

Evaluation and Acquisition of Network-driven DSM Resources

**Research Report No 4
Task XV of the International Energy Agency
Demand Side Management Programme**

**Second Edition
14 October 2008**



OPERATING AGENT:

DR DAVID CROSSLEY, ENERGY FUTURES AUSTRALIA PTY LTD, AUSTRALIA

UNDERTAKEN WITH PARTICIPATION AND SUPPORT FROM:

AUSTRALIA (EIGHT ELECTRICITY TRANSMISSION AND DISTRIBUTION BUSINESSES)

*FRANCE (AGENCE DE L'ENVIRONNEMENT ET DE LA MAITRISE DE L'ÉNERGIE AND
RESEAU DE TRANSPORT D'ELECTRICITE)*

INDIA (BUREAU OF ENERGY EFFICIENCY, MINISTRY OF POWER)

*NEW ZEALAND (ENERGY EFFICIENCY AND CONSERVATION AUTHORITY, ELECTRICITY
NETWORKS ASSOCIATION, ELECTRICITY COMMISSION AND TRANSPOWER)*

SOUTH AFRICA (ESKOM)

SPAIN (RED ELECTRICA DE ESPAÑA)

UNITED STATES (OAK RIDGE NATIONAL LABORATORY)

Disclaimer

While this document has been prepared to the best of the author's knowledge and understanding and with the intention that it may be relied on by the clients, Energy Futures Australia Pty Ltd and the individual author of the document make no representation or warranty as to the accuracy or completeness of the material contained in this document and shall not have, and will not accept, any liability for any statements, opinions, information or matters (expressed or implied) arising out of, contained in or derived from this document or any omissions from this document, or any other written or oral communication transmitted or made available to any other party in relation to the subject matter of this document.

Second Edition
14 October 2008

Publisher: Energy Futures Australia Pty Ltd
11 Binya Close
Hornsby Heights NSW 2077
Australia
Telephone: + 61 2 9477 7885
Facsimile: + 61 2 9477 7503
Email: efa@efa.com.au
Website: <http://www.efa.com.au>

Principal Investigator: Dr David Crossley
Energy Futures Australia Pty Ltd

IEA DSM Secretariat: Anne Bengtson
IEA DSM Executive Secretary
PO Box 47096
S-100 74 Stockholm
Sweden
Telephone: + 46 8 5105 0830
Facsimile: + 46 8 5105 0830
Email: anne.bengtson@telia.com
Website: <http://dsm.iea.org/>

CONTENTS

THE IEA DEMAND SIDE MANAGEMENT PROGRAMME.....	iii
FOREWORD.....	v
EXECUTIVE SUMMARY	vii
1. INTRODUCTION.....	1
1.1 Types of DSM.....	1
1.2 Focus of this Report.....	2
2. PROCESSES FOR EVALUATING, ACQUIRING AND IMPLEMENTING.....	2
DSM RESOURCES	
2.1 Australia.....	3
2.1.1 DSM in Australia	3
2.1.2 Processes for Acquiring DSM Resources	4
2.1.3 National Regulatory Framework for Acquiring DSM Resources.....	5
2.1.4 NSW Demand Management Code of Practice.....	6
2.1.5 Case Study: TransGrid Major Network Augmentation	9
2.2 France.....	13
2.2.1 DSM in France	13
2.2.2 Processes for Acquiring DSM Resources	13
2.2.3 Case Study: The French Riviera DSM Program	14
2.2.4 Case Study: The Tempo Tariff.....	19
2.3 India	19
2.3.1 DSM in India.....	19
2.3.2 Processes for Acquiring DSM Resources	20
2.3.3 Case Study: Maharashtra Electricity Regulatory Commission.....	21
DSM Resource Acquisition Process	
2.4 New Zealand	23
2.4.1 DSM in New Zealand.....	23
2.4.2 Processes for Acquiring DSM Resources	24
2.4.3 Case Study: Transpower Grid Support Contract.....	25
2.5 South Africa	27
2.5.1 DSM in South Africa	27
2.5.2 Processes for Acquiring DSM Resources	27
2.6 Spain	28
2.6.1 DSM in Spain.....	28
2.6.2 Processes for Acquiring DSM Resources	28
2.6.3 Case Study: Red Eléctrica de España Interruptibility Program	28

2.7	United States	30
2.7.1	DSM in the United States.....	30
2.7.2	Processes for Acquiring DSM Resources	31
2.7.3	Relieving Local Constraints.....	32
2.7.4	Reducing Peak Loads Across a Service Territory	32
2.7.5	Maintaining and Improving Overall System Reliability.....	33
2.7.6	Providing Ancillary Services	34
3.	BEST PRACTICES IN EVALUATING AND ACQUIRING.....	36
	NETWORK-DRIVEN DSM RESOURCES	
3.1	Stages in Acquiring DSM Resources.....	36
3.2	Assessing the Need for DSM Resources	36
3.3	Identifying and Evaluating Available DSM Resources	37
3.4	Contacting Potential Providers of DSM Resources	38
3.5	Negotiating the Provision of DSM Resources	38
3.6	Acquiring and Implementing DSM Resources	39
4.	CONCLUSION	40

LIST OF FIGURES

Figure 2.1	Electricity System Development Procedure for Distribution Network.....	7
	Operators in New South Wales, Australia	
Figure 2.2	Winter Peak Demand by End-use in the Eastern Part of the	15
	Provence-Alpes-Côte d'Azur Region	
Figure 2.3	Summer Peak Demand by End-use in the Eastern Part of the.....	15
	Provence-Alpes-Côte d'Azur Region	
Figure 2.4	Forecasts of Potential Load Reductions Achievable through the.....	16
	French Riviera DSM Program 2005 to 2020	
Figure 2.5	Forecasts of Potential Load Reductions Achievable through the.....	16
	French Riviera DSM Program in Winter 2006	
Figure 2.6	Forecast Impacts and Costs of Identified DSM Measures in the	18
	French Riviera DSM Program	
Figure 2.7	Demand Supply Scenario in Maharashtra, 2001/02 to 2007/08.....	21

LIST OF TABLES

Table 2.1	Options in the Red Eléctrica de España Interruptibility Program	29
Table 2.2	ERCOT Load Acting as a Resource (LAAR) Program.....	35

THE IEA DEMAND SIDE MANAGEMENT PROGRAMME

The International Energy Agency (IEA) was established in 1974 as an autonomous agency within the framework of the Economic Cooperation and Development (OECD) to carry out a comprehensive program of energy cooperation among its 25 Member countries and the Commission of the European Communities.

An important part of the Agency's program involves collaboration in the research, development and demonstration of new energy technologies to reduce excessive reliance on imported oil, increase long-term energy security and reduce greenhouse gas emissions. The IEA's R&D activities are headed by the Committee on Energy Research and Technology (CERT) and supported by a small Secretariat staff, headquartered in Paris. In addition, three Working Parties are charged with monitoring the various collaborative energy agreements, identifying new areas for cooperation and advising the CERT on policy matters.

Collaborative programs in the various energy technology areas are conducted under Implementing Agreements, which are signed by contracting parties (government agencies or entities designated by them). There are currently over 40 Implementing Agreements, including the IEA Demand-Side Management. Since 1993, the following 20 member countries and the European Commission have been working to clarify and promote opportunities for DSM.

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

A total of 20 Tasks (multi-national collaborative research projects) have been initiated by the IEA DSM Programme, 13 of which have been completed. Each Task is managed by an Operating Agent (Project Director) from one of the participating countries. The Operating Agent is responsible for overall project management including project deliverables, milestones, schedule, budget and communications. Overall control of the program rests with an Executive Committee comprised of one representative from each contracting party to the Implementing Agreement. In addition, a number of special ad hoc activities—conferences and workshops—have been organized.

The actual research work for a Task is carried out by a combination of the Operating Agent and a group of Country Experts, depending on the nature of the work to be carried out. Each country which is participating in a Task nominates one or more persons as its Country Expert. Each Expert is responsible for carrying out any research work within his/her country which is required for the Task. All the Experts meet regularly to review and assess the progress of the work completed by the Operating Agent and by the group of Experts. Experts meetings are usually held between two and four times a year.

Evaluation and Acquisition of Network-driven DSM Resources

The IEA DSM Programme has undertaken the following Tasks to date:

- Task I International Database on Demand-Side Management
- Task II* Communications Technologies for Demand-Side Management
- Task III* Cooperative Procurement of Innovative Technologies for Demand-Side Management
- Task IV* Development of Improved Methods for Integrating Demand-Side Management
- Task V* Investigation of Techniques for Implementation of Demand-Side Management Technology in the Marketplace
- Task VI* Mechanisms for Promoting DSM and Energy Efficiency in Changing Electricity Businesses
- Task VII* International Collaboration on Market Transformation
- Task VIII* Demand Side Bidding in a Competitive Electricity Market
- Task IX* The Role of Municipalities in a Liberalized System
- Task X* Performance Contracting
- Task XI* Time of Use Pricing and Energy Use for Demand Management Delivery
- Task XII Cooperation on Energy Standards (not proceeded with)
- Task XIII* Demand Response Resources
- Task XIV* Market Mechanisms for White Certificates Trading
- Task XV Network-Driven Demand Side Management
- Task XVI Competitive Energy Services
- Task XVII Integration of Demand Side Management, Energy Efficiency, Distributed Generation and Renewable Energy Sources
- Task XVIII Demand Side Management and Climate Change
- Task XIX Micro Demand Response and Energy Saving
- Task XX Branding of Energy Efficiency

* Completed Task

For additional information contact:

Anne Bengtson
IEA DSM Executive Secretary
PO Box 47096
S-100 74 Stockholm
Sweden
Telephone: + 46 8 5105 0830
Facsimile: + 46 8 5105 0830
Email: anne.bengtson@telia.com

Also, visit our web site at: <http://dsm.iea.org>.



FOREWORD

This report is a result of work which was completed within Task XV of the International Energy Agency Demand-Side Management Programme. The title of Task XV is “Network-Driven Demand Side Management.” Task XV is a multinational collaborative research project which is investigating demand-side management (DSM) measures which may provide viable alternatives to augmentation of electricity networks and also provide network operational services.

Task XV is organised into five subtasks as follows:

- **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.
- **Subtask 5:** Communication of Information About Network-Driven DSM.

This report summarises the results from Subtask 4.

The Operating Agent (Project Director) for Task XV is Energy Futures Australia Pty Ltd, based in Sydney, Australia.

The work of Task XV is supported (through cost and task sharing) by the seven participating countries: Australia, France, India, New Zealand, South Africa, Spain and the United States. Participants provided one or more Country Experts who were responsible for contributing to the work of the Task and for reviewing work as it was completed. Some countries also nominated representatives who also contributed to the work of Task XV.

Information for this report was collected, and the document was reviewed by, Country Experts and representatives from the organisations listed in the Table on page vi.

The Principal Investigator for, and main author of, this report is Dr David Crossley of Energy Futures Australia Pty Ltd. Any errors and omissions are the sole responsibility of the Principal Investigator.

Country Experts and Representatives Participating in Task XV		
Name	Organisation	Country
Leith Elder	Country Energy	Australia
Ian Thompson	Country Energy	Australia
Bevan Holcombe	Energex	Australia
Mark Lendich	Energex	Australia
*Neil Gordon	EnergyAustralia	Australia
Neil Lowry	Ergon Energy	Australia
Gabriel Wan	Jemena	Australia
John Dyer	Jemena	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
*Frédéric Trogneux	Réseau de Transport d'Electricité (RTE)	France
*Balawant Joshi	ABPS Infrastructure Pvt Ltd	India
Ron Beatty	Electricity Commission	New Zealand
Alan Jenkins	Electricity Networks Association	New Zealand
Steve Torrens	Energy Efficiency and Conservation Authority	New Zealand
*Magnus Hindsberger	Transpower	New Zealand
*Duncan Ramsbottom	ESKOM	South Africa
*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		

EXECUTIVE SUMMARY

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 of the IEA DSM Programme, and consequently this report, are concerned with a particular type of DSM – “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.

This report has two objectives:

- to summarise and review how DSM resources are evaluated, acquired and implemented in participating countries; and
- to develop ‘best practice’ principles, procedures and methodologies for the evaluation and acquisition of network-driven DSM resources.

The survey of practices in the seven participating countries, Australia, France, India, New Zealand, South Africa, 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.

1. INTRODUCTION

1.1 NETWORK-DRIVEN DSM

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 of the IEA DSM Programme, and consequently this report, are concerned with a particular type of DSM – “network-driven DSM”¹.

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 is 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 has 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 are considered:

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

¹ For a more comprehensive discussion of network-driven DSM see the first report from Task XV: Crossley, D.J. (2008a). *Worldwide Survey of Network-driven Demand-side Management Projects*. International Energy Agency Demand Side Management Programme, Task XV Research Report No 1. Second edition. Hornsby Heights, NSW, Australia, Energy Futures Australia Pty Ltd.

1.2 FOCUS OF THIS REPORT

This is the fourth report from Task XV and it is intended to achieve the objective of Subtask 4 which is “develop ‘best practice’ principles, procedures and methodologies for the evaluation and acquisition of network-driven DSM resources².”

This report has two objectives:

- to summarise and review how DSM resources are evaluated, acquired and implemented in participating countries; and
- to develop ‘best practice’ principles, procedures and methodologies for the evaluation and acquisition of network-driven DSM resources.

² Energy Futures Australia (2004). *Prospectus: Research Project on Network-driven DSM*. Hornsby Heights, NSW Australia, EFA, p 6.

2. PROCESSES FOR EVALUATING, ACQUIRING AND IMPLEMENTING DSM RESOURCES

In Subtask 4 of Task XV, the objective of Activity 4-1 is to collect information about how DSM resources are evaluated, acquired and implemented in participating countries³. This section of the report summarises the results from Activity 4-1.

2.1 AUSTRALIA

2.1.1 DSM in Australia

Demand-side management was brought to Australia in 1990 by the former State Electricity Commission of Victoria (SECV), a vertically integrated monopoly utility that was then owned by the Government of the State of Victoria. In the early 1980s, the SECV proposed to build 21 power stations on the Latrobe Valley coalfields by the first quarter of the 21st century. This stimulated an inquiry by a Victorian Parliamentary committee which in 1988 suggested that alternative approaches to meeting future electricity demand in Victoria should be investigated, including DSM⁴.

After studying DSM programs in the United States, the SECV decided to implement a US-style DSM program in Victoria (though calling it “demand management” rather than “DSM”). Between 1990 and 1995, with the assistance of US consultants, the SECV designed and implemented the largest DSM program which has yet been seen in Australia. The main purpose of this program was to investigate the potential for DSM to contribute to reducing perceived future shortfalls in generation capacity.

The early 1990s was also the period during which micro-economic reform of the Australian electricity industry was being carried out and competition was being introduced into electricity markets in Australia. In 1992, the *National Grid Protocol*, the initial design of the (competitive) National Electricity Market, stated⁵:

Demand management and renewable energy options are intended to have equal opportunity alongside conventional supply-side options to satisfy future requirements. Indeed, such options have advantages in meeting short lead-time requirements.

This principle became somewhat lost during the turmoil created by the micro-economic reform process and the establishment of the competitive electricity market. The SECV closed its DSM program in 1995 and most of the program staff moved on to work on various reform agendas. Between 1995 and the early 2000s, few DSM programs were implemented by Australian electricity businesses.

³ Energy Futures Australia (2004). *op cit*.

⁴ Natural Resources and Environment Committee (1988). *Electricity Supply and Demand Beyond the Mid-1990s*. Melbourne, Parliament of Victoria.

⁵ National Grid Management Council (1992). *National Grid Protocol: First Issue*, Melbourne, NGMC, p iii.

One exception to this low level of DSM implementation was the use of ripple control remote switching technology to shift residential water heating loads to off-peak periods, particularly to the middle of the night. This is a long-standing network-driven DSM measure which has been used in Australia for over 50 years. In some highly congested distribution networks with aging infrastructure, shifting of hot water load targeted at particular network elements has been used very actively, simply to keep the network operating.

In the early 2000s the attitude of electricity businesses towards DSM started to change with the recognition that coping with rapidly increasing peak loads would require massive investment in electricity network infrastructure. DSM came to be seen as a possibly cheaper and quicker way of relieving some types of network constraints. Consequently, the majority of DSM currently being implemented in Australia is network-driven.

Discrete DSM projects targeted at particular network elements have been increasingly implemented in Australia since the late 1990s. Some State regulators have provided incentives for DNSPs to implement DSM projects for this purpose. Until recently, there has been a particular emphasis on using energy efficiency load reductions to defer network augmentations, such as the construction or upgrading of substations and feeders.

In the future, it is expected that the emphasis will shift to deferring augmentation through short-term demand response load reductions at peak times on targeted network elements, particularly peaks caused by residential air conditioning on hot summer days. Various measures have been trialled to achieve demand response, including direct load control remote switching technologies and pricing initiatives aimed at encouraging changed behaviour by end-use customers.

2.1.2 Processes for Acquiring DSM Resources

As noted in a previous report⁶, most electricity networks in Australia are owned, operated and managed by stand-alone businesses that are participants in the National Electricity Market – a competitive wholesale market. The processes used by network businesses in Australia for evaluating, acquiring and implementing DSM resources are governed by the requirements of electricity industry regulators.

Regulation of the electricity industry in Australia is currently in the process of being transferred from several State-based regulators to a single national regulator, the Australian Energy Regulator. Consequently, until recently, distribution network businesses have acquired DSM resources under separate regulatory regimes established in each state, whereas transmission network businesses have operated under a single national regulatory regime.

⁶ Crossley, D.J. (2008b). *Incorporation of DSM Measures into Network Planning*. International Energy Agency Demand Side Management Programme, Task XV Research Report No 3. Second Edition. Hornsby Heights, NSW, Australia, Energy Futures Australia Pty Ltd.

Despite the diversity of regulatory regimes, processes for evaluating, acquiring and implementing DSM resources are all generally based on a national regulatory framework. Some States have implemented more detailed requirements within the national framework.

2.1.3 National Regulatory Framework for Acquiring DSM Resources

The national regulatory framework for acquiring DSM resources for network-related purposes is defined by the provisions of the *National Electricity Rules*⁷. Chapter 5 of the *Rules* sets out the network development process to be followed for all electricity network assets that are covered by the National Electricity Market⁸.

1. Each network operator⁹ must analyse the expected future operation of its network(s) over an appropriate planning period, taking into account the relevant forecast loads, any future generation, market network service, demand side and transmission developments and any other relevant data.
2. Each transmission network operator (TNSP) must conduct an annual planning review with each distribution network operator (DNSP) connected to its transmission network within each region. The annual planning review must incorporate the forecast loads submitted by the DNSP and must include a review of the adequacy of existing connection points and relevant parts of the transmission system and planning proposals for future connection points. The minimum planning period for the purposes of the annual planning review is five years for distribution networks and 10 years for transmission networks.
3. Where the necessity for network augmentation or a non-network alternative is identified by the annual planning review, the relevant network operators must undertake joint planning in order to determine network development plans that can be considered by interested parties.
4. The relevant DNSP must consult with interested parties on the possible options, including but not limited to demand side options, generation options and market network service options to address the projected limitations of the relevant distribution system.
5. Each DNSP must carry out an economic cost effectiveness analysis of possible options to identify options that satisfy the Regulatory Test¹⁰, while meeting technical requirements.

⁷ Australian Energy Market Commission (2007). *National Electricity Rules Version 13*. Available at: <http://www.aemc.gov.au/pdfs/rules/rulesv13.pdf>

⁸ In effect, all electricity network assets in Australia except for those located in Western Australia and the Northern Territory.

⁹ Referred to in the *Rules* as Transmission Network Service Providers (TNSPs) and Distribution Network Service Providers (DNSPs).

¹⁰ The Regulatory Test is an economic cost-benefit test applied by network service providers in the National Electricity Market (NEM) to assess and rank the economic viability of network and non-network options. It is described in detail in: Crossley, D.J. (2008b). *Op cit*.

6. The DNSP must prepare a report that is to be made available to interested parties which: (1) includes assessment of all identified options; (2) includes details of the DNSP's preferred proposal and details of its economic cost effectiveness analysis and its consultations; (3) summarises the submissions from the consultations; and (4) recommends the action to be taken.
7. Within 40 business days after the report is made available, certain interested parties may dispute the recommendation of the report in respect of any proposal that is a new large distribution network asset or is reasonably likely to change the distribution use of system service charges by more than 2%.
8. Following the completion of the 40 business day dispute period, the DNSP must arrange for the network options (if any) recommended by its report to be available for service by the agreed time.

2.1.4 NSW Demand Management Code of Practice

The Demand Management Code of Practice¹¹ in force in the State of New South Wales (NSW) prescribes a formal process to be followed by distribution network operators (DNSPs) in procuring demand-side resources for network support. The process is illustrated in Figure 2.1 (page 7).

The first edition of the Code was published in 1999 and its evolution to the current third edition, published in 2004, has closely followed the corresponding evolution of the *National Electricity Rules* from their origins during the development and implementation of the National Electricity Market during the 1990s.

The third edition of the Code was prepared by a working group comprising representatives from the NSW electricity industry, the NSW electricity industry regulator, electricity users and environmental and consumer groups, facilitated by the NSW Department of Energy, Utilities and Sustainability.

While the first two editions of the Code were purely advisory, the third edition was formally issued in accordance with NSW legislation. This requires DNSPs in NSW to take the Code into account in the development and implementation of their network management plans. In particular, a network management plan must specify where the plan, or its implementation, departs from the provisions of the Code and, if so, what arrangements are in place to ensure an equal or better outcome.

The basis of the Code is a market-based procurement process for demand-side options for electricity system support (including DSM, distributed generation and storage options) and their evaluation at the same time and in the same manner as supply-side options.

The approach in the Code is focused not just on the network, but rather on the electricity system as a whole. Constraints that arise within the distribution network can be addressed by changes in customer behaviour, by changes in equipment used by customers or by installation of small-scale generation at a local level, as well as by augmentation of the distribution network. These options could be devised and implemented by end-use customers or third parties or by the DNSP itself.

¹¹ Department of Energy, Utilities and Sustainability (2004). *Demand Management for Electricity Distributors: NSW Code of Practice*. Sydney, DEUS. Available at: www.efa.com.au/Library/DMCode3rdEd.pdf

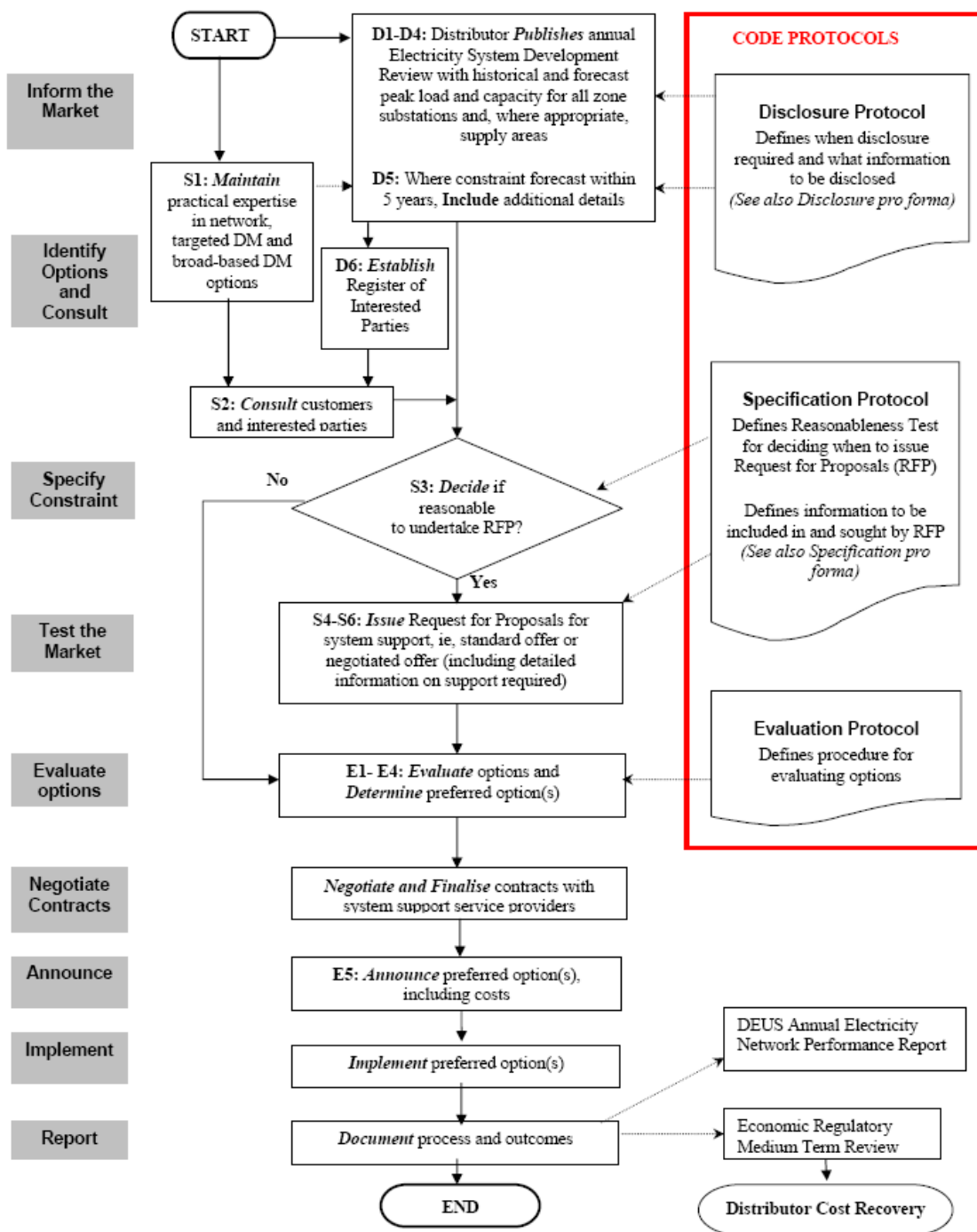


Figure 2.1 Electricity System Development Procedure for Distribution Network Operators in New South Wales, Australia¹²

¹² Department of Energy, Utilities and Sustainability (2004). *Op cit.*

The Code requires DNSPs in New South Wales to:

- publish information that makes transparent the underlying assumptions and decision-making process relating to investments that expand their distribution networks;
- publish detailed information regarding the need for network expansion in a way that enables interested parties to identify likely locations of forthcoming constraints;
- use a formal process to determine whether investigations of demand-side options are warranted for identified emerging constraints, and publish the results;
- carry out investigations of demand-side options that provide opportunities for market participation;
- analyse demand-side and network expansion options on an equal basis according to the published methodology and assumptions and publish the result of those determinations;
- implement demand-side options where they are determined to be cost effective; and
- prepare and publish reports on these activities annually.

Under the Code, there are two types of procurement offers that may be made to providers of demand-side options: negotiable offers and standard offers. For negotiable offers, the distributor and the proponent of a demand-side project (who may also be a network customer) negotiate a contract specifically designed for that particular project. Negotiable offers are more appropriate for larger-scale, relatively complex demand-side projects where the transaction costs and time associated with negotiating a unique contract are relatively insignificant compared with the benefits from the project.

Standard offers specify the conditions for the provision of demand-side resources in advance. Standard offers are usually made on fixed prices, take it or leave it, first come first served basis. Standard offers may be targeted to shorter-term network constraints or to capture demand reduction opportunities that provide longer-term distribution network benefits by delaying future, less well-defined constraints.

A standard offer may be made in conjunction with, prior to, or in place of, a negotiable offer being issued or a constrained area being identified. A subsequent negotiable offer or Request for Proposal may revise the standard offer as the details of the constraint and the requirement to overcome the constraint are more clearly defined.

The Code suggests that DNSPs should make standard offers where the firm rating of the local distribution network will be exceeded within a 10 year forecast period. A standard offer can be made during the early period of a constraint being identified and may be re-evaluated and incorporated into a Request for Proposals in accordance with the timeframe shown in Figure 2.1 (page 7).

2.1.5 Case Study: TransGrid Major Network Augmentation

TransGrid is a transmission network operator (TNSP) owned by the Government of New South Wales. TransGrid owns, operates and manages the high voltage electricity transmission system throughout NSW.

In September 2005, TransGrid published a *Needs Statement* for emerging major transmission network limitations affecting the supply to the Newcastle–Sydney–Wollongong load area¹³. This transmission corridor delivers power to the area of the highest concentration of electricity demand in NSW. As a result of continued growth in electricity consumption, future peak electricity demand delivered via this corridor will outstrip the capability of the current transmission infrastructure.

TransGrid's analysis suggested that the transmission system currently operating at 330kV that serves this corridor will require significant augmentation by the summer of 2008/09. TransGrid proposed to upgrade the transmission system to operate at its design capability of 500kV. In addition to proposing this network solution, TransGrid also committed to investigating the potential for suitable non-network solutions (such as demand response, energy efficiency, and embedded and distributed generation) to provide capacity to address the emerging transmission limitations.

In May 2006, TransGrid issued an *Application Notice* for public consultation on a proposed new large transmission network asset in the Newcastle–Sydney–Wollongong load area¹⁴. The *Notice* described seven network options and a number of non-network options. None of the non-network options was regarded as sufficiently developed, at that stage, for consideration by the Regulatory Test. However, the *Notice* stated that development of non-network options was continuing.

TransGrid's investigation of non-network solutions involved two major initiatives:

- working with third-party organisations that could provide possible non-network solutions either directly or by organising end-use customers to do so;
- working directly with end-use customers that had the ability to provide potential non-network solutions.

TransGrid carried out a project to identify the magnitude and cost of possible non-network solutions and contracted a consultant specialising in DSM to assist them with the project.

Stage 1 of the project included data gathering, desktop analysis and identification of non-network alternatives that could achieve the objectives. At the conclusion of Stage 1 an assessment was made whether or not it was worthwhile proceeding further and it was agreed to go ahead with Stage 2.

¹³ TransGrid (2005). *Emerging Major Transmission Network Limitations in Supplying the Newcastle–Sydney–Wollongong Load Area: Needs Statement*. Available at: <http://www.transgrid.com.au/trim/trim191126.pdf>.

¹⁴ TransGrid (2006a). *Application Notice: Proposed New Large Transmission Network Asset - Development of Supply to the Newcastle–Sydney Wollongong Area*. Available at: <http://www.transgrid.com.au/trim/trim210951.pdf>

Stage 2 commenced with seeking assistance from various parties in the geographical region under evaluation, including DNSPs, electricity retailers and generators, agencies and interest groups. In addition, a preliminary meeting was held with the Australian Energy Regulator to discuss and better understand the treatment by the regulator of DSM undertaken by a TNSP.

A series of documents were prepared and publicly advertised: a Request for Proposal (RFP), a Network Support Agreement and other ancillary paperwork. These documents were prepared jointly by legal advisers and TransGrid's commercial group, using as a basis the State Government guidelines for tenders.

The RFP was issued in August 2006¹⁵ and sought non-network solutions that in aggregate would provide network support in the Newcastle–Sydney–Wollongong area such that capacity of the current system:

- would remain sufficient to meet the remaining aggregate customer peak demand in the area for an additional one or more years; and
- might enable deferral of the 330 kV to 500 kV conversion.

It was envisaged that these non-network solutions could include:

- reductions in end-use demand, either in the proponent's facility or in the facilities of other end-users as arranged by the proponent, including the use of standby generators located within these facilities, whether or not the generators were synchronised with the grid;
- local generation projects (also referred to as embedded generation) connected to the lower voltage networks supplying end-use proponents;
- larger generation projects which may connect to TransGrid's 330 kV network or to the underlying 132 kV networks owned by DNSPs; and/or
- operational changes and/or plant expansions whereby existing larger generation plant already connected within the constrained area could produce additional output.

The RFP stated that network support was most likely to be required during periods of extremely high system demand, which tend to occur on working weekdays during sustained periods of high temperature in the period from mid-November to mid-March, excluding the period from 24 December through mid January.

Under the RFP, each proposal had to be for the supply of network support (ie load reduction or generation) in the defined geographic area on working weekdays during the specified four month period in the years 2008/09 to 2010/11. The smallest block of network support acceptable to TransGrid was 30 MW. However, to allow smaller participants to participate, the RFP encouraged the formation of aggregating teams who could put forward joint proposals of not less than 30 MW.

15 TransGrid (2006b). *Request for Proposal Number 104/06: Non-Network Solutions in the Newcastle–Sydney–Wollongong Area*. Sydney, TransGrid.

The criteria used to evaluate proposals comprised:

- the magnitude of network support (in MW) to be provided – larger amounts were preferred, subject to consideration of the extent to which the size and/or nature of the resource might reduce the reliability of the aggregate network support portfolio;
- the total expected cost to TransGrid, which was calculated using the prices submitted in the proposal and the expected timing, frequency, and duration of dispatch events;
- the proportion of the total expected cost to TransGrid represented by estimated availability and dispatch payments; proposals in which dispatch payments represented higher proportions of total expected cost were preferred;
- the ability to maintain contracted network support levels for the anticipated frequency and duration of dispatch. The following parameters were regarded as ‘pluses’:
 - ◆ ability to provide greater frequency of network support;
 - ◆ ability to provide greater duration of network support;
 - ◆ ability to provide more consecutive days (up to three) of network support;
 - ◆ ability to provide network support outside the specified season and hours;
- the notification period required for dispatch of network support; shorter notification periods were preferred;
- the cancellation period for a dispatch order for network support; shorter cancellation lead times were preferred;
- the technical feasibility of the proposed project(s);
- the firmness/reliability of the network support proposed;
- a clear demonstration by the proponent that the network support proposed was being brought forward as a result of funding support from TransGrid relative to business-as-usual conditions;
- the adequacy, accuracy and level of transparency of the proponent’s proposed verification plan;
- the degree to which the proponent appeared capable of delivering the amount of network support offered within the desired timeframe for availability of network support; and
- the demonstrated track record of the proponent in similar undertakings.

The RFP also required project proponents to:

- provide development plans (where no plant existed at the time of lodging a response to the RFP);
- develop a verification plan to ensure that what was claimed to be delivered was actually delivered;
- provide metering facilities in accordance with the relevant standards.

The RFP stated that proposals for non-network solutions would only be accepted if the solutions satisfied the applicable regulatory requirements for the adoption of, and recovery of the costs of, such options. In other words, the Australian Energy Regulator would have to approve TransGrid passing through the cost of non-network solutions to its network customers.

The RFP was advertised in a number of daily newspapers (state and national) as well as TransGrid's website. The responses received underwent evaluation by a committee that included members drawn from across all TransGrid's business areas. During the evaluation process, TransGrid met with all proponents on an individual basis to clarify various points in their submissions.

In October 2006, TransGrid issued a final report on the proposed new large transmission network asset¹⁶. The report proposed the conversion of two existing 330 kV transmission lines to operate at 500 kV. To manage the network limitations in the short term, it was also proposed to continue the development of non-network projects with identified proponents to implement up to 350 MW of network support capability for the Newcastle–Sydney–Wollongong area by 2008/09.

The final report also stated that “the magnitude of non-network projects offered could be sufficient to manage the network limitations over summer 2008/09 and summer 2009/10”. TransGrid was able to provide estimates of the overall costs and capacities of certain non-network projects and these estimates enabled the projects to be included as components of options in the Regulatory Test. However, before any non-network solutions could be implemented, the Australian Energy Regulator would have to approve TransGrid passing through the cost of these projects to network customers.

Following the publication of the final report, TransGrid continued negotiations with prospective providers of network support through non-network projects. In the first quarter of 2008, contracts were signed for a total of 350MW of network support from three providers that provided the most cost effective non-network alternatives for summer 2008/09:

- Energy Response, an aggregator of demand response load reductions;
- a large industrial load (name not disclosed); and
- an embedded generator (name also not disclosed).

These contracts comprise two components: availability payments and dispatch payments. There are no penalties as such in the contracts. However, should a support provider not respond to a dispatch call, the provider would forfeit the monthly availability payment. There are also funds allocated for trials prior to the commencement of the 'peak period' which is defined as occurring from 17 November 2008 to 12 March 2009. These trials will replicate a real dispatch situation. If the network support provider does not meet its obligations as per contract during the trial, the provider has to repeat the trial at no cost to TransGrid.

¹⁶ TransGrid (2006c). *Final Report: Proposed New Large Transmission Network Asset - Development of Supply to the Newcastle–Sydney Wollongong Area*. Available at: <http://www.transgrid.com.au/trim/trim224993.pdf>.

In May 2008, the Australian Energy Regulator approved¹⁷ a pass through of AUD21.9 million for 350MW of network support to defer the conversion of the two existing 330 kV transmission lines to operate at 500 kV. It is expected that the provision of network support through non-network projects will defer the AUD327 million conversion project by a year.

This is the largest known contract for network support signed by a TNSP in Australia, and possible worldwide.

2.2 FRANCE

2.2.1 DSM in France

In France, the transmission network operator, Gestionnaire du Réseau de Transport d'Electricité (RTE), is prevented by its founding legislation from undertaking DSM. Consequently, network-driven DSM has been undertaken by the distribution units of Electricité de France (EDF) and local government-owned rural distributors, usually in collaboration with the French Government's environmental and energy management agency Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME).

DSM has not been used to provide network operational services in France. Network-driven DSM has been used mainly in projects aimed at deferring network augmentation and reinforcement, particularly in rural areas. It is expected that this use will increase in the future as it becomes more difficult to obtain environmental approvals to build new transmission and distribution lines.

EDF also utilises a network-driven DSM measure, the Tempo critical peak pricing tariff, to enable smoothing of both the annual and daily electricity load curves, particularly to reduce load during critical peak periods.

2.2.2 Processes for Acquiring DSM Resources

Processes for acquiring DSM resources for network-related purposes in France rely on directly contacting end-use customers.

Where DSM is used to defer network augmentation, the process involves first analysing the load profile on the affected network element (eg a particular line or substation) to determine the time(s) at which the constraint occurs and the loads contributing to the constraint. Tailored DSM programs are then developed to target reductions in specific loads at the time(s) when the constraint occurs.

Using the Tempo tariff to reduce load during system peaks involves a marketing campaign to encourage end-users to sign up for the tariff and then a communication campaign to inform people about the days when critical peaks will occur.

¹⁷ Australian Energy Regulator (2008). *Statement of Reasons. TransGrid. Notice of Proposed Pass-through for Network Support for Deferral of the Western 500 kV Conversion*. Melbourne, AER.

2.2.3 Case Study: The French Riviera DSM Program

The purpose of the French Riviera DSM program is to use energy efficiency and renewable energy distributed generation to defer the need to upgrade a major transmission line serving the eastern part of the Provence-Alpes-Côte d'Azur region of France¹⁸. The following description is based on the analysis and program design developed following the initial decision to proceed with the DSM program. This initial decision was based on deferring the need for a further transmission line after a new 400 kV line was built in the mid-2000s. However, planning permission for the new line was refused in May 2006 and the DSM program will have to be strengthened to meet the new constraints.

2.2.3.1 Preliminary Studies

Preliminary studies were carried out in 2001:

- to quantify the level of load reduction required, after the expected scheduled completion of the new 400 kV line in 2005, to avoid network constraints in the period to 2020;
- to understand the evolution and structure of peak demand in the eastern part of the Provence-Alpes-Côte d'Azur region;
- to quantify the potential load reductions achievable through implementing DSM and distributed generation; and
- to identify a detailed program of DSM and distributed generation measures.

The analysis showed that to avoid a further new line being required before 2020, the DSM program would have to reduce load by 35 MW in winter¹⁹.

Figures 2.2 and 2.3 show the end-use composition of peak demand in the region in winter and summer. In winter, peak demand is dominated by lighting and heating and in summer air conditioning is dominant with lighting also an important contributor to the peak.

¹⁸ A detailed case study of the French Riviera DSM program is included in the first report from Task XV: Crossley, D.J. (2008a). *Op cit*.

¹⁹ Jean-Pierre Harinck and Bertrand Combes (2003). "Plan Eco-Energie: Programme de Maîtrise de la Demande d'Electricité et de Développement des Energies Renouvelables sur l'Est de la Région Provence-Alpes-Côte d'Azur". Presentation to *6ème Rencontres Nationales Sciences et Techniques de l'Environnement*. Istres, 28 October. Available at: <http://www.planete-sciences.org/enviro/rnstef6/ateliers/ppt/plan-eco-nrj.ppt>

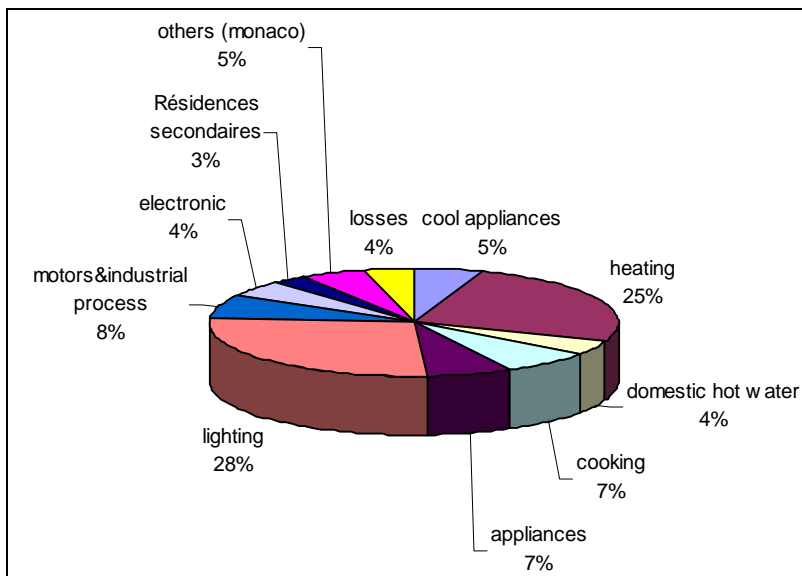


Figure 2.2. Winter Peak Demand by End-use in the Eastern Part of the Provence-Alpes-Côte d'Azur Region²⁰

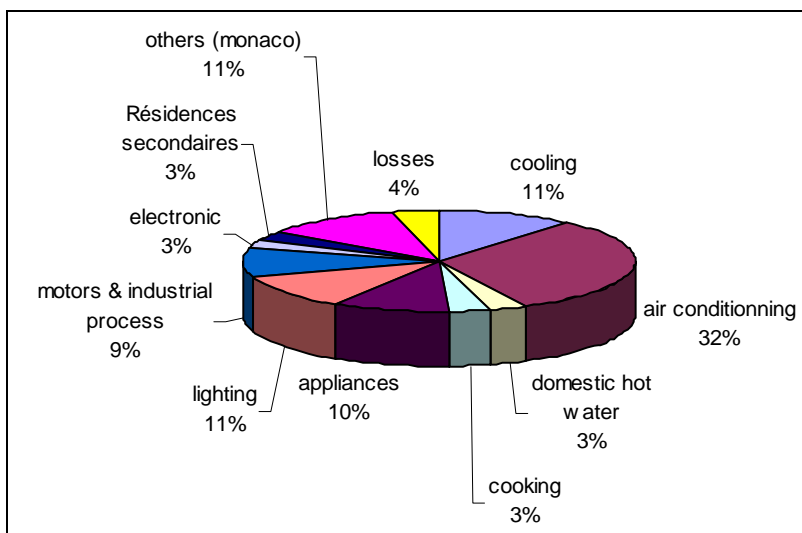


Figure 2.3. Summer Peak Demand by End-use in the Eastern Part of the Provence-Alpes-Côte d'Azur Region²¹

²⁰ Jean-Pierre Harinck and Bertrand Combes (2003). *Op. cit.*

²¹ Jean-Pierre Harinck and Bertrand Combes (2003). *Op. cit.*

Figure 2.4 shows forecasts of the potential load reductions achievable by implementing DSM and distributed generation over the period 2005 to 2020. Figure 2.5 shows a breakdown of the forecast load reductions achievable in winter 2006. Based on these forecasts, the target load reduction to be achieved through the DSM program in winter 2006 was set at 45 MWe.

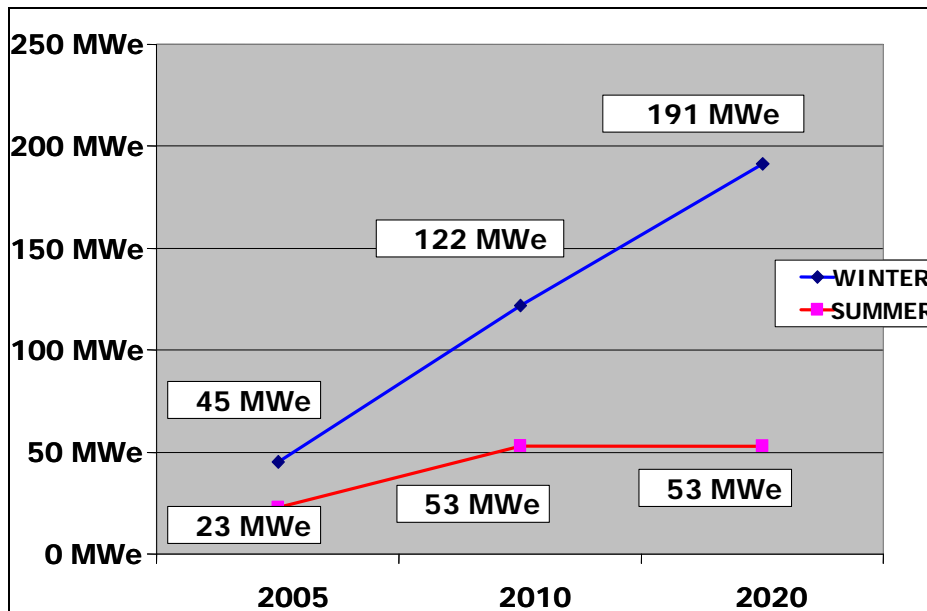


Figure 2.4. Forecasts of Potential Load Reductions Achievable through the French Riviera DSM Program 2005 to 2020²²

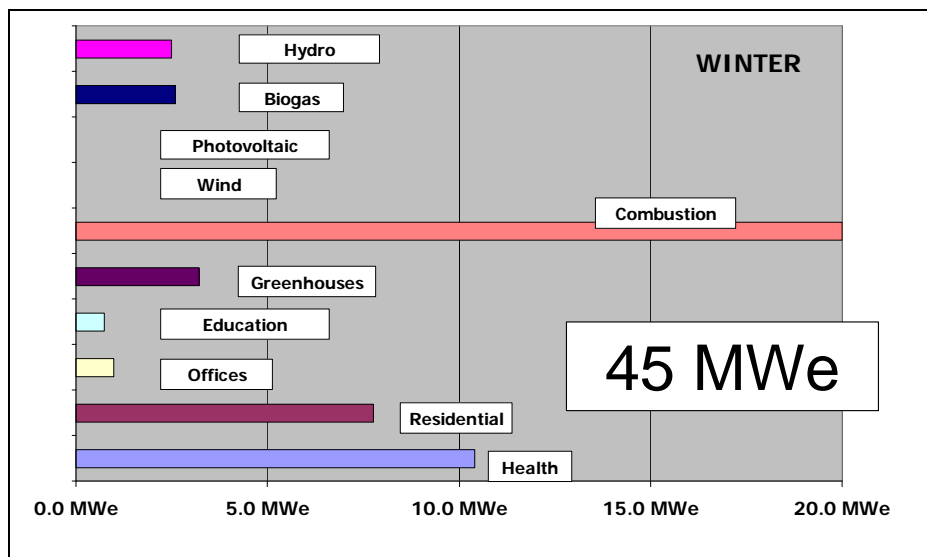


Figure 2.5. Forecasts of Potential Load Reductions Achievable through the French Riviera DSM Program in Winter 2006²³

²² Jean-Pierre Harinck and Bertrand Combes (2003). *Op. cit.*

²³ Jean-Pierre Harinck and Bertrand Combes (2003). *Op. cit.*

2.2.3.2 Implementation

The DSM program was launched in March 2003. Initially, six priority areas were identified²⁴:

- communication and information;
- new building construction;
- efficient lighting and domestic electrical appliances;
- large consumers and distributed generation;
- demonstration projects by institutional partners; and
- public housing.

In 2004, a further two priority areas were added:

- existing buildings; and
- tourism.

A general public information campaign was launched on 18 March 2003²⁵. Each year, the campaign is implemented in two waves on a seasonal basis: summer and winter. The campaign includes: paid advertisements in newspapers, and on radio and television; information booklets and posters; a quarterly newsletter; a telephone information centre; a website; energy audit software for residential dwellings; and displays in shopping centres and fairs. Targeted educational material on energy saving has been produced for use by school children, including information on how to carry out energy saving projects at home. These projects are intended to influence whole families to save energy not just the children.

Individual targeted communication and enrolment programs have also been developed for each of the identified priority areas. These include²⁶:

- targeted information material on energy efficient lighting for engineering and building design firms;
- negotiations with lamp manufacturers to enable energy efficient lamps to be offered at a 20% discounted price in the Alpes-Maritime region;
- loans to cover the cost of energy efficient lighting installations;
- establishment of a working group on cogeneration and completion of a study to identify the potential for the development of small cogeneration installations (200-300 kW) in the region;
- feasibility studies of energy efficiency and DSM demonstration projects in public buildings;
- facilitation of local communities in the Alpes-Maritimes region to undertake effective DSM measures;
- working with managers of public housing to improve the energy efficiency of their properties;

²⁴ Plan Éco-Énergie (2005). *Infos*. Newsletter, July edition.

²⁵ ADEME (2006). *Plan Éco-Énergie: Campagne de Communication Grand Public 2003 - 2006*. PowerPoint presentation.

²⁶ Eco-Energy Plan website at: www.planecoenergie.org

- development of a book of technical solutions applicable to the Mediterranean area that assist the design of buildings adapted to the local climatic conditions and which make use of local renewable energies.

Figure 2.6 shows the forecast impacts and costs of the identified DSM measures to be implemented through the French Riviera DSM program.

	Impact on Winter Peak (MW)	Impact on Summer Peak (MW)	Impact on Consumption (GWh)	Public Funding (M€)
Communication and information campaigns				2.9
Increasing awareness and training of engineering departments and installers				3.6
Demonstration energy management projects in State and local authorities, EDF and ADEME	26	5.5	52.5	4.6
Specific measures for new residential and commercial buildings	1.2	0.1	2.5	7.6
Large-scale dissemination of CFLs in social sector	2.3	0.5	6	2
Promotion of efficient lighting in commercial sector	24	12	72	1.8
Promotion of CFLs and energy efficient white goods	57	8	115	3.6
Energy efficient retrofitting in residential and commercial sectors	41	11.5	125	9.1
Energy efficient retrofitting in tourism sector	3	2.3	9	2.6
Domestic hot water		15	5	3.3
Wood heating	8		7	2.1
Specific measures for large industrial and commercial consumers	16.5	11		2.3
Cogeneration, biogas, hydro installations	45	23		3
Photovoltaic installations	0	0.3		0.9
Evaluation				3
Total	224	89.2	394	52.4

Figure 2.6. Forecast Impacts and Costs of Identified DSM Measures in the French Riviera DSM Program²⁷

²⁷ Frédéric Rosenstein (2004). "The Transmission Network-Driven DSM Project in the French Riviera". Presentation to IEA DSM Programme Task XV Experts Meeting, Atlanta, Georgia, 11 to 12 October.

2.2.4 Case Study: The Tempo Tariff

Under the Tempo tariff, each day of the year is colour coded²⁸. There are three colours, blue (*jours bleus*), white (*jours blancs*) and red (*jours rouges*) which correspond to low, medium and high electricity prices. The colour of each day is determined mostly by EDF based on the forecast of electricity demand for that day - the level of demand is mainly influenced by the weather. RTE also has the ability to determine the day colour if there is significant congestion on the electricity network.

The Tempo tariff is promoted to high use households, such as very large houses, and those with electric heating and full time occupation, and to small business customers.

Customers who choose the Tempo tariff are informed each night about the colour for the next day. At 8 pm a signal is sent down powerlines using a ripple control system. Most Tempo customers have a display unit that plugs into any power socket and picks up the signal. The display unit shows the day colour with lights, both for the current day and (from 8pm) for the next day. An (optional) beep informs the consumer if the following day will be a red day. The display unit also shows whether or not the current electricity price is at the off-peak rate. For older systems without a display unit the information is available over the telephone or via the internet²⁹.

Customers can adjust their electricity consumption manually by switching off appliances, adjusting thermostat settings, etc. Some customers who have the necessary communications and load control equipment are able to select load control programs which enable automatic connection and disconnection of separate water-heating and space-heating circuits.

2.3 INDIA³⁰

2.3.1 DSM in India

Electricity utilities in India have usually not been actively involved in influencing consumer demand for electricity³¹. Rather, utilities have followed the approach of passively meeting forecasted electricity demand or balancing the demand supply equation in times of shortages.

²⁸ A detailed case study of the Tempo tariff is included in the first report from Task XV: Crossley, D.J. (2008a). *Op cit*.

²⁹ Kärkkäinen, S. (ed) (2004). *Energy Efficiency and Load Curve Impacts of Commercial Development in Competitive Markets: Results from the EFFLOCOM Pilots*. EU/SAVE 132/01 EFFLOCOM Report No 7. Available at: www.efflocom.com/pdf/EFFLOCOM%20report%20no.%207%20Pilot%20Results.pdf

³⁰ This section has been mainly developed from material in: ABPS Infra (2008). *Research Report No 5. Evaluation and Acquisition of Network-driven DSM Resources*. Mumbai, ABPS Infra.

³¹ Except for isolated instances of programs designed to increase electricity sales. Examples include initiatives in the 1950s by the Brihan Mumbai Electricity Supply & Transport Undertaking (BEST), a municipal utility in Mumbai, to provide incentives to its consumers to purchase electricity consuming appliances, and an "All Electric Home" scheme in the early 1970s by the erstwhile Karnataka Electricity Board, a State distribution utility.

Nevertheless, the concept of DSM is not new to Indian utilities, though it is yet to gain momentum. In India, power shortages are a major problem. Therefore, the most important opportunities for DSM in India derive from its potential to mitigate power shortages, to reduce capital needs for electricity sector capacity expansion and to enhance the energy security of the country. In particular, opportunities for network-driven DSM in India arise in the following ways:

- utilisation of distributed generation to mitigate load shedding and to optimise investment in the transmission and distribution sectors;
- design, development and implementation of energy efficiency programs in the agricultural and municipal sectors; and
- reform of electricity pricing and tariffs.

2.3.2 Processes for Acquiring DSM Resources

In India, the operations of the electricity industry are mandated by licences granted by the central and State governments. Licenses impose relatively stringent conditions and requirements on both the cost and revenue sides of the industry, with most activities requiring approval by the relevant Electricity Regulatory Commission. Therefore, it is imperative that any new activity which has cost and revenue implications be mandated by regulation. In particular, most State Electricity Regulatory Commissions have mandated electricity distribution Licensees to establish dedicated DSM cells within their operations with responsibility to initiate DSM projects. Some utilities have also signed memoranda of understanding with the central Government's Ministry of Power that require the establishment of DSM cells. However, there is nothing in the *Electricity Act 2003* that directly requires utilities to implement DSM.

The central Government enacted the *Energy Conservation Act 2001* to coordinate various activities associated with efficient use of energy and its conservation. The Government created the Bureau of Energy Efficiency under Section 3 of the Act. The Bureau plays a very critical role in working with utilities to identify, develop and implement DSM measures and also carries out the necessary coordination with various agencies of the central and State governments to facilitate the implementation of DSM measures. The Bureau also offers training support for DSM cells set up by the utilities.

Some of the specific activities that electricity distribution Licensees are expected to undertake are consumer awareness programs, load research programs, development of DSM schemes in conjunction with the Bureau of Energy Efficiency, and development of the necessary infrastructure for DSM implementation. However, the widespread implementation of DSM schemes by utilities is yet to take off and such schemes on the ground are rarely more than at the pilot or experimental scale. Therefore, at present, there are no generally established methods for acquiring DSM resources in India.

2.3.3 Case Study: Maharashtra Electricity Regulatory Commission DSM Resource Acquisition Process

The Maharashtra Electricity Regulatory Commission (MERC) has been particularly active in developing a DSM resource acquisition process for utilities within the State of Maharashtra. Maharashtra State has witnessed rapid economic growth and is not in a position to meet its requirements for electricity, either in energy terms or in relation to peak capacity requirement. Figure 2.7 shows the demand supply scenario in Maharashtra for the last seven years. The state had an energy shortfall of 7,051 gigawatt-hours during financial year 2001/02 and the shortfall increased to 21,039 gigawatt-hours in financial year 2007/08. Peak demand in Maharashtra was 18,441 MW during financial year 2007/08; however, the State was able to meet only 13,575 MW.

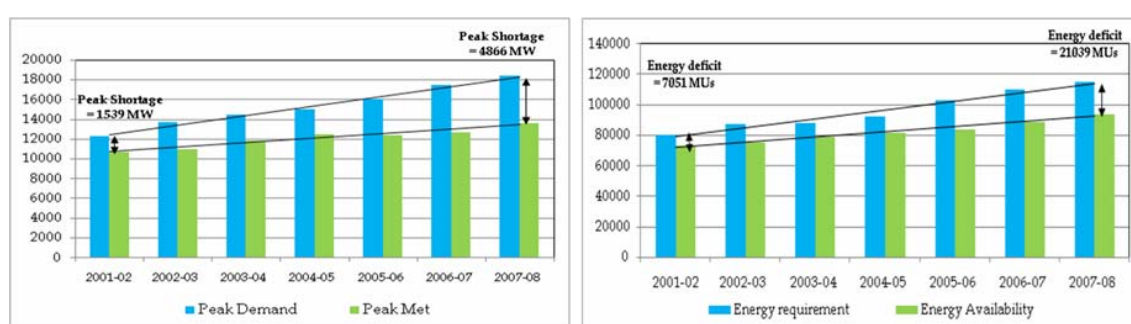


Figure 2.7 Demand Supply Scenario in Maharashtra, 2001/02 to 2007/08

Given this situation, MERC used power vested in state regulators under Section 23 of the *Electricity Act 2003* to mandate uptake of DSM by utilities in Maharashtra. MERC's 2005 Tariff Regulations treated energy conservation and energy efficiency measures as a 'supply' source and stipulated that long term power procurement plans of distribution licensees shall include proposals about energy conservation and energy efficiency measures to be implemented.

To assist utilities in Maharashtra to comply with these requirements, MERC initiated a study to assess the feasibility of a DSM resource acquisition process. To develop, design and implement the process, MERC appointed an international consultant who designed a DSM bidding process that took into account benefits from several end uses such as lighting, water pumping and water heating in the domestic sector.

The approach adopted involves identifying individual network elements (substations or feeders) to which tailored DSM measures could be applied. The network elements are then made available to interested parties for management and implementation of DSM measures.

2.3.3.1 Selection of Representative Substations and Feeders

MERC directed the consultant to choose a set of 10 representative substations or feeders, each with loads totalling about five megawatts and with a mix of residential, small commercial, commercial and industrial consumers. For each of these network elements, the contractor carried out the following tasks:

- recorded metered energy consumption and losses (at transformers and user meters);
- carried out customer segmentation (customer categorisation and average unit rate based on billing analysis);
- identified billing cycle and revenue losses;
- analysed the load profile and identified peaking and non-peaking segments;
- carried out an initial analysis of the increase in demand over the past five years;
- identified sub-metering and power quality enhancement hardware;
- developed performance factors for each network element (cost of supply of electricity against revenue recovered).

2.3.3.2 Review of End-Use Applications and Assessment of Potential Impacts

The following activities were carried out by the consultant to identify end use applications having technical potential to reduce loads:

- assembled data on end-use applications and equipment, and developed load profiles for different applications;
- analysed current efficiency levels and possible efficiency gains with changed stock of key equipment / appliances;
- developed energy savings scenarios for the DSM investments required and the net utility benefits achieved from avoided costs (capturing the gap between the cost of supply and revenue recovery);
- quantified the utility benefits from energy (kWh) and demand (kW) savings;
- assessed potential reductions in greenhouse gas emissions;
- developed standard offers estimates (INR/kWh and/or INR/kW saved) for energy and demand savings scenarios;
- clarified the regulatory treatment of the payments made by utilities for DSM resources.

2.3.3.3 Preparation of Bidding Documents

This step involved the development of standard bidding documents (technical and commercial) that can be used by participating utilities. The bidding documents included a notice inviting expression of interest, a notice inviting tenders, and standard contracts/agreements between the utility and prospective implementers of DSM measures. These documents were developed taking into account:

- existing standards for typical end-use applications (domestic and area lighting, domestic water pumping; refrigerators and air-conditioners), with a focus on combined benefits and impacts on the power quality;
- complementary metering and power quality enhancement equipment required to be purchased and installed by the utility or the proposed bidder;

- a monitoring and evaluation protocol to form part of the contractual agreements (M&E protocol to include spot and continuous energy monitoring/accounting);
- the methodology for short listing of bidders;
- the bid evaluation criteria.

2.3.3.4 Current Progress

Currently, competitive bidding is in progress for the right to implement DSM measures on two feeders. The successful bidder will be selected on the basis of the committed potential load reduction. However, lack of capability among Energy Services Companies has so far constrained selection of the successful bidder.

In general, the DSM resource acquisition process developed by MERC may be very useful for quickly achieving peak load reductions and may therefore represent an excellent option for States that are experiencing severe capacity shortages. Further, the competitive bidding approach offers the advantage that it may cost less to acquire the resources using this approach.

2.4 NEW ZEALAND³²

2.4.1 DSM in New Zealand

Opportunities for network driven DSM in New Zealand currently arise in five ways:

- through provision of demand side alternatives for transmission grid support, whether to defer the need for transmission investment or manage the risk of delayed delivery of transmission or higher than expected demand growth;
- through provision of demand side alternatives for distribution investment or deferral of the need for distribution investment;
- through targeted load shifting by distribution network operators responding to pricing incentives or for security purposes. This includes the use of ripple control for the potential reduction in network losses;
- through demand side bidding in the wholesale market to assist in the removal of network constraints;
- through price signals at the distribution network level.

The *Electricity Governance Rules* require that when assessing transmission upgrades, Transpower, as grid planner, considers alternatives to the proposed transmission investment. These alternatives include consideration of demand side options that might replace or defer transmission investment.

Likewise distribution network companies have a regulatory obligation to consider demand side alternatives when considering new investments. There are, however, currently no requirements for these companies to call for proposals for demand side solutions, or to accept a demand side proposal if it is more economic than a traditional network solution.

³² This section has been developed from material provided by Transpower New Zealand Limited.

2.4.2 Processes for Acquiring DSM Resources

Currently, in New Zealand there are two processes for acquiring DSM resources for network support:

- through load control by network companies; and
- through the instantaneous reserves market.

2.4.2.1 Load Control by Network Companies

In New Zealand, the majority of demand side response capability is managed by distribution companies. There is up to 880 MW of controlled load, typically controlled water heating (ripple controlled or pilot wire). Controlled loads are managed by distribution companies, who use the resource to reduce peak loads to limit losses, to enable maintenance of the network infrastructure and, most importantly, to defer the need for investments in the transmission and/or distribution network.

Distributors receive a pricing signal to manage demand from the transmission system operator, Transpower, through the charges to interconnect with the transmission system. These charges are, in most cases, re-bundled with the distributor's own cost of providing peak capacity before they are passed on to retailers and/or end-use consumers.

The methodology used to signal the need for load management varies among distribution companies and the level of the pricing signal varies from network to network. Specific distribution load control tariffs or a general price signal may be offered to retailers or directly to end-use consumers. In a small number of distribution networks, load control is a mandatory requirement of connection.

2.4.2.2 Instantaneous Reserves Market

The instantaneous reserves market is a formal market operated by the system operator, Transpower. The market is based on offers of generation and interruptible load as instantaneous reserves.

Instantaneous reserves are defined in the *Electricity Governance Rules* as:

“The provision of interruptible load, partly loaded spinning reserve and/or tail water depressed reserve (in each case as either fast instantaneous reserve or sustained instantaneous reserve) available to counter an under frequency excursion.....The total response expected will be fast enough and in a quantity sufficient to arrest the fall in frequency (fast instantaneous reserve), and assist in the recovery of frequency (sustained instantaneous reserve).”

Arising from this definition, there are two types of instantaneous reserves:

- **Fast instantaneous reserves (FIR).** – reserves that are available within six seconds of an unexpected generator or transmission outage; and
- **Sustainable instantaneous reserves (SIR)** – reserves that are available within 60 seconds of an event and must remain available for up to 15 minutes after the event.

Prior to 1996, the electricity industry in New Zealand relied on reserves provided by generators. No financial transactions took place for the availability or actual provision of reserves. In 1996, an ancillary services market was developed that created contestability and many providers invested in interruptible load DSM as a way of providing reserves to the market.

Questions about the performance of ancillary service agents began to be raised in 2000 and compliance requirements increased in 2004 with the introduction of a formal procurement plan in the *Electricity Governance Rules*. Many ancillary service providers and potential providers found that they were unable to meet compliance requirements so withdrew or did not enter the market.

Currently, in accordance with the *Electricity Governance Rules*, ancillary service agents offer load reduction availability into the market. These offers are co-optimised with the reserves offered by hydro generators to optimise the use of the combined capacity. Participants are paid for reserves at the clearing prices calculated by the system operator.

The Automatic Under frequency Load Shedding (AUFLS) commitments of the directly connected participants must be met before interruptible load is offered into the reserves market. This ensures the stability of the system in case of a double pole failure of the HVDC link connecting the North Island and South Island of New Zealand. The AUFLS commitment is a minimum of 32% of the connected load of each party and the load is shed in tranches depending on the frequency. AUFLS commitments effectively quarantine 32% to 50% of the potential interruptible load.

2.4.3 Case Study: Transpower Grid Support Contract

Transpower is currently developing a standard Grid Support Contract product that will be a mechanism for Transpower to evaluate non-transmission options as part of the assessment of alternatives to transmission investments. Non transmission options include the use of large (market) generators, large industrial loads and demand side participation (DSP) to manage peak demand, which can drive the need for transmission investment. DSP also includes the use of smaller distributed generation.

Part F of the *Electricity Governance Rules* enables Transpower, as the owner of New Zealand's transmission network, to obtain regulatory approval to recover the costs of contracting for non-transmission solutions to address reliability needs. Under the *Rules*, Transpower has to demonstrate that any non-transmission alternatives considered are technically feasible and reasonably practicable, likely to proceed, expected to provide similar benefits, and expected to enable the deferment of the proposed investment by at least one year. A New Zealand Government Policy Statement of October 2006 states further that security of supply must be able to be maintained if the non-transmission alternative is delayed or does not proceed.

As in many jurisdictions worldwide, the lack of significant transmission investment for many years, coupled with strong demand growth and the lead time of transmission projects has led to many investments across the New Zealand transmission network becoming urgent. There is uncertainty about the time required to plan, obtain regulatory approval, obtain the necessary designations, consents, easements and

property, and to build and commission new transmission assets. Transpower is therefore developing the Grid Support Contract product to enable it to evaluate, gain regulatory approval for, and contract with, non-transmission alternatives where they provide a reliable and economic means of supporting the transmission network.

Transpower has concluded that the most appropriate model for the Grid Support Contract would include the following key components.

- Contracting rather than ownership, ie Transpower would contract for services rather than own generation or demand-side assets.
- Transpower as the contract counterparty in its capacity as grid owner, rather than as system operator.
- Consideration of all forms of non-transmission alternatives, including generation and demand-side, and aggregated and distributed resources.
- Clear qualification criteria. These would define a set of minimum criteria, including reliability and availability, that submitters must meet as a prerequisite to qualify as an acceptable non-transmission alternative.
- Competitive acquisition through a request for proposals (RFP) process, to elicit a range of eligible proposals.
- Standard contracts as a basis for bilateral negotiation following RFP response.
- Where one (or more) of the proposals for non-transmission alternatives forms part of a grid investment proposal, the commercial terms and conditions will be finalised – conditional on Electricity Commission approval – prior to application under a formal Grid Upgrade Plan.

Transpower has experience in the responsiveness and reliability of market generators and large industrial loads, but does not have the same level of experience in the use of DSP. Therefore, the Grid Support Contract is being developed with the benefit of experience gained by Transpower in a large-scale DSP trial. The objective of the trial is to find out whether DSP can be reliably used to deliver a cost effective solution to assist in transmission investments.

The DSP trial is being run on a real dollars for real megawatts basis to test the commercial realities of a grid Support Contract. The trial is testing DSP in the Upper South Island in two stages:

- a pilot DSP trial during winter 2007³³; and
- a substantive DSP trial during winter 2008.

³³ A detailed case study of the 2007 pilot DSP trial carried out by Transpower is included in the first report from Task XV: Crossley, D.J. (2008a). *Op. cit.*

2.5 SOUTH AFRICA³⁴

2.5.1 DSM in South Africa

At present Eskom, the vertically integrated electricity utility in South Africa, has zero generation reserve capacity. South Africa is also experiencing growth rates in electricity consumption of up to 5% in certain areas. Eskom has therefore embarked on a huge DSM drive, managed by a national DSM department based in Johannesburg.

The focus of Eskom's DSM activities is to reduce load everywhere and throughout the day and night. Regional targets have recently been incorporated in the regional performance measurements of the six Eskom Distribution regions. There is an Energy Services Manager in each region who is tasked with achieving these targets.

Eskom has two main initiatives in the residential market:

- swapping incandescent light bulbs for compact fluorescent lamps;
- installation of water heating load control systems.

In addition to Eskom, there are also many municipalities in South Africa which reticulate and sell electricity mainly in urban areas. A large portion of the Eskom DSM drive takes place in residential areas within urban municipal service territories. This complicates the process as the customers are not direct Eskom customers. Municipalities are not always willing to take part in this initiative, probably because they fear a loss of income.

2.5.2 Processes for Acquiring DSM Resources

Eskom provides capital for municipalities to install water heating load control systems and then binds them contractually to reduce load during peak times. Private Energy Services Companies (ESCOs) have been established with the help of Eskom to assist municipalities in installing, operating and maintaining these control systems.

Eskom Transmission and Eskom Distribution are ring-fenced and a wholesale time of use electricity tariff is charged by Eskom Transmission for energy sold to the Distribution business. Eskom Distribution in turn charges most of its large customers a time of use tariff called Megaflex which has the same peak, standard and off peak periods as the wholesale tariff. In the winter months of June, July and August the rates are higher because this is when the peak loads occur.

Eskom has also recently introduced subsidies for the installation of solar water heaters and subsidies for replacing motors with more efficient ones.

DSM project evaluation committees have been set up in the six Eskom Distribution regions to evaluate any project proposals to save 1MW or less. If a project is approved, Eskom will provide the capital for the project. All approved projects undergo a metering and verification process to ensure that the forecast savings are actually achieved.

³⁴ This section has been developed from material provided by Eskom.

2.6 SPAIN

2.6.1 DSM in Spain

In Spain, DSM is mainly used at the transmission network level to relieve network constraints and to provide network operational services to the system operator. DSM to defer network augmentations by targeting specific network elements has so far not been used in Spain.

The main opportunity for network-driven DSM in Spain is through the interruptibility program offered by the transmission system operator, Red Eléctrica de España (REE). Under this program, end-use customers obtain a discount for partial interruption of load during periods called by REE.

Eligible customers that are directly connected to the transmission network may also obtain a discount on their network access tariff for operating their reactive compensation equipment when requested by the system operator.

Currently, end-use customers are able to offer load reductions into the market for solving network constraints in real time. However the participation rate is very low. Eligible customers also have the option to provide voltage control services to the system operator. Customer participation in other ancillary services markets such as the Secondary Regulation Market and the Deviation Management Market are currently under evaluation.

2.6.2 Processes for Acquiring DSM Resources

In Spain, processes for evaluating, acquiring and implementing DSM resources to provide support for electricity networks have so far been implemented only by REE, as the transmission network system operator. These processes comprise market-based programs that provide financial incentives to large end-use customers who provide DSM resources to the system operator.

2.6.3 Case Study: Red Eléctrica de España Interruptibility Program

Red Eléctrica de España has established a program of load interruption contracts under which it may call for loads to be interrupted to cover operational shortfalls in either network or generation capacity³⁵. Currently there are about 2600 MW of interruptible load registered in the REE interruptibility program.

The load interruption contract is an agreement through which large customers receive a discount on their electricity bills in return for being available to reduce their consumption on request from the system operator. REE is responsible for issuing, controlling and supervising all interruption orders. Customers participating in the interruptibility program must submit to REE monthly schedules for hourly energy demand and maintenance planning.

³⁵ A detailed case study of the REE interruptibility program is included in the first report from Task XV: Crossley, D.J. (2008a). *Op. cit.*

The requirements for end-users to participate in the interruptibility program are as follows:

- the interruptible load must be supplied at high voltage under a general tariff;
- the interruptible load offered must be larger than 5MW (in some cases, smaller loads may be accepted);
- the customer site must have adequate facilities to measure the size and duration of any load reductions³⁶.

Table 2.1 shows the four types of interruption options available in the REE interruptibility program.

Table 2.1 Options in the Red Eléctrica de España Interruptibility Program		
Interruption Type	Maximum Duration of Interruption	Advance Notice
A	12 hours	16 hours
B	6 hours	6 hours
C	3 hours	1 hour
D	45 minutes	5 minutes

The maximum duration of interruption for types A and B is divided into three periods with different load reduction requirements:

P_{maxi}: Maximum load demanded will be equal to or lower than the maximum load established in the interruption program.

P_{50%}: Maximum load demanded will be equal to or lower than $P_{maxi} + 0.5(P_c - P_{maxi})$, where P_c is the contracted power for the interruption period.

P_c: Maximum load demanded will not be limited by the interruption order.

Only customers with a specific high voltage tariff contract or with an Hourly Power Tariff contract can participate in a load interruption contract. They include iron, steel and other metal industries, cement and chemical industries, airports, etc. Currently, the Spanish electricity industry regulator and the system operator (REE) are working on developing the interruptibility program to modify contract conditions so new consumers can be included, particularly in the eastern and southern coastal areas of Spain, where summer peak has increased considerably in recent years.

³⁶ Spanish Ministerial Decree, 12 January 1995.

2.7 UNITED STATES

2.7.1 DSM in the United States

From the mid-1980s to the mid-1990s, DSM became a major business in the United States electricity industry. State-based regulators imposed stringent requirements on electricity utilities to implement broadly-targeted, environmentally-driven DSM programs. DSM was seen as being more cost-efficient than supply-side resources and it also had environmental and social benefits.

Many US utilities were required by regulators to undertake “integrated resource planning” (aka “least cost planning”) in which supply-side and demand-side options were compared to determine which were the most cost-effective from the societal perspective. Consequently, electricity planning in the United States became a highly legalistic process with armies of lawyers arguing about what should and should not be taken into account in the cost benefit analyses of supply-side and demand-side options.

From the mid-1990s, electricity regulators in the United States began to turn their attention away from DSM and towards electricity market reform. Without the regulatory imperative, US utilities very quickly dropped or substantially reduced implementation of broadly-targeted, environmentally-driven DSM programs. For example, spending on energy efficiency DSM programs³⁷ by electricity utilities fell by 50 percent from 1994 to 1997³⁸. Consequently, policymakers in many US states that adopted electricity industry restructuring also created public benefits funding mechanisms to help ensure the continued implementation of broadly-targeted, environmentally-driven DSM programs.

DSM targeted to relieving network constraints has been implemented in the United States since the mid-1980s. However, until the late 1990s, only a few specifically network-driven DSM programs had been developed. More recently, as problems with ageing network infrastructure become more apparent, increasing numbers of network-driven DSM programs are being implemented. In particular, United States utilities have implemented load management programs that can be used to relieve network constraints as well as to respond to generation capacity shortfalls. These include time-based pricing (primarily TOU), interruptible rates, curtailment programs, and direct load control programs. The most active of these have been direct load control programs, particularly of customer HVAC and residential hot water systems.

With the advent of open access to transmission networks and the development of competitive wholesale electricity markets in many parts of the United States, there has been increasing use of DSM measures to provide short-term network operational services. There is a rapid evolution underway from traditional load management to demand response concepts and programs, and the capabilities that new load control technologies provide to utilities, system operators, customers and other actors in

³⁷ As opposed to other types of DSM programs.

³⁸ Kushler, M. and York, D. (2004). State public benefits policies for energy efficiency: What have we learned? *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*, pp 5-156 to 5-167.

electricity markets³⁹. Today, some Independent System Operators conduct demand response programs through which demand-side resources can be offered to the market. This is typically done through a market participant, e.g., a utility, demand response aggregator, or competitive retail supplier⁴⁰.

To date, there has not been much use of DSM programs to defer network augmentations in the United States. One pilot project was the Model Energy Communities Program (Delta Project) implemented by the Pacific Gas and Electric Company (PG&E) from 1991 to 1993⁴¹. The Delta Project successfully deferred capital investment in a substation for at least two years, albeit for a shorter deferral period than originally projected. More recently, some utilities, particularly the Bonneville Power Administration, are again starting to use DSM to defer network augmentations.

2.7.2 Processes for Acquiring DSM Resources

In the United States, electricity businesses have used a range of processes for evaluating, acquiring and implementing DSM resources to provide support for electricity networks. The processes used in a particular network-driven DSM project depend on the purpose of the project, ie what network-related outcome it is intended to achieve. In the United States, network-driven DSM has generally been used for four purposes:

- relieving network constraints in specific geographical locations;
- reducing peak load across a service territory;
- maintaining and improving overall system reliability across a network region;
- providing ancillary services.

The regulatory treatment of network-driven DSM projects in the United States varies, depending on the (usually State-based) regulator involved. In general, if a DSM option can be shown to have a lower total resource cost than an equivalent network augmentation option, regulators will usually allow the electricity business to include the cost of the demand-side option in the rate base.

In addition, in February 2007, FERC made a ruling (Order No 890) that changed the *Pro Forma Open Access Transmission Tariff* to put demand-side resources, for the first time, on an equal footing with other resources in directly contributing to the reliability and efficient operation and expansion of the United States electricity transmission system⁴². The changes provide that demand-side resources, distributed generation, and other non-generation resources capable of providing the service may provide the ancillary services Reactive Supply and Voltage Control, Regulation and Frequency

³⁹ Scarpelli, P. (2005). *Op cit*.

⁴⁰ Detailed case studies of some of these ISO demand response programs are included in the first report from Task XV: Crossley, D.J. (2008a). *Op cit*.

⁴¹ Kushler, M., York, D. and Vine, E. (2005). Energy-efficiency measures alleviate T&D constraints. *Transmission & Distribution World*, 1 April. Available at: www.tdworld.com/mag/power_energyefficiency_measures_alleviate/index.html

⁴² Federal Energy Regulatory Commission (2007). *February 15, 2007 Open Commission Meeting: Statement of Commissioner Jon Wellinghoff*. Washington DC, FERC.

Response, Energy Imbalances, Spinning Reserves, Supplemental Reserves, and Generator Imbalances.

2.7.3 Relieving Local Constraints

Some network-driven DSM projects in the United States are directed to relieving network constraints in specific geographical locations. Typically, the processes used by network operators to acquire DSM resources in these projects involve first analysing the load profile on the affected network element (eg a particular line or substation) to determine the time(s) at which the constraint occurs and the loads contributing to the constraint. Tailored DSM programs are then developed to target reductions in specific loads at the time(s) when the constraint occurs.

For example, in the Olympic Peninsula project in the Pacific Northwest⁴³, the transmission system operator, Bonneville Power Authority (BPA), is carrying out several pilot projects to determine whether it is possible to use non-wire solutions to defer a transmission line construction project. The DSM measures employed include: direct load control, demand response, voluntary load curtailments, networked distributed generation and energy efficiency. One particularly interesting DSM measure is the use of Grid-Friendly™ appliances which sense frequency disturbances in the electricity network and reduce load to act as spinning reserve - no communications technology is required beyond the network itself. The demand response, voluntary load curtailment and distributed generation pilot projects will be aggregated by Pacific Northwest National Laboratory into a demonstration of how a future electricity network might function. This demonstration is part of a project of the United States Department of Energy known as GridWise.

BPA, as a transmission network operator, acquires DSM resources mainly by providing incentives to local distribution network operators. The distributors then contact local end-users and negotiate arrangements for the customers to reduce load at relevant times and locations. These arrangements include payment of incentives to customer who participate in DSM programs.

2.7.4 Reducing Peak Loads Across a Service Territory

In many areas of the United States, where electricity industry restructuring has not yet taken place, traditional vertically integrated electricity utilities hold franchises to carry out electricity generation, transmission, distribution and retailing within specified service territories. Many utilities are now increasingly using DSM to provide network support by reducing peak loads across their service territories.

For example, the Long Island Power Authority (LIPA) has developed the LIPAEdge program⁴⁴ to use central control of residential and small commercial air-conditioning thermostats to achieve peak load reduction. The system operator interfaces with the resource through a web-based system. Two-way pagers are used to transmit a

⁴³ A detailed case study of the Olympic Peninsula project is included in the first report from Task XV: Crossley, D.J. (2008a). *Op cit.*

⁴⁴ A detailed case study of the LIPAEdge program is included in the first report from Task XV: Crossley, D.J. (2008a). *Op. cit.*

curtailment order to 20,000 thermostats and to receive acknowledgment and monitoring information. The thermostats take immediate action or adjust their schedules for future action, depending on what the system operator ordered. The command is received and acted upon by all loads, providing full response within about 90 seconds. This is far faster than generator response, which typically requires a 10-minute ramp time.

LIPA acquired the DSM resource by communicating directly with end-use customers. The LIPAedge program was originally made available to Residential Central Air Conditioning customers and Small Business customers. However, the program is now closed to new participants because LIPA has enough air conditioner load under direct load control. Customers who signed up to the LIPAedge program received a thermostat and installation free of charge. Customers also received a one-time bonus payment of USD 25 (residential customers) or USD 50 (small commercial customers). During 2001, LIPAedge customers were offered an opportunity to earn a USD 20 cash reward for each LIPA customer referral they provided who installed a LIPAedge thermostat.

2.7.5 Maintaining and Improving Overall System Reliability

The restructuring of the electricity industry in some areas of the United States has led to the establishment of independent system operators (ISOs) and regional transmission operators (RTOs) responsible for the operation of electricity transmission systems and, in some cases, also charged with the operation of wholesale electricity markets in geographical regions. These organisations are now routinely implementing market-based processes to acquire DSM resources to maintain and improve overall system reliability at the regional level.

For example, under the demand response programs established by the New England Independent System Operator (ISO-NE)⁴⁵, commercial and industrial electricity users can receive incentive payments if they reduce their electricity consumption or operate their own electricity generation facilities in response to high real-time prices in the wholesale electricity market or when the reliability of the region's electricity network is stressed. ISO-NE informs customers when a demand response is required. An advanced electricity meter capable of recording energy consumption every 5 to 15 minutes is required to participate in most of the ISO-NE demand response programs. A range of demand response programs is available to customers, including programs where the customer's load is under direct load control by ISO-NE and programs where the customer is free to choose whether or not to react to a call for a demand response.

ISO-NE acquired the DSM resource by using third parties to enrol end-use customers in the various demand response programs on offer. Customers who wish to participate in a demand response program can do so through an Enrolling Participant. Enrolling Participants can be a local distribution company, Demand Response Provider or a competitive electricity retailer. Demand Response Providers are companies that provide technology and services to help customers participate in the demand response programs. Enrolling Participants are responsible for helping customers identify the demand response program that is most suitable for their operation and enrolling them

⁴⁵ A detailed case study of the ISO-NE demand response programs is included in the first report from Task XV: Crossley, D. J. (2008a). *Op cit*.

with ISO New England. ISO New England makes incentive payments to Enrolling Participants who then share the incentives with their customers. Enrolling Participants may also offer other incentives and services.

Similar market-driven demand response programs are operated by the New York Independent System Operator and the PJM Interconnection.

2.7.6 Providing Ancillary Services

Historically, control area operators in the United States have relied on generation resources to provide ancillary services. Recently, however, technology and other improvements have enabled the use of certain demand-side resources to provide a range of ancillary services, such as spinning reserve and regulation to adjust any imbalances between load and generation.

The North American Electric Reliability Council (NERC) prescribes two standards that control areas must meet in order to maintain reliability, namely the Control Performance Standard (CPS) and the Disturbance Control Standard (DCS). NERC does not have any restrictions on the type or size of reserves that must be maintained in order to meet these standards. Instead, it leaves these requirements up to the Regional Reliability Councils. The NERC position, together with the February 2007 ruling by FERC (Order No 890), cleared the way for demand-side resources, distributed generation, and other non-generation resources to provide ancillary services.

In providing ancillary services, demand-side resources function similarly to a generator except that, rather than changing the level of generation output to the grid, the demand resource changes its level of consumption from the grid⁴⁶. For example, to provide spinning reserve, the demand resource must be able to curtail a pre-assigned amount of load within (say) a 10 minute window of notification, and be able to maintain the load curtailment for up to about 30 minutes (although most spinning reserve events are completed in less than 15 minutes). Once the load is restored, it must be immediately readied for curtailment again in case another system contingency occurs.

Although it may seem likely that individual demand-side resources will have a high failure rate to curtail load on short notice, the aggregation of several smaller resources into one larger resource makes it probabilistic that the assigned response will be achieved. This characteristic potentially makes demand-side resources more reliable than conventional generation resources, where the failure of one generator can cause significant loss of ancillary services.

Many ISOs and RTOs in the United States are now developing processes to acquire demand-side resources to provide ancillary services⁴⁷. Typically, this involves modifying the remuneration arrangements in ancillary services markets to cater for the particular characteristics of demand-side resources.

⁴⁶ The PJM Interconnection (2004). *Demand Response as Ancillary Services Whitepaper*. Version 1. Available at: http://www.energetics.com/madri/pdfs/whitepaper_121004.pdf

⁴⁷ In May 2006, the PJM Interconnection opened its synchronized reserves and regulation markets to demand response providers.

For example, the merit order price in a spinning reserve market is typically determined by summing a generation unit's offer price, opportunity cost, plus any energy consumed while providing the service (applicable to condensers which must consume energy to run the generator as a motor)⁴⁸. For a demand-side resource, the costs incurred in shutting down (lost production etc) would be expected to be included in the offer price. However, since no cost is incurred until the resource shuts down, there would be no further cost component. Since demand resources that are assigned to provide ancillary services would not be able to participate in other markets for load reductions, it may be appropriate to include in the pricing regime for demand-side resources compensation for the cost of any such lost opportunity.

The Electric Reliability Council of Texas (ERCOT), allows load to supply up to half the spinning and non-spinning reserve. At present, load supplies 1100 MW of spinning reserve and 1200 MW of non-spinning reserve (the full amount allowed). Table 2.2 summarises the conditions under which the ERCOT Load Acting as a Resource (LAAR) program operates⁴⁹.

Table 2.2 ERCOT Load Acting as a Resource (LAAR) Program	
Qualified Loads	Qualified loads must have telemetry on each breaker. As of March 2006, there was 1800 MW of load registered for the ERCOT ancillary services market, including refineries, gas compressors, pumps, plastics manufacturers. ERCOT's total resources comprised 69,000 MW.
Timing	When dispatched as part of the ancillary services market. Responsive Reserve service load must be controlled by under-frequency relays and be able to be manually interrupted in 10 minutes. Non-spinning reserve must be interruptible within 30 minutes.
Metering	Qualified loads must have either an Interval Data Recorder or ERCOT polled settlement, plus telemetry on each breaker. For multiple loads less than 10 MW, calculated MW is allowed. LAAR response is included in the Qualified Scheduling Entity's Schedule Control Error (SCE).
Payment	The value of the LAAR reduction is equal to that of an increase in generation by a generating plant. Any provider of operating reserves selected through an ERCOT ancillary services market is eligible for a capacity payment, regardless of whether the demand side resource is actually curtailed.
Duration	As bid and dispatched.

⁴⁸ The PJM Interconnection (2004). *Op. cit.*

⁴⁹ Kueck, J. and Kirby, B. (2006). *Spinning Reserve from Large Responsive Load*. Presentation to US Department of Energy Visualization and Controls Program Peer Review.

3. BEST PRACTICES IN EVALUATING AND ACQUIRING NETWORK-DRIVEN DSM RESOURCES

Activity 4-2 of Subtask 4 develops ‘best practice’ principles, procedures and methodologies for the evaluation and acquisition of network-driven DSM resources⁵⁰. This section of the report summarises the results from Activity 4-2.

3.1 STAGES IN ACQUIRING DSM RESOURCES

The survey in Section 2 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. These processes vary depending on:

- the purpose for which the DSM resources were being acquired;
- commercial practices within the electricity network business acquiring the resources; and
- the applicable regulatory framework.

Given the variation among these factors, it is not possible to identify a single “best practice” for acquiring DSM resources to provide support for electricity networks. However, it is possible to identify the stages involved in a good DSM resource acquisition process. These stages comprise:

- 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.

3.2 ASSESSING THE NEED FOR DSM RESOURCES

The first stage in using DSM resources to provide support for electricity networks is to assess the need for the resources. The method used to carry out this needs assessment depends on the specific purpose for which the resources are required.

Projects that aim to use DSM resources to relieve specific network constraints (including projects aimed at deferring network augmentations) require information about the timing and geographical locations of those constraints that are likely to become binding over the lifetime of the project. This information can be obtained by analysing network element load profiles and modelling the likely impacts of expected future load growth.

⁵⁰ Energy Futures Australia (2004). *Prospectus: Research Project on Network-driven DSM*. Hornsby Heights, NSW Australia, EFA.

A previous report⁵¹ identified two methods developed in France for carrying out this type of analysis. The first method is based on a local micro-economic analysis of the network. This approach offers good economic efficiency, but requires complex studies and is suitable for only a limited number of network situations. The second method is based on a macro-economic analysis of network/consumption characteristics covering a defined geographical area. This geostatistical type of analysis can be a powerful tool but the geographical localities in which DSM measures will be implemented must be properly defined. The economic efficiency of the analysis will be reduced if some of the DSM measures are applied to parts of the network which are not subject to constraints.

Using DSM resources to provide network operational and ancillary services requires information about the precise nature and timing of the services to be provided. Typically, the demand-side resources are replacing existing supply-side resources and, in these cases, such information is often readily available from the system operator.

3.3 IDENTIFYING AND EVALUATING AVAILABLE DSM RESOURCES

In making a decision to use DSM resources to provide support for electricity networks, detailed information about the available DSM resources is crucial. The type of information required again depends on the specific purpose for which the resources are required.

Projects that aim to relieve specific network constraints require detailed information on the quantity and geographical location of DSM resources, and their availability over time. Such information is usually not readily available and considerable effort may be required to obtain it. Some information about available DSM resources may be obtained from analyses of customer billing records to identify loads that may be interruptible and/or curtailable. However, detailed information is best obtained from on-the-ground customer surveys.

In the Binda Bigga DSM Project in Australia⁵², a survey of residents in the communities of Binda and Bigga was carried out to identify households that had electrical room heaters and cooking stoves. Use of these appliances was causing unacceptable voltage fluctuations on a local feeder during winter evenings. The household survey identified the quantity of load that could be removed from the feeder on winter evenings by replacing the electrical appliances with gas ones.

The following information is required about a DSM resource that is used to provide network operational services:

- the quantity of the resource;
- the availability of the resource over time; and
- the extent to which the resource can be relied on (ie its “firmness”).

⁵¹ Crossley, D. J. (2008b) *Op. cit.*

⁵² A detailed case study of the Binda Bigga DSM Project is included in the first report from Task XV: Crossley, D. J. (2008a). *Op cit.*

Most DSM resources used to provide network operational services are acquired through open market transactions. The required information about a particular DSM resource is usually made available by the resource provider as part of their market bid.

3.4 CONTACTING POTENTIAL PROVIDERS OF DSM RESOURCES

Once a decision has been made to use DSM resources to provide support for electricity networks, the first step in actually acquiring a resource is to contact potential resource providers. There are several methods that can be used to do this.

One method often used in projects that aim to relieve specific network constraints is to publicly release detailed information about the constraints and the DSM resources required (ie the results of the needs assessment). Potential DSM resource providers are then invited to submit proposals either in response to a detailed Request for Proposals or more generally in response to the publicly released information. In Australia, as noted in Sections 2.1.3 (page 5) and 2.1.4 (page 6), national and State regulatory regimes specify in detail how this must be done.

Another method for contacting potential providers of DSM resources is to actively canvass individual providers. Projects that carry out on-the-ground surveys of potential providers often also encourage identified providers to consider providing DSM resources at the same time as, or soon after, the survey is carried out. Alternatively, known customers with loads that may be interruptible or curtailable can be approached directly.

A third method for contacting potential providers is to establish an open market for DSM resources. Typically, this method is used for DSM resources that provide network operational services. In the United States, as noted in Section 2.7.5 (page 33), most Independent System Operators and Regional Transmission Operators have established markets for ancillary services that now accept bid from providers of DSM resources. New Zealand has an ancillary services market that accepts bids involving interruptible loads and distributed generation (see Section 2.4.2.2, page 24). The Spanish transmission system operator has also established a market for interruptible loads to provide network operational services (see Section 2.6.3, page 28).

Finally, large numbers of potential DSM resource providers can be contacted by building into tariff schedules signals for end-use customers to reduce loads at particular times. The Tempo tariff in France is an example of a critical peak pricing mechanism that can be used to markedly increase electricity prices during times when the transmission system is constrained (see Section 2.2.4, page 19). Time of use and critical peak pricing is now being used routinely by many electricity utilities in the United States.

3.5 NEGOTIATING THE PROVISION OF DSM RESOURCES

Once a network operator has identified a suitable DSM resource and the resource provider has agreed to provide it, the detailed terms for the transaction must be negotiated and settled. The details of these terms are highly dependent on the nature of the resource and the specific purpose for which the resource is required.

For DSM resources that are required only intermittently, typically two types of payments are made: an availability payment for the capacity of load reduction or additional generation made available (measured in MW); and a dispatch payment for the quantity of load reduction or additional generation actually provided in response to a call (measured in MWh). These payments may be negotiated on a case by case basis, or the network operator can specify a schedule of payments through a standard offer (see Section 2.1.4, page 6). For large loads or generators, contracts with the network operator may include highly specific conditions about the availability of the resource, prior notice of calls, discretion in responding to calls, etc.

Terms for DSM resources that are provided permanently vary widely, depending on the particular circumstances. For example, in the Bind Bigga DSM Project referred to in Section 3.3 (page 37), the provided householders with discounted gas room heaters and cooking stoves (a maximum of two appliances per household); free installation of gas appliances and gas bottles, and removal of electrical appliances for metal recycling; and gas credits of AUD 170 per appliance – equivalent to free gas for a year.

3.6 ACQUIRING AND IMPLEMENTING DSM RESOURCES

Once the terms for providing a DSM resource have been agreed and settled, the network operator has to actually acquire and implement the resource. The methods for doing this are highly dependent on the nature of the resource.

For DSM resources that are provided permanently, acquisition and implementation is usually a once-only operation, eg the replacement of electrical appliances with gas ones in the Binda Bigga DSM Project.

For DSM resources that are required only intermittently, the network operator must have some method for signalling when the resource is required and the provider must have a method for providing the resource in response to the call.

The provision of the resource may be done automatically, as in the LIPAedge program that uses central control of residential and small commercial air-conditioning thermostats to achieve peak load reduction (see Section 2.7.4, page 32).

In other cases, particularly with large loads, some prior notice from the network operator may be required, and the resource provider may have some discretion specified in their contract with the network operator over whether or not to respond to the call.

Finally, in the case of time varying pricing, it is entirely up to the end-use customer to decide whether or not to respond to the price signal. In this case responses by individual end-users have a much lower level of “firmness” than other types of DSM resource. However, because this type of DSM resource is provided by a large number of individual end-users, the reliability of the aggregate load reduction may be relatively high. With experience over time, it may be possible for the network operator to forecast reasonably accurately the amount of aggregate load reduction that will be achieved in each call.

4. CONCLUSION

The 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.