be completed by 30 April 2006. At this meeting, the Executive Committee also approved a modification of the Objectives and Work Plan for Task XV to include the use of DSM measures to provide both relief of electricity network constraints and network operational services. At its meeting in October 2005, the Executive Committee approved a six month no-cost extension of Task XV to 30 September 2006. At its meeting in April 2006, the Executive Committee approved a further no-cost extension to no later than 30 March 2007.

2. MOTIVATION FOR TASK XV

In the electricity industry, the term 'demand-side management' (DSM) is used to refer to actions which change the electrical demand on the system. Task XV was concerned with a particular type of DSM – "network-driven DSM".

Prior to initiating Task XV, the IEA DSM Programme had not undertaken any work on the potential for DSM to cost-effectively relieve electricity network constraints. However, such constraints are becoming a significant problem in countries where electricity demand is increasing and network infrastructure ('poles and wires') is ageing.

As loads grow and infrastructure reaches the end of its economic life, the potential cost of augmenting networks is increasing exponentially. In many situations, network-driven DSM can delay the need for network augmentation. In certain limited situations, network-driven DSM may be able to cost-effectively defer or even eliminate the requirement to build a 'poles and wires' solution

In addition to relieving network constraints, DSM measures can also provide operational support services for electricity networks, including: reactive supply and voltage control, regulation and frequency response, energy imbalances, spinning reserves, supplemental reserves, and generator imbalances. Task XV also covered the use of DSM measures to provide network support services.

3. WHAT IS NETWORK-DRIVEN DSM?

Network-driven DSM comprises demand-side measures used to relieve network constraints and/or to provide services for electricity network system operators. In Task XV, network-driven DSM was defined as follows:

> *Network-driven demand-side management is concerned with reducing demand on the electricity network in specific ways which maintain system reliability in the immediate term and over the longer term defer the need for network augmentation.*

Task XV identified the following two prime objectives for network-driven DSM:

- to relieve constraints on distribution and/or transmission networks at lower costs than building 'poles and wires' solutions; and/or
- to provide services for electricity network system operators, achieving peak load reductions with various response times for network operational support.

In Task XV, the following network-driven DSM measures were considered:

- distributed generation, including standby generation and cogeneration;
- energy efficiency;
- fuel substitution;
- load management, including interruptible loads, direct load control, and demand response;
- power factor correction;
- pricing initiatives, including time of use and demand-based tariffs.

4. TASK XV OBJECTIVES AND SUBTASKS

4.1 Objectives

The objectives of Task XV, as approved at the October 2004 Executive Committee meeting, were as follows:

- to identify a wide range of DSM measures which can be used to relieve electricity network constraints and/or provide network operational services;
- to further develop the identified network-driven DSM measures so that they will be successful in cost-effectively achieving network-related objectives;
- to investigate how existing network planning processes can be modified to incorporate the development and operation of DSM measures over the medium and long term;
- to develop 'best practice' principles, procedures and methodologies for the evaluation and acquisition of network-driven DSM resources;
- to communicate and disseminate information about network-driven DSM to relevant audiences.

4.2 Subtasks

The Work Plan for the Network-Driven DSM Task comprised five Subtasks.

Subtask 1: Worldwide Survey of Network-Driven DSM Projects

Subtask Objective

To identify a wide range of DSM measures which can be used to relieve electricity network constraints and/or provide network operational services.

Subtask Deliverable

A report listing and summarising network-driven DSM projects implemented around the world.

Subtask 2: Assessment and Development of Network-Driven DSM Measures

Subtask Objective

To further develop the identified network-driven DSM measures so that they will be successful in cost effectively achieving network-related objectives.

Subtask Deliverable

A report listing and summarising successful network-driven DSM measures and the specific network problems they address.

Subtask 3: Incorporation of DSM Measures into Network Planning

Subtask Objective

To investigate how existing network planning processes can be modified to incorporate the development and operation of DSM measures over the medium and long term.

Subtask Deliverable

A report on ways in which network planning processes can be modified to incorporate DSM measures as alternatives to network augmentation.

Subtask 4: Evaluation and Acquisition of Network-Driven DSM Resources

Subtask Objective

To develop 'best practice' principles, procedures and methodologies for the evaluation and acquisition of network-driven DSM resources.

Subtask Deliverable

A report on 'best practice' principles, procedures and methodologies for the evaluation and acquisition of network-driven DSM resources.

Subtask 5: Communication of Information About Network-Driven DSM

Subtask Objective

To communicate and disseminate information about network-driven DSM to relevant audiences, including representatives of electricity network businesses, government agencies and electricity end-users.

Subtask Deliverables

- An internal Task Newsletter.
- An on-line database about network-driven DSM projects and measures.

5. WORLDWIDE SURVEY OF NETWORK-DRIVEN DSM PROJECTS

The worldwide survey identified 45 network-driven DSM projects undertaken over about the last 10 years. The survey focused on projects carried out in the four countries participating in Task XV, but it also includes some projects from other countries. Detailed case studies of the projects were prepared and included in an on-line case study database. Appendix A (page 9) lists the projects included in the database.

The network-driven DSM projects included in the survey were classified by the major DSM measure implemented, as follows:

- distributed generation, including standby generation and cogeneration;
- energy efficiency;
- fuel substitution;
- integrated DSM projects;
- load management, including interruptible loads, direct load control and demand response;
- power factor correction;
- pricing initiatives, including time of use and demand-based tariffs.

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.

The survey also showed that all types of demand DSM measures can be used to relieve network constraints and/or provide network operational services. However, whether a particular DSM measures is appropriate and/or cost effective in a particular situation will depend on the specific nature of the network problem being addressed and the availability and relative costs of demand-side resources in that situation.

6. ASSESSMENT AND DEVELOPMENT OF NETWORK-DRIVEN DSM MEASURES

Task XV concluded that the value of a network-driven DSM project varies among categories of stakeholders and may even vary among individual stakeholders (eg customers located in network-constrained areas vs customers located outside these areas). The distribution of the benefits from network-driven DSM projects among many different stakeholders means that the project proponent is unlikely to capture all the benefits from such a project; other parties who have not contributed to the cost of implementing the project may well receive some of the benefits. To provide significant value to the project proponent, the total benefits from a network-driven DSM project must be quite large and the proponent must be able capture a significant proportion of these benefits.

The Task identified a number of external and internal factors that may contribute to the success of network-driven DSM projects. Network-driven DSM projects containing the same DSM measures (such as energy efficiency, load shifting, direct load control or pricing initiatives) tend to have a common set of factors which contribute to their success and to this extent it is possible to identify sets of success factors that apply to each category of DSM measure. The challenge in designing a network-driven DSM project that will ultimately be successful in achieving its objectives is to clearly identify the success factors for each of the DSM measures included in the project and then concentrate on optimising each of these factors.

Task XV also identified the network problems that each category of network DSM measures can address; characterised the success factors which apply to each category; and examined how the DSM measures in each category should be implemented for them to be most effective in achieving network-related objectives.

7. INCORPORATION OF DSM MEASURES INTO NETWORK PLANNING

Among the four countries studied in Task XV, planning processes for electricity transmission and distribution systems vary significantly, particularly in relation to the types and functions of the various organisations involved, the detailed planning processes and methodologies used, and the policy and regulatory regimes within which electricity network businesses operate. However, there is sufficient commonality to identify a number of key areas in which changes could be made to enable increased use of demand-side resources as alternatives to network augmentation and to support electricity networks.

There are four key areas in which such changes can and should be made.

Forecasting future electricity demand. Forecasting methodologies frequently reduce global load forecasts by an assumed (usually small) amount to take account of DSM activity. Such methodologies discount the potential contribution by DSM towards supporting electricity networks. Forecasting methodologies for network planning should be modified to recognise more accurately the potential contribution of DSM.

Communicating information about network constraints. Information about future network constraints is often retained inside network businesses. It is then very difficult for anyone else to propose options for relieving network constraints. Network businesses should make this information publicly available so that other organisations with the required expertise can develop DSM options to relieve the constraints.

Developing options for relieving network constraints. Network businesses should provide formal opportunities for third parties with expertise in DSM to participate in the development of options that use demand-side 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 demand-side resources to support electricity networks. There are two ways in which this can be achieved: by providing policy and regulatory incentives to network businesses; and/or by imposing policy and regulatory obligations on network businesses.

8. EVALUATION AND ACQUISITION OF NETWORK-DRIVEN DSM RESOURCES

A survey of practices in Australia, France, Spain and the United States identified a range of processes for evaluating, acquiring and implementing DSM resources to provide support for electricity networks.

Good DSM resource acquisition processes include the following stages:

- assessing the need for DSM resources;
- identifying and evaluating available DSM resources;
- contacting potential providers of DSM resources;
- negotiating the provision of DSM resources; and
- acquiring and implementing 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.

9. CONCLUSION

While there is increasing use of DSM measures to support electricity networks, Task XV was the first broad and systematic investigation of this particular application of DSM.

Task XV concluded that DSM can be successfully used to support electricity networks in two main ways:

- by relieving constraints on distribution and/or transmission networks at lower costs than building 'poles and wires' solutions; and/or
- by providing services for electricity network system operators, achieving peak load reductions with various response times for network operational support.

Through participating in Task XV, country Experts and representatives were able to:

- understand the advantages and disadvantages of network-driven DSM measures as alternatives to network augmentation;
- gain information about network-driven DSM measures currently in use in other countries and about the relative effectiveness of these measures;
- understand the factors which lead to a network-driven DSM measure being effective;
- participate in further developing network-driven DSM measures so that they will be successful in cost-effectively relieving network constraints;
- identify modifications which can be made to existing network planning processes to incorporate network-driven DSM measures as alternatives to network augmentation;
- understand the interaction between network-driven DSM and the operation of competitive electricity markets;
- participate in developing business models, rules and procedures to achieve the successful implementation of network-DSM measures under different electricity market structures and regulatory regimes.

APPENDIX A: NETWORK-DRIVEN DSM PROJECTS INCLUDED IN THE TASK XV WORLDWIDE SURVEY

Distributed Generation	
DG01	Nelson Bay Embedded Generation - Australia
DG02	Bromelton Embedded Generation - Australia
DG03	Kerman Photovoltaic Grid-Support Project - USA
DG04	Chicago Energy Reliability and Capacity Account - USA
Energy Efficiency	
EE01	Efficient Lighting Project DSM Pilot - Poland
EE02	Oncor Standard Offer Program for Residential and Commercial Energy Efficiency - USA
EE03	Oncor Air Conditioning Distributor Market Transformation Program - USA
EE04	Espanola Power Savers Project - Canada
EE05	Katoomba DSM Program - Australia
Fuel Substitution	
FS01	Tahmoor Fuel Substitution Project - Australia
FS02	Binda-Bigga Demand Management Project - Australia
Integrated DSM Projects	
IP01	Blacktown DSM Program - Australia
IP02	Castle Hill Demand Management Project - Australia
IP03	Parramatta DSM Program - Australia
IP04	Olympic Peninsula Non-wires Solutions Pilot Projects and GridWise Demonstration - USA
IP05	Brookvale / DeeWhy DSM Program - Australia
IP06	Maine-et-Loire DSM Project - France
IP07	Deferring Network Investment - Finland
IP08	French Riviera DSM Program - France

Load Management	
LM01	Ethos Project Trial of Multimedia Energy Management Systems - Wales, UK
LM02	Winter Peak Demand Reduction Scheme - Ireland
LM03	ISO New England Demand Response Programs - USA
LM04	New York ISO Demand Response Programs - USA
LM05	Sydney CBD Demand Curtailment Project - Australia
LM06	LIPAedge Direct Load Control Program - USA
LM07	PJM Load Response Programs - USA
LM08	Sacramento Peak Corps - USA
LM09	PEF Direct Load Control and Standby Generator Programs - USA
LM10	Eskom DSM Profitable Partnership Programme - South Africa
LM11	Load Interruption Contract - Spain
LM12	Flexible Load Interruption Contract - Spain
LM13	Interruptibility Contract for Cogenerators - Spain
LM14	Active / Reactive Power Exchange - Spain
LM15	TU Electric Thermal Cool Storage Program - USA
LM16	Mad River Valley Project - USA
LM17	California Energy Cooperatives - USA
LM18	Baulkham Hills Substation Deferral Project - Australia
Power Factor Correction	
PC01	Marayong Power Factor Correction Program - Australia
Pricing Initiatives	
PI01	California Critical Peak Pricing Tariff for Large Customers - USA
PI02	Loire Time of Use Tariff Program - France
PI03	Queanbeyan Critical Peak Pricing Trial - Australia
PI04	Hourly Demand Tariff - Spain
PI05	End User Flexibility by Efficient Use of Information and Communication Technologies - Norway
PI06	Tempo Electricity Tariff - France
PI07	Reduced Access to Network Tariff - Spain

APPENDIX B: COUNTRY EXPERTS AND REPRESENTATIVES PARTICIPATING IN TASK XV

Name	Organisation	Country
Gabriel Wan	Alinta	Australia
Ed Pegiel	Alinta	Australia
John Dyer	Alinta	Australia
Leith Elder	Country Energy	Australia
Ian Thompson	Country Energy	Australia
Bevan Holcombe	Energex	Australia
Martin Hoelscher	Energex	Australia
Neil Higgins	Energex	Australia
Mark Lendich	Energex	Australia
*Neil Gordon	EnergyAustralia	Australia
Neil Lowry	Ergon Energy	Australia
Adam Leslie	Powerlink Queensland	Australia
Michael Pelevin	Powerlink Queensland	Australia
Stephen Martin	Powerlink Queensland	Australia
Bruce Bennett	SP AusNet	Australia
Max Rankin	SP AusNet	Australia
Ashok Manglick	TransGrid	Australia
*Harry Schnapp	TransGrid	Australia
*Frédéric Rosenstein	Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME)	France
Thérèse Kreitz	Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME)	France
Alain Valsemey	Réseau de Transport d'Electricité (RTE)	France
*Christian Poumarede	Réseau de Transport d'Electricité (RTE)	France
*Frédéric Trogneux	Réseau de Transport d'Electricité (RTE)	France
*Beatriz Gómez Elvira	Red Eléctrica de España	Spain
Carmen Rodríguez Villagarcía	Red Eléctrica de España	Spain
*Brendan Kirby	Oak Ridge National Laboratory	USA
*John Kueck	Oak Ridge National Laboratory	USA

* Country Expert

APPENDIX C: TASK XV PRODUCTS

Research Reports

The following four reports were produced by Task XV:

International Energy Agency Demand Side Management Programme (2006). *Worldwide Survey of Network-driven Demand-side Management Projects*. Task XV Research Report No 1. Hornsby Heights, NSW, Australia, Energy Futures Australia Pty Ltd. 278 pp.

International Energy Agency Demand Side Management Programme (2006). *Assessment and Development of Network-driven Demand-side Management Measures*. Task XV Research Report No 2. Hornsby Heights, NSW, Australia, Energy Futures Australia Pty Ltd. 57 pp.

International Energy Agency Demand Side Management Programme (2007). *Incorporation of DSM Measures into Network Planning*. Task XV Research Report No 3. Hornsby Heights, NSW, Australia, Energy Futures Australia Pty Ltd. 69 pp.

International Energy Agency Demand Side Management Programme (2007). *Evaluation and Acquisition of Network-driven DSM Resources*. Task XV Research Report No 4. Hornsby Heights, NSW, Australia, Energy Futures Australia Pty Ltd. 30 pp.

Database

The following on-line database was produced by Task XV:

Case Studies of Network-Driven Demand Side Management Projects (contains 45 detailed case studies)