Guidebook on Analytical Methods and Processes for Integrated Planning

IEA DSM Implementing Agreement
A Report of Task IV — Development Of Improved Methods For Integrating Demand-Side Options Into Resource Planning (Subtask IV/3)

Final Report - October 1996

Guidebook on Analytical Methods and Processes for Integrated Planning

IEA DSM Implementing Agreement
A Report of Task IV — Development Of Improved Methods For Integrating Demand-Side Options Into Resource Planning (Subtask IV/3)

Final Report - October 1996

Participation and Support from:
AUSTRALIA (AUSTRALIAN CONSORTIUM OF ELECTRIC UTILITIES AND GOVERNMENT AGENCIES)
AUSTRIA (AAPU)
DENMARK (DANISH ENERGY AGENCY AND THE ZEALAND CO-OPERATION)
FINLAND (VTT ENERGY)
FRANCE (ADEME AND EDF)
ITALY (ENEL)
KOREA (KOREA ELECTRIC POWER CORP.)
NETHERLANDS (SEP)
SPAIN (UNION FENOSA)
SWEDEN (NUTEK)
SWITZERLAND (BKW)
UNITED STATES (DOE)
Operating Agent:
ELECTRIC POWER RESEARCH INSTITUTE (EPRI)
Consultant:
SRC INTERNATIONAL INC.

CONTENTS

FOREWORD

Overview of the IEA and the Demand-Side Management Agreement

International Energy Agency (IEA)

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD) which carries out a comprehensive program of energy cooperation among its 23 member countries. The European Commission also participates in the work of the Agency.

The policy goals of the IEA include diversity, efficiency and flexibility within the energy sector, the ability to respond promptly and flexibly to energy emergencies, the environmentally sustainable provision and use of energy, more environmentally-acceptable energy sources, improved energy efficiency, research, development and market deployment of new and improved energy technologies, and cooperation among all energy market participants.

These goals are addressed in part through a program of international collaboration in the research, development and demonstration of new energy technologies under the framework of over 40 Implementing Agreements. The IEA's R&D activities are headed by the Committee on Energy Research and Technology (CERT) which is supported by a small Secretariat staff in Paris. In addition, four working parties (in Conservation, Fossil Fuels, Renewable Energy and Fusion) are charged with monitoring the various collaborative agreements, identifying new areas for cooperation and advising the CERT on policy matters.

IEA Demand-Side Management Program

The Demand-Side Management Program is a new collaboration with fifteen IEA member countries working to clarify and promote opportunities for demand-side management (DSM).

The members are:

- Australia
- Austria
- Denmark
- European Commission
- Finland
- France
- Italy
- Japan
- Korea
- Netherlands

- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

Six projects or "Tasks" have been undertaken since the beginning of the Demand-Side Management program. The overall program is monitored by an Executive Committee consisting of representatives from each of the member countries. The leadership and management of the individual Tasks are the responsibility of Operating Agents. These Tasks and their respective Operating Agents are:

- Task I — International Data Base on Demand-Side Management Technologies and Programs - The Netherlands
- Task II — Communications Technologies for Demand-Side Management - United Kingdom
- Task III — Cooperative Procurement of Innovative Technologies for Demand-Side Management - Sweden
- Task IV — Development of Improved Methods for Integrating Demand Side Management into Resource Planning - United States
- Task V — Investigation of Techniques for Implementation of Demand-Side Management Technology in the Marketplace - Spain
- Task VI — Mechanism for Promoting DSM and Energy Efficiency in New Business Environments - Australia)

Task IV Objectives and Workplan

This task focuses on assisting utilities and governments in participants' countries to consider demand-side options on an equal basis as alternatives or additions to conventional and non-conventional supply-side resources. The goal is to have a common exchange of experiences, as well as a common learning process among Annex members. Task IV is divided into five subtasks, these include:

- Subtask IV/1 — Review and documentation of utility and market structures, and institutional contexts of agency member countries
- Subtask IV/2 — Inventory of available methods and processes for assessing the benefits, costs and impacts of demand-side options
- Subtask IV/3 — Preparation of guidebook on analytical methodologies
- Subtask IV/4 — Development and recommendations of procedures for implementing improved analytical methods and processes

- Subtask IV/5 — Development of guidelines for adoption and application of processes and methods from one country to another

A further description of Annex IV is provided in the Annual Report of the IEA DSM Research Program. There are 12 countries participating in Subtasks IV/1 through 5 of Task IV

DSM and Energy Efficiency for Changing Electricity Business Environments

In addition to the original scope of work (Subtasks IV/1 through 5), the Executive Committee of the IEA DSM Program has decided to undertake new work to investigate available and new mechanisms to promote DSM and energy efficiency in new business environments. The objectives of this work include:

- To present description of and critically review mechanisms which have been used, or proposed for use, to incorporate DSM and energy efficiency into restructured electricity industries

- To present a process model for policymakers to use in developing and evaluating potential new mechanisms for incorporation of DSM in restructured ESIs

- To present examples of potential new mechanisms, and their evaluation, as formulated by a panel of policymakers from the UK, Norway, US and other countries with restructuring experience to share

- To provide an opportunity to apply the process model in an on-going forum and stimulate dialogue and an exchange of experience and results

This work is undertaken in two phases of which Phase I is part of Task IV. Phase II is scheduled to be undertaken by a new Task VI. Phase I has been organized into the following three subtasks:

- Subtask IV/6 — Review of Existing Mechanisms. The objective of this Subtask is to document and review existing mechanisms which have been used, or proposed for use, in incorporating DSM and energy efficiency into restructured electricity industries

- Subtask IV/7 — Preliminary Development and Evaluation of New Mechanisms. This Subtask will assess the factors identified in Subtask IV/6 as contributing to the comparative effectiveness of the various mechanisms.

- Subtask IV/8 — Communication and Dissemination of Results. This Subtask will arrange a series of regional workshops addressing DSM and energy efficiency in restructured markets. Other communications and dissemination strategies will also be included

This report is the first product from the new work.

Available Products from Task IV

Available products from Task IV include:

The report characterizes energy markets, utility industry structures and regulatory types influencing the role and type of DSM and energy services

- **Subtask IV/1 report — "Review and Documentation of Utility Structure and Characteristics of Participating Countries."**[a] This report establishes a framework for discussing and understanding the role of DSM and energy services programs. Such an understanding is necessary in order to perform a meaningful analysis and transfer of results. The report characterizes energy markets, utility industry structures and regulatory types to identify the factors influencing the role and type of DSM and energy services programs in different situations. Four generic situations are established to discuss this. the report also includes a glossary of integrated planning terms and a country summary of utility structure and characteristics using the framework established.

A survey of more than 40 different computer tools and the approach taken to integrated planning in 15 different countries

- **Subtask IV/2 report — "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options."** The objective of this report is to compile information on the methods, techniques, and models being used in different countries by utilities and governments to address various issues related to the planning, analysis, and forecasting of the benefits, cost and impacts of DSM options. The report includes a survey of more than 40 different tools used for performing the elements of integrated planning, and a survey of the approach taken to integrated planning in 15 different countries.

Discussion of how the approach to integrated planning varies between utility-market situations

- **Subtask IV/3 Report — "Guidebook on Analytical Methods and Processes for Integrated Planning."** This report reviews the key elements involved in integrated planning and describes alternative approaches to demand-side planning and integration of demand-side options in utility resource plans and government policy. The report discusses how approaches might vary with supply characteristics, market conditions, regulatory situations, pricing and tariff structures, government policies, and institutional contexts. The report applies a framework for characterization, and shows how the approach to integrated planning varies between a set of generic situations. As part of the review, case studies with detailed descriptions of alternative approaches to integrated planning are included. Each case study is selected so that it describes an approach taken to integrated planning and focuses on how some unique aspects of the integrated planning process was solved (e.g., how to value flexibility).

[a] IEA DSM Program 1995

- **Subtask IV/4 Report — "Recommendations for Implementing Improved Analytical Methods and Processes for Integrated Planning."** This report discusses a series of analytical and policy issues for recommended procedures, analytical methods, and processes to improve the integration of demand-side options in utility resource planning. These recommendations are based on two workshops conducted in this project. The first workshop, conducted in Charleston, U.S.A., addressed analytical issues such as valuing the flexibility benefits of DSM, impacts of DSM on system reliability, estimating market penetration of DSM, and multi-fuel optimization. The second workshop, conducted in Copenhagen, Denmark, addressed the treatment of policy issues such as environmental policy objectives, cross-sectoral impacts, and impacts of power sector restructuring on integrated planning.

Recommendation of procedures, method and processes to integrate demand-side options into resource planning

- **Subtask IV/5 Report — "Guidelines for Transferring Methods and Processes for Integrated Planning."** This report reviews the application of processes and methods for assessing integrating planning options across the range of conditions in different countries, and develops a generic approach for transferring the methods and processes given different market conditions, supply characteristics, utility structure, regulatory environments, tariff structures, institutional context, and government policies. The report includes a definition of the factors influencing successful transferability and the key considerations in the transfer of methods and processes from one utility to another. Six case studies of successful transfer of methods/processes are included.

Generic approach for transferring planning methods and processes to new electricity business environments

- **Subtask IV/6 Report — "Review of Existing Mechanisms for Promoting DSM and Energy Efficiency in New Electricity Business Environments."** This report documents and reviews existing mechanisms for promoting DSM and energy efficiency in the new electricity business environments that result from unbundling the traditional electricity utility functions and exposing some of them to competition. The information was collected through extensive telephone and face-to-face interviews with key policy makers and leading decision makers in governments and electricity industry businesses. The survey was carried out in countries or regions that have implemented—or are considering implementing—specific mechanisms to promote DSM and energy efficiency in restructured electricity markets. The report also discusses and indicates key future issues and which mechanisms seem to work better than others in restructured power sectors.

Which mechanisms seem to work best in new electricity business environments?

- **Subtask IV/7 Report – "Preliminary Concepts for New Mechanisms for Promoting DSM and Energy Efficiency in New Electricity Business Environments."** This report identifies preliminary concepts for new mechanisms for promoting DSM and energy efficiency in restructured electricity markets. It is based on the results of two Experts Meetings and two Subtask Workshops. The report builds upon the work completed in the Subtask 6 of this project and has been designed to meet the immediate needs for information about the new mechanisms. It has been produced to maximize the synergies between the Task IV effort and the new Task VI to be initiated in early 1997.

Preliminary concepts for new mechanisms in restructured electricity markets

Acknowledgments

The information in this report is collected and reviewed in collaboration with Experts representing Australia (Western Power), Austria (Austrian Association of Power Utilities), Denmark (Danish Energy Agency and NVE), Finland (VTT Energy), France (ADEME and EDF), Italy (ENEL), Korea (Korea Electric Power Corp.), Netherlands (SEP), Spain (Union Fenosa), Sweden (NUTEK), Switzerland (BKW), and the United States (DoE and EPRI). Country Experts involved in producing this document include:

Name	**Organization**	**Country**
Randall Bowie	NUTEK	Sweden
Iben Spliid	Danish Energy Agency	Denmark
Francoise Garcia	ADEME	France
Anna Englaryd	NUTEK	Sweden
Jesus M. Martin Giraldo	Union Electrica Fenosa	Spain
Walter Grattieri	ENEL S.p.A	Italy
Craig Hosking	Western Power	Australia
Seppo Kärkkäinen	VTT Energy	Finland
Moon-Duk Kim	Korea Electric Power Corporation	Korea
Jean Eudes Montcomble	Electricite de France	France
Diane Pirkey	U.S. Department of Energy	USA
Alfred Reichl	Austrian Association of Power Utilities	Austria
Jens Rubæk	NVE	Denmark
Giancarlo Scorsoni	ENEL SpA/DPS	Italy
Fritz Spring	Bernische Kraftwerke AG	Switzerland
Jean Pierre Tabet	ADEME	France
Jan van den Berg	SEP	Netherlands

In addition, much of the information is collected through extensive interviews with leading policy and planning practitioners from the energy business industry and government in 15 different countries.

Editors for this report have been Dr. Grayson Heffner, EPRI, USA supported by SRC International Inc. (SRCI). Principal investigator from SRCI was Dr. Ståle Johansen, SRC International ApS, Copenhagen. Matthew Rose, Dilip Limaye and Craig McDonald, SRC International Inc., Philadelphia, USA were responsible for synthesis of Appendix A and B. The editors would like to thank all who contributed to this study through providing information and reviewing the text.

EXECUTIVE SUMMARY

Integrated planning for new business environments

Two key observation can be emphasized from reviewing information from many countries about the role and type of integrated planning[a] performed and the type of methods and tools available:

- Difference in role of integrated planning across utility-market situations — There are large differences and variations between utility market situations regarding the role and function filled by the integrated planning effort, i.e., why and who carries out the integrated planning effort
- Similarity in technical elements across utility-market situations — Many of the technical elements of integrated planning can be found across most utility-market situations. The relative emphasis of these elements in the integrated planning effort varies

Restructuring and privatization

Many countries have started separating out the ESI functions into individual businesses and exposing some of these businesses to competition. Typically, generation and retail supply are regarded as being open to competition, whereas the transmission and distribution 'wires' businesses are retained as natural monopolies. In several countries, another element of the industry restructuring involves the privatization of utility businesses where these are currently government-owned.

The role of the integrated planning clearly has historical reasons. There are large historical differences between countries as to how each country has organized its energy sector in terms of degree of utility industry franchise, integration, ownership and regulation. The various functions of the industry (namely, generation, transmission, distribution and retail supply) have usually been regarded as natural monopolies. Frequently, all of these functions are carried out within vertically integrated, monopolistic utilities.

As part of this report is described alternative approaches to demand-side planning and integration of demand-side options in utility resource plans and government policy. The report focuses on how approaches might vary with supply characteristics, market conditions, regulatory situations, pricing and tariff structures, government policies, and institutional contexts. The report also documents how some of the methods identified have been successfully applied in different situations[b] and summarizes how different analytic approaches have been incorporated into available models.

General Findings

The general framework for performing integrated planning is relatively consistent across utility-market situations. The variations are manifested in the elements included in the process which are emphasized to accommodate planning objectives.

The initial step in an integrated planning process is the need to establish planning objectives. Objectives must be grounded on the mission-goals of the utility and/or energy policy for the government entity. For example, if a publicly owned utility's integrated

[a] See Subtask IV/2 Report "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options"

[b] See Subtask IV/2 Report "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options" for a further documentation of how integrated planning has been implemented into different utility-market situations.

planning goal is to become a reliable low-cost provider, the range of analysis is geared towards this result. Such an analysis may include more societal perspectives when looking at economic results. If the utility then shifts to become more market oriented and commercial in its orientation, the criteria for evaluating resource options are likely to be shifted towards impacts on rates and assessment of risk as well as risk management strategies.

The need to incorporate flexibility as a criteria becomes increasingly important in more competitive business environments. Integrated planning in this situation may include: option pricing for energy, multiple decision points in identifying plant siting, designs and construction, and transmission and distribution offsets in constrained networks.[a]

Regardless of the utility-market situation, the robustness of the results must be examined through some form of sensitivity analysis. This will require an identification of the variables most sensitive to the resource decision, which in part is linked to the overall planning objectives.

The best indicator of likely DSM program adoption is actual market experience. If such experience is available, focus on market penetration results of existing projects to help gauge or reconcile acceptance estimates. If market adoption data is not available, consider use of a scenario approach to assess range of impacts.[b]

A shift to resource options pricing and tariff structures requires careful market research and/or pilot testing to identify potential adoption estimates. This is particularly important for less informed or sophisticated customer who are less likely to truly understand economic trade-offs.

The continued shift to a more competitive business environment generally results in shorter planning horizons for the integrated planning functions. The traditional 20-30 year planning horizons are often shifting towards a 2-5 year planning horizon.

This study classifies integrated planning following a framework[c] — by who and why the planning effort is carried out. In this context two key types of integrated planning are identified and characterized — public policy driven integrated planning and business driven integrated planning.

Public Policy-Based Integrated Planning

Public policy-based integrated planning refers to a case where the utility industry and/or government entities can be involved to balance the above collective interests (1) and

[a] Examples of this is illustrated in “Appendix A — Integrated planning case studies.” For example the Tennessee Valley Authority (TVA) used two flexible resource options; call options or purchase of power, and flexible construction of power plants to meet future customer energy needs.

[b] Examples of this is illustrated in “Appendix A — Integrated planning case studies.” For example the Jersey Central Power and Light Company (JCP&L) case study which included a comprehensive set of demand-side management (DSM) programs designed to reduce energy demand and manage customer load. One unique element of JCP&L's planning process is the designed use of evaluation results as a method of establishing market penetration estimates.

[c] Similar to the Subtask IV/1 report “Review and Documentation of Utility Structure and Characteristics of Participating Countries.” This report establishes a framework for discussing and understanding the role of DSM and energy services programs. (IEA DSM Program 1995).

individual interests (2) and to identify key elements in a resource allocation strategy towards achieving specific energy policy objectives, e.g., CO_2 emission targets. The involvement of the utility industry is motivated by the industry assuming a larger public policy responsibility.

From a government or national perspective, the objectives reports to be more strongly focused on social policy goals to guide industry regulation. The specific tools used to perform this analysis need to be more focused on the implications of policy decision, rather than specific actions. The entire IRP analysis from this policy perspective may become more macro-economic. A utility's perspective would go in the opposite direction. It will be more focused on short term financial goals and less on long term efficiency, and detailed analysis of specific actions will be critical. This recognizes the increased risk faced by individual businesses.

Focused on social policy goals to guide industry regulation

The case study examples (Appendix A) which best reflect a public-policy based planning approach include Pacific Northwest Planning Council which describes a modified process which was designed to solicit and incorporate input from the range of affected stakeholders beyond the utility. It treated the planning process on a more regional basis and looked at ways of minimizing the utility and societal risks associated with constructing new generation. Another example is British Columbia (B.C.) Hydro which focuses on a process which includes community planning approach to optimize the necessary energy infrastructure needs and investment requirements.

Business-Based Integrated Planning

"Business-based" integrated planning refers to this efforts being part of the corporate planning effort. For example, the energy company may use integrated planning — or elements of integrated planning — to identify corporate strategies consistent with corporate objectives.

Since competitive markets place utilities under pressure to cut costs, integrated planning for utilities in this environment will generally focus on identifying least cost solution that are robust and incorporate future uncertainties. A key objective is the need to lower unit energy prices to remain competitive, and some utilities report to actively use elements of the integrated planning process to identify new products and services to offer in a more competitive environment. Integrated planning can also be used to address risk issues in a more competitive electricity business environment, and example of this is illustrated in The Tennessee Valley Authority (TVA) Case Study (Appendix A) which used two flexible resource options; call options or purchase of power, and flexible construction of power plants to meet future customer energy needs. The need to introduce flexible resource options was driven by the changing resource planning environment as markets become increasingly competitive. Thus in their analysis, they place greater emphasis on future prices, rather than cost, of electricity as a planning criteria.

Table 1 Overview of Four Utility-Market Characterization Models

	Characterization model	*Most similar to situation in*[a]
Model 1 — Vertically integrated, regulated monopoly	• Franchised energy market • Single entity responsible for all utility functions • Government regulation	France, Italy, Korea, Japan
Model 2 — Unbundled monopoly	• Separated generation and distribution functions • Franchised energy market • Transmission linked to either generation or distribution functions • Government regulation	the Netherlands, Denmark, Germany, Spain, Australia
Model 3 — Unbundled, limited competition	• Separated generation, transmission and distribution functions • Open access to transmission and distribution grid • Competition to supply large customers • Government regulation of franchise market and of transmission and distribution functions	Sweden, Finland, England & Wales, New Zealand, USA
Model 4 — Unbundled, full competition	• Separated generation, transmission and distribution functions • Open access to transmission and distribution grid • Competition to supply all customers • Government regulation of transmission and distribution functions	Norway

Relationship Between Integrated Planning and Utility-Market Situations

To meaningfully discuss and draw general conclusions regarding the role of integrated planning across different utility-market situations, this study has developed a limited set of

[a] Many of the countries mentioned as examples are currently moving towards or planning some form of liberalization and restructuring of their energy markets and electricity supply industry.

generic situations that are based on a robust framework for characterization.[a] Table 1 provides an overview of the generic utility-market situations.

In a vertically integrated, franchised monopoly (model 1), integrated planning is often perceived as one of the most suitable approaches to identify and implement energy policy objectives. Various forms of integrated planning has been used to assess the economically optimal development of the energy sector and the power sector in particular.[b] Many or all of the elements described in Appendix A and B are observed as being relevant in this utility-market situation. There are often observed collaborative processes between the utility, industry regulators, government and other stakeholders, particularly in North-America. This process is likely to contribute to improving the public acceptance of resource plans.

In a situation of an unbundled monopoly (model 2), integrated planning methodology can also be implemented as an effective mean to identify and reach energy policy objectives. The success of the implementation of integrated planning in this situation depends largely upon how close collaboration is established between the unbundled utility functions. The integrated planning process is further complicated relative to model 1 (above) because costs and benefits often occur with different entities. The industry regulator faces a potentially more complex situation since distinctly different utility entities must be monitored.

In the situation of unbundled, limited or full competition (models 3 and 4), the elements of integrated planning — as performed by energy utilities — are likely to become more decentralized and business oriented. There is more focus on energy commodity price forecasting, risk assessment, and risk control, and the results from the planning process often are proprietary. There is a stronger need to distinguish the business-driven functions and public-policy-driven functions of integrated planning. Energy utilities can be less expected to undertake public policy functions as part of their commercial corporate activities. Integrated planning is still perceived as a tool to specify main guidelines for energy policy and to consider longer-term aspects of energy supply, diversification of primary energy sources, energy conservation strategies, environmental issues, etc. Such integrated planning functions can be carried out for the whole energy sector and for the power sector, in particular to identify and assess impacts from fuel substitution issues.[c]

[a] A similar approach of designing generic situations has been applied in other studies, including: Integrated Resource Planning and Demand-side Management in Europe: Present Status and Potential Role"(UNIPEDE 1994) and "European B/C Methodology for DSM and energy efficiency services programs" (SRC International 1994)

[b] See Subtask IV/2 Report "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options" for examples and a further discussion.

[c] Examples of this use of integrated planning is further discussed in Subtask IV/2 Report "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options" and in Appendix A.

1. INTRODUCTION

1.1 Background and Purpose

There are large differences and variations in the role and type of integrated planning[a] performed and the type of methods and tools available. To a large extent these differences relate to the utility-market situations, i.e., several key factors, including the utility industry structure, the market type and the type of regulation.[b]

New electricity business environments

Many countries have started separating out the ESI functions into individual businesses and exposing some of these businesses to competition. Typically, generation and retail supply are regarded as being open to competition, whereas the transmission and distribution 'wires' businesses are retained as natural monopolies. In several countries, another element of the industry restructuring involves the privatization of utility businesses where these are currently government-owned.

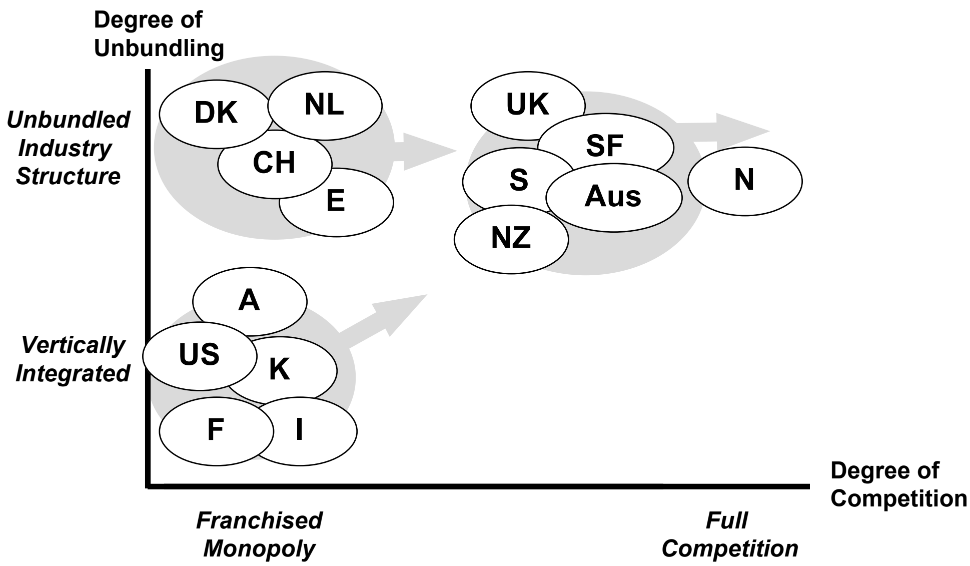
There are also large historical differences between countries as to how each country has organized its energy sector in terms of degree of utility industry franchise, integration, ownership and regulation. The various functions of the industry (namely, generation, transmission, distribution and retail supply) have usually been regarded as natural monopolies. Frequently, all of these functions are carried out within vertically integrated, monopolistic utilities. Even where some of the functions are carried out by separate utility businesses, each business is still regarded as being a monopoly.

An illustrative overview of these changes for countries included in this study — as they refer to the unbundling of traditional utility business functions and to the degree of competition in power markets — is mapped in Figure 1.

Figure 1 Overview and Characterization of Changes in the Electricity Supply Industry.

[a] See Subtask IV/2 Report "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options"

[b] See Subtask IV/1 report (IEA DSM Program 1995) for a framework for characterizing these differences and discussing how they affect DSM and energy services programs.



Changes in the justification and motivation for utility businesses to perform the elements of integrated planning

The impact of these major structural changes fundamentally alters the context of integrated planning and how DSM and energy efficiency programs are included in the planning process and can be carried out. The changes specifically alter the justification and motivation for utility businesses to perform the elements of integrated planning and to undertake DSM and energy efficiency. The changes may also establish new roles for governments and non-utility businesses to plan and facilitate the delivery of DSM and energy efficiency programs.

At the same time as this restructuring is occurring, climatic and environmental concerns are resulting in requests for more vigorous work to improve end-use energy efficiency. Therefore many elements of integrated planning is performed with a large emphasis on using DSM and energy efficiency as part of a strategy to achieving environmental objectives.

Approach to integrated planning varies significantly between situations

Because of these differences, the approach to integrated planning varies significantly between situations and between perspectives. Some of these differences include:

- Variation in planning objectives — integrated planning in some situations is performed as an instrument to develop national energy policy, in another situation the objective for an integrated planning process can be corporate strategic planning or an energy provider

- Variation between the elements included in analysis — The elements to be included in the integrated planning process varies, in some situations only selective elements are performed (such as forecasting or risk assessment), while in other situations a full integrated planning approach is undertaken

- Variation between relative emphasis of elements — e.g., in some situations, an optimal resource development plan is the objective, and as such all elements are potentially equally important. In another situation an assessment of prices and risk exposure is the most important, and price forecasting and risk assessment may be the only interesting elements.

1.2 Objectives

The objectives of this report include:

- Describe alternative approaches to demand-side planning and integration of demand-side options in utility resource plans and government policy

- Focus on how approaches might vary with supply characteristics, market conditions, regulatory situations, pricing and tariff structures, government policies, and institutional contexts

- Document how some of the methods identified have been successfully applied in different situations

- Summarize how different analytic approaches have been incorporated into available models.

1.3 Approach and Overview of this Report

This report reviews the key elements involved in integrated planning and describes alternative approaches to demand-side planning and integration of demand-side options in utility resource plans and government policy. As part of the review, detailed descriptions of alternative approaches to integrated planning are included. This is done both in how the methods have been developed and how some of them have been applied. The application of integrated planning methods is best discussed through reviewing case studies. Each case study is selected so that it describes an approach taken to integrated planning and focuses on how some unique aspects of the integrated planning process was solved (e.g., how to value flexibility).[a]

[a] This document also builds on comprehensive reviews performed by electricity industry experts from participating countries, and on interviews with leading policymakers and integrated planning practitioners in more than 15 different countries.

Integrated planning — and overview

Chapter 2 provides an introduction to integrated planning. It discusses the historical justification for DSM and energy efficiency services and integrated planning, and it defines the key elements involved in the integrated planning process. The methods for performing integrated planning is further discussed in Appendix B.

Relationship Between Integrated Planning and Utility-Market Situations

Chapter 3 discusses how approaches might vary with supply characteristics, market conditions, regulatory situations, pricing and tariff structures, government policies, and institutional contexts. This section applies a framework for characterization, and shows how the approach to integrated planning varies between a set of generic situations. Chapter 3 also discusses how some of the integrated planning methods described in Appendix B have been successfully applied in different situations. Each application is selected to focus on how the approach may vary with utility-market situation. In particular is illustrated how the approach deals with particular issues or problems formed by the specific situation.

Chapter 4 offers some conclusions.

Integrated planning case studies

Appendix A provides detailed descriptions of alternative approaches to integrated planning, as these have been applied in practice.[a] This is done in the form of reviewing case studies which have been applied to different situations. Each case study is selected to achieve several objectives, including:

- To describe a particular approach taken to integrated planning
- To focus on how to overcome some unique aspects of the integrated planning process (e.g., how to value flexibility integrated planning).

In some cases the examples represent state-of-the-art in applying specific analytical techniques in an innovative way. In other cases the examples are selected for its application in a unique situation.

Review of alternative methods for integrated planning

Appendix B describes alternative approaches and methods to demand-side planning and integration of demand-side options in utility resource plans and government policy.[b] Alternative analytical methods are described for each step in integrated planning — approaches to forecasting, assessment of demand side options, assessment of supply side and integration of options.

---

[a] As part of Experts meetings, Experts have performed focus groups to identify which planning approaches they felt as being most applicable to apply in different utility-market situations. The experts have been divided into four different groups to discuss planning approaches in different situations.

[b] Information in this section is largely based on a survey of more than 40 different tools used for performing the elements of integrated planning, and a survey of the approach taken to integrated planning in 15 different countries. A further description of this survey results is provided in "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options" (Subtask IV/2 report frp, Task IV).

2. INTEGRATED PLANNING — AN OVERVIEW

The planning elements and the relative emphasis will vary by situation and perspective

This section outlines the fundamental steps of performing integrated planning. The purpose is to establish an understanding of elements likely to be included in most integrated planning processes. The selection of which elements to be included, and the relative emphasis among the elements in the analysis process will vary from situation to situation, and from perspective to perspective. Further, the purpose, the roles of the different actors and the techniques applied will vary. Appendix A reviews a series of case studies which illustrates different aspects of performing integrated planning. Appendix B reviews alternative methods for performing integrated planning.

2.1 Historical Justification

This section discusses the original justification for performing DSM and energy efficiency services and integrated planning.

2.1.1 Justification for DSM and energy efficiency services

DSM programs refer to utility, government or other activities that seek to encourage customer implementation of energy-efficient technologies, products, equipment, and services.[a] Such programs can have significant utility, societal, and customer benefits in terms of reducing long-term costs of meeting energy needs, minimizing environmental damage from energy production, and increasing customer value. DSM programs can have a primary target other than end-use customers, (e.g., Energy Service Companies (ESCOs) or appliance retailers), but the objective is still to encourage customer implementation of energy-efficient products and services.

Types of DSM and energy efficiency activities

There are multiple approaches and numerous program designs available to achieve DSM goals. Examples of different types of DSM and energy efficiency programs are presented in Table 2.

Table 2 Description of Possible Demand-side Options

DSM OPTIONS	PROGRAM DESCRIPTION	EXAMPLE

[a] DSM programs can further be targeted as to influencing customer consumption behavior, e.g., amount and timing of energy use, to provide a "more efficient" utilization of the energy system, as for example in the case of electrical "load shifting programs" increasing the utilization of the electricity grid assets.

DSM OPTIONS	PROGRAM DESCRIPTION	EXAMPLE
Conservation	An energy use reduction for a particular end use. Generally, designed to save energy, but also can be used to reduce demand for end uses coincident with the system peak.	Efficient Motors
Peak Clipping	A strategy for reducing peak demand for short periods of time. Generally does not significantly reduce energy consumption.	Interruptible Contracts
Load Shifting	A reduction in peak load which causes a parallel increase in an off-peak period. Energy consumption is sometimes reduced, but is often the same and sometimes increases.	Thermal Storage
Load Growth	An increase in energy consumption, usually the result of marketing efforts. Growth could occur in all hours or at strategic times of the day, such as during hours night-time (valley filling).	Security Lighting
Fuel Switching To Electricity	An increase in electric load is caused by changing from an end use that currently uses another fuel, such as natural gas, oil or renewable resources	Electric Heat Pump Replacing Gas Furnace
Fuel Switching From Electricity	The elimination or decrease in an electric end use that is replaced by natural gas or another fuel, including renewable resources	Electric Space Heating Replaced by Gas Space Heating
Fuel Switching Between Fossil Fuels	The replacement of one fossil fuel at the end use level with an alternative fossil fuel.	Oil Boiler Replaced by Gas Boiler

While much of the practice on DSM programs originated in the electric utility sector, DSM as discussed in this study refers not only to electric utility applications, but also to other energies such as natural gas. DSM refers to programs designed to influence demand regardless of the particular fuel type considered. [a]

The Original Justification — Market Failures

Ample literature and public policy debate has shown the weaknesses of monopolistic electricity sector in relation to achieving an economically justified level of energy efficiency. Proponents of intervention have identified a number of market failures that

[a] DSM programs can also seek to transform markets. Market transformation can be defined as "DSM programs that induce a lasting beneficial change in the behavior of some group of actors within the market system. (Prahl, Ralph, "Evaluation Exchange," Vol. 3, No. 4, September/October 1993, p. 6.)

cause consumers not to choose a level of energy efficiency that appears to be economically justified. These market failures include:

- The Payback Gap — Consumers of energy appear to value investments in energy efficiency with discount rates or payback hurdle rates that are much higher than those used by energy producers. The result is that a lower level of energy efficiency is implemented than is economically justified. In this situation, it can be much cheaper from the societal perspective to reduce demand by inducing customers to invest in energy efficiency (or having the energy supplier invest in energy efficiency for the customer) than it is to build new supply resources.

- Prices Differ from Marginal Cost — Economists often discuss the importance of prices and how they serve as signals to consumers. When prices reflect the cost of providing the next unit of service, then the price signals are efficient. But in a world of franchised monopolies with government or regulatory oversight, prices rarely reflect the marginal cost of providing the service. In this situation, the signals provided to customers in relation to the cost of energy efficiency improvements are wrong. Consequently, a lower level of energy efficiency than is economically justified is likely to be implemented.

- Risk Sheltering of the Utility — This market failure is somewhat similar in effect to the payback gap. Some have argued that a monopoly franchise and regulation shield the utility from risk. Hence, the utility makes investments with risks that few firms in a competitive market would be willing to assume. The result is that the utility builds larger and more expensive plants before they are really needed, and customers underinvest in energy efficiency.

- Averch-Johnson-Willig Effect — Academic economists argue that rate-of-return regulation (as practiced, for example, in the United States) leads to an incentive for the utility to overinvest and "gold-plate" the investments that are made. Some academic economists have argued that, subsequent to the large disallowances of new plant made by US regulators in the late 1970's and early 1980's, the opposite effect is true. If the AJW effect holds, then it is likely that a market failure exists and this could serve as a rationale for intervention to promote energy efficiency.

- Externalities — The production, distribution, and use of electricity involves costs that are not seen by producers, transporters, or consumers. These "external" costs primarily comprise environmental damage. Since the various players do not see these external costs, they are not likely to make decisions which lead to an economically justified level of energy efficiency.

- Lack of Information and High Transactions Costs — When consumers have difficulty in acquiring information about products and services that can increase energy efficiency, they may not choose technologies that they otherwise would have chosen. This occurs simply due to lack of knowledge on the part of the consumer. Further, when the "hassle" of implementing these measures is too great, consumers may miss opportunities that are economically justified, simply because of the high transactions costs. These market failures can be a rationale for intervention.

- Disconnected Decision Maker — These are market failures where the consumer of energy services who pays the energy bills may not be able to influence the efficiency of the energy using equipment. These market failures arise most notably in landlord/tenant relationships and in new construction where the developer is not the owner of the building. They can also occur when the distributor of electricity (who controls investment in the distribution system) does not incur the cost of losses, and hence has little incentive to invest to avoid them.

These are a selection of the range of market failures that have been cited as a rationale for intervening in energy markets to encourage higher levels of energy efficiency. In the absence of market failures, the market itself would act to select an economically justified higher level of energy efficiency.

How Restructuring Affects Market Failures

A number of the market failures identified above are directly linked to the existence of a franchised monopoly in electricity supply and the type of regulation that has been applied to limit monopoly electricity utilities' market power. With restructuring of the electricity sector to encourage (1) competition in generation and (2) full customer choice of their electric supplier, many of these market failures are either reduced or eliminated. Specifically:

- Since the shielding effects of regulation and monopoly are removed from the generation market, the difference in investment payback between generators and customers is likely to be reduced and approach levels that exist in other segments of the economy. This reduction in the payback gap is achieved through generators requiring a risk-premium, e.g., through requiring shorter payback time on investment in generation. This is different from the objective of many DSM programs (e.g., rebate programs) that were aimed at reducing customer discount rate

- In those countries where rate-of-return regulation applies, the discipline of the market is likely to remove the incentives to overbuild provided by this form of regulation.

- In a fully functioning electricity commodity market, competition is likely to drive prices for electricity towards marginal costs. Thus, pricing market failure is likely to be removed.

- If electricity suppliers choose to use energy efficiency services as one of their competitive tools in the electricity commodity market, then the market failures of lack of information and high transactions costs may be reduced.

However, several market failures are likely to remain following restructuring of the electricity commodity market. For example:

- Restructuring in itself does nothing to address externalities. The external costs are likely to remain significant and omitted from decisions which producers, transporters, and consumers make.

- The disconnected decision maker market failure is not affected by the structure of the electricity commodity market and therefore will remain.

- The market failures of lack of information and high transaction costs are likely to remain, although they may be reduced by restructuring as noted above.

Rationale for Intervention

Restructuring of the electricity market will eliminate some market failures and reduce others. However, some market failures will remain. These are likely to constrain the level of energy efficiency achieved through the "natural" operation of market forces to below the economically justifiable level. Therefore, the rationale to encourage DSM and energy efficiency still exists, though the nature of the market failures will have altered.

Determining whether there is still a compelling rationale to intervene in the electricity market to encourage DSM and energy efficiency will undoubtedly be a policy decision. In developing an effective policy for intervention, policy makers would be well-advised to be as specific as possible in identifying the market failures that the intervention is intended to influence, and to prioritize (to the extent possible) the competing objectives of intervention.

2.1.2 Justification for Integrated Planning

Integrated planning is performed for very different purposes in different situations, by different actors, to achieve different objectives. The ideological platform is "optimal resource allocation" — with resources including labor, capital, raw materials, etc. Integrated planning is characterized as[a]

> A balanced evaluation of the supply side and the demand side in which all energy supply alternatives and all conversion of energy into energy services are subject to evaluation on a level playing field.

Integrated planning — a process for balancing individual as well as collective preferences

Such a characterization clearly involves individual as well as collective preferences. For example on the individual side customers want full control of choices which they make based on the options presented to them, while on the collective side customers do accept affiliation to a group and therefore admit to assume their share of a collective responsibility (e.g., environmental issues or the quality of life of present and future generations). Integrated planning can be viewed as a process for balancing individual as well as collective preferences.[b] Recognizing this as being a complex and difficult task, the purpose of integrated planning has not so much been to identify the "right" or "wrong" choices as to demonstrate which key elements are necessary to shed lights on in key interests involved and demonstrate how these choices balance between the interests involved. Therefore, the methodology, the tools and the criteria used are of key concern to succeed.

Impetus and justification for IRP in the US

Integrated Resource Planning (IRP) emerged in the US from the aftermath of State regulatory commission reviews of the prudence of investing in expensive baseload generation plants. As noted above, many utilities chose to build large baseload plants (primarily nuclear and coal) based on demand forecasts that diverged from what actually occurred. A review of these situations resulted in the disallowance of billions of dollars of investment. As a result, the State commissions believed that greater regulatory oversight of the planning process was necessary. Utilities also believed that greater oversight might be beneficial since then the Commission would have a certain amount of responsibility for the decisions that were made. States first instituted review of the demand forecasting process, as this was originally seen as the "culprit" of the planning process. State reviews expanded to the resource planning side, then evolved to "Least Cost Planning." Least Cost Planning

[a] Danish Electric Utilities Oct.-1994 "Integrated Resource Planning — from Concept to Practice," IRP in the Danish Electric Utilities, Main Report, October 1994.

[b] A relevant example of balancing collective and individual concerns is the value allocated to external costs and benefits, e.g., environmental impacts from electricity generation and transmission.

brought forth the idea that utilities should consider not only supply additions, but also demand-side options such as load control and (potentially) energy conservation. This concept evolved into the concept of Integrated Resource Planning (IRP). Integrated planning has since evolved, and in some cases disappeared in its original form. Some of these changes and how they affect integrated planning, and how it is being done, is discussed in this report.

2.2 Key Elements of Integrated Planning

Appendix B — "Alternative Methods for Integrated Planning."

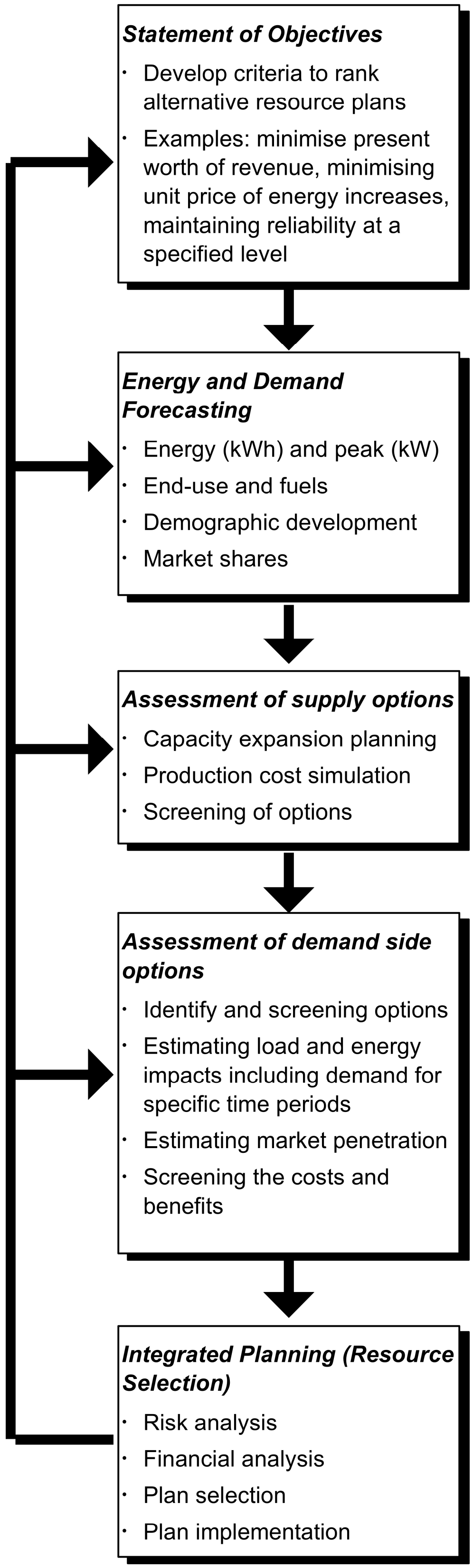
The basic elements of integrated planning are being performed relatively unaffected by changes in electricity business industry structure, market structure and regulation. However, the reason why various elements are being performed, as well as the relative emphasis and importance between them, continues to change. As a starting point, it is useful to review the key elements of integrated planning, recognizing that the elements are likely to change from situation to situation. A more comprehensive review of the methods for performing integrated planning is included in Appendix B of this report — "Alternative Methods for Integrated Planning."

Integrated planning attempts to consider the entire spectrum of options available to energy companies, utilities and government, including utility generation, non-utility generation, load management, energy conservation, pricing and taxes, alternative service levels, fuel substitution, and power exchanges and purchases; and that it provides explicit evaluation of the interactions among the various aspects of the planning process (for example, alternative supply plans can affect rates, which will affect the demand forecast, which will affect the costs and benefits of both the demand-side and supply options). In general, to fully consider these interactions, several iterations through the entire planning process are necessary — this is referred to as integrated planning. Integrated planning includes the following key elements:

- Definition and explicit statement of objectives
- Energy and demand forecasting
- Assessment and planning of demand options
- Assessment and planning of supply options
- Integrated planning (selection of options)

2.2.1 Objectives

The first step in an integrated planning process is defining the objectives to apply in assessing the range of options. From the objectives, specific criteria are developed which are used to rank alternative resource plans. Examples of objectives include minimizing the present worth of revenue requirements, minimizing rate increases, maintaining reliability at a specified level, or maintaining certain financial ratios at specified levels. It is important that the objectives that will be used as the basis for selecting among alternative resource plans be established, so that appropriate measures of performance can be developed during the evaluation of these plans.



2.2.2 Energy and Demand Forecasting

The next step in the integrated planning process is usually to develop long-range forecasts of electricity sales and load shapes. Generally, a range of forecasts should be developed. A major problem is assuring that the assumptions (e.g., number of households, fuel shares, average energy use per appliance) are consistent between the forecast and the DSM analysis. Assuring consistency requires: 1) significant interaction between the forecasters and the DSM planners ; and 2) a schedule that allows sufficient time for DSM analysis after the forecast is completed. Often, during the forecast process some of the assumptions are changed at the last minute. These revised assumptions must be communicated to the DSM planners and they need sufficient time to incorporate these revised assumptions into their analyses. An overview of forecasting approaches is provided in Appendix B.

The major additional analytical requirements for load forecasting to support integrated resource planning include: 1) development of load shape forecasts; and 2) estimation of the net effect of conservation and load management programs, including consideration of the actions that customers would have undertaken without utility programs and the efficiency rebound effect (i.e., customers tend to increase their comfort and/or level of energy savings as their energy efficiency improves - for example, after insulating one's home, one may increase the thermostat setting). It is, e.g., extremely difficult to fully quantify the net effect of conservation and load management programs using aggregate load forecasting models.

Thus, the need to analyze the impact of DSM programs on the load forecast is a major driving force behind the increasing use of end-use load forecasting models.

A range of forecasts reflecting uncertainty about load growth should be developed. This is usually done by developing a set of consistent assumptions concerning population growth and economic conditions for each possible load forecast scenario.

2.2.3 Demand-Side Planning

Demand-side management (DSM) planning generally requires the completion of the following steps:

- Identifying and screening DSM alternatives to determine measures and programs for evaluation
- Estimating unit (i.e., impact per participating customer) load impacts including effects on annual energy sales and demand for specific time periods
- Estimating the market penetration of the DSM actions with and without a utility program
- Screening the costs and benefits of the DSM alternatives to identify those resource options that will be evaluated in the integrated demand-supply planning process
- Developing and planning the implementation programs that cost-effectively promotes customer adoption of the DSM actions.

An overview of demand-side planning approaches is provided in Appendix B.

2.2.4 Supply-side planning

Supply-side planning is performed to determine the least-cost and most reliable supply options needed to meet the net load forecast, as modified for least-cost demand-side options, including an adequate reserve margin. Supply-side options include conventional options such as fossil steam units (coal, gas and oil), nuclear units, combustion turbine units, combined-cycle units, and hydro units, as well as non-conventional options such as fuel cells, geothermal, wind turbines, and solar generation. Other supply-side options include life extension of existing generating units, purchased power options, and transmission options.

The objective of supply-side planning is to determine the least-cost mix of supply options to meet net loads, while also maintaining an adequate level of reliability. The major uncertainties in supply-side planning are load growth; capital and operating costs, performance characteristics, and lead times of generating technologies; and purchased power costs. Primary options considered in the supply-side analysis are:

- Life extension of existing generating units
- Small power technologies with short lead times
- Conventional generation options
- Cogeneration and standby generation

- Purchased power options
- Transmission options.

An overview of approaches to supply side planning is provided in Appendix B.

2.2.5 Integrated Planning (Resource Selection)

The integration phase of the evaluation applies the results of all the prior planning elements to allow demand-side management and supply-side options which have survived the screening phases to compete on a fair and level playing field. This integration can be accomplished (1) using optimization models or (2) through an iterative procedure with traditional resource planning models.

Risk analysis

The integrated evaluation will provide the least-cost plan under a prescribed set of conditions, along with numerous alternate plans. Because the future is uncertain, the "least-cost" plan may not be best, in the sense that an alternate plan may have the "least expected cost" across the wide range of possible futures.

The purpose of uncertainty analysis is to decide which plan is best, given the uncertainty in planning assumptions. Several approaches including scenario analysis, sensitivity analysis or decision analysis can be used to systematically determine the risks associated with the alternative plans.

Financial analysis

The financial analysis of the possible resource plans is performed to ensure that financial integrity is maintained throughout the planning horizon. Financial integrity is defined as the ability to raise funds to finance the resource options identified as being most desirable. The financial analysis provides an understanding of the financial risks of each possible plan, and aids in final plan selection.

Plan selection

Based on the results of the detailed evaluation, uncertainty analysis and financial analysis, one or more plans are selected. Several plans may be selected, with one designated the primary plan and the other plans identified as contingency plans, to be implemented only if conditions change substantially from those that had been assumed during the planning process - for example, if demand growth or fuel prices are higher or lower than expected.

In general, only some of the planning objectives can be easily incorporated in the formal modeling of alternative resource plans. There is usually little difference among the top resource plan in terms of costs, reliability and rates. Other objectives, e.g. environmental and social, may then be used to select from among these top plans.

Plan implementation

Finally, an action plan for implementing the selected resource plan is developed. This includes the development of a plan for monitoring and evaluating the resource plan as it is implemented. The objective of the monitoring and evaluation plan is to provide early feedback that will warn of the following potential problems:

- Resources are not being developed as expected (e.g., costs are escalating, energy savings are not being fully realized, or a project is behind schedule)
- Conditions have changed sufficiently from those that were assumed during the planning phase to warrant re-examination of the plan
- There are opportunities for fine-tuning specific projects and/or programs as experience is gained in the implementation phase. Monitoring and evaluation plans should specify milestones and key indicators that are to be tracked during the implementation of the plan.

A review schedule and procedures to monitor implementation of the plan are also developed. A key issue here is to assess and manage risk as actual data and new forecasts become available. The integrated plan should, e.g., be integrated with the short-term revenue, construction, and operating budget for monitoring, financial planning. The plan should be updated as part of the corporate planning process. Particular emphasis on these elements has been expressed from those situations of unbundled industry structures and competitive energy markets. In these situations systems for tracking and forecasting variations in energy commodity price and communicating these changes in terms of size and type of risk exposure are viewed as critical elements of the planning process. An overview of approaches to integrated planning and resource selection is provided in Appendix B.

Assess and manage risk as actual data and new forecasts become available

2.3 Generic Utility-Market Situations

There are large differences and variations in the role and type of DSM and energy efficiency activities performed in various countries and regions, and thus the role and type of integrated planning. To a large extent these differences relate to the utility-market situations, i.e., several key factors, including the utility industry structure, the market type and the type of regulation. Many countries have started separating out the ESI functions into individual businesses and exposing some of these businesses to competition. Typically, generation and retail supply are regarded as being open to competition, whereas the transmission and distribution 'wires' businesses are retained as natural monopolies. In several countries, another element of the industry restructuring involves the privatization of utility businesses where these are currently government-owned.

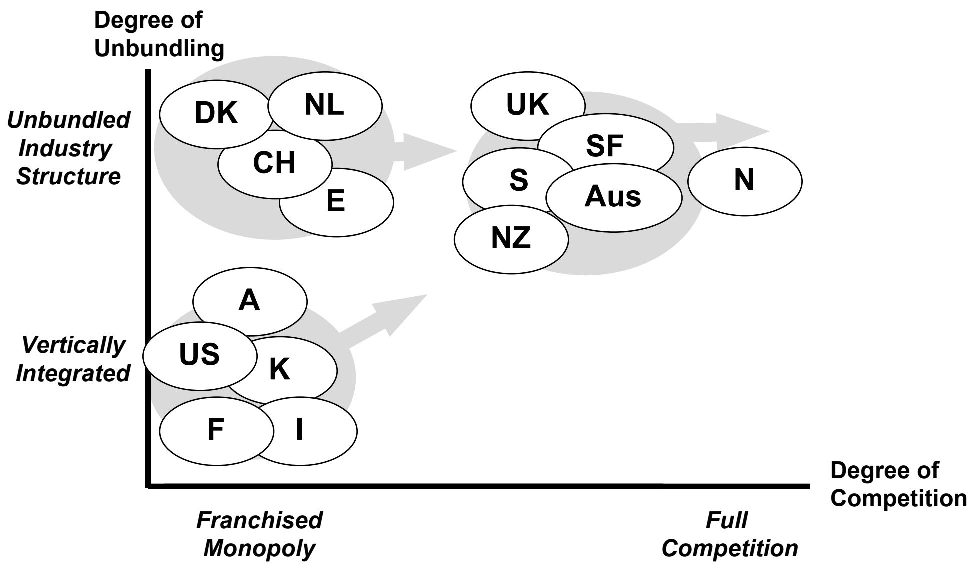
There are also large historical differences between countries as to how each country has organized its energy sector in terms of degree of utility industry franchise, integration, ownership and regulation. The various functions of the industry (namely, generation, transmission, distribution and retail supply) have usually been regarded as natural monopolies. Frequently, all of these functions are carried out within vertically integrated, monopolistic utilities. Even where some of the functions are carried out by separate utility businesses, each business is still regarded as being a monopoly.

Some of these differences and current changes can be studied along two-dimensions:

- The degree of vertical integration — i.e., to what extent is the same utility business entity responsible for all traditional utility business functions i.e., generation, transmission, distribution and retail supply

- The degree of competition — to what extent is the energy market exposed to competition. E.g., are end-use customers permitted to select retail supplier of electricity, or are some customers allowed to choose suppliers while others are not?

Figure 2 Overview of industry structure and degree of power sector competition.



For the purpose of overview and comparison, the countries that have been surveyed as part of this study[a] can be mapped into a two-dimensional diagram as described in Figure 2. Figure 2 also indicates that many countries are moving towards a larger degree of unbundling of utility business functions and introduction of competition.

The shaded areas in Figure 2 indicates some common characteristics between countries. For the purpose of establishing general conclusions and consistent comparisons, it is not meaningful to assess all possible combinations of utility industry structures, market and regulatory types. Rather it is beneficial to develop a limited set of generic situations examples that are based on a robust framework,[b] which serves as a basis for further discussion.

Figure 3 Overview of Generic Utility-market Situations

[a] See e.g., Task IV report "Inventory of available methods and processes for assessing the benefits and costs and impacts of demand-side options" (IEA DSM Program, April 1996)

[b] A similar approach of designing generic situations has been applied in other studies, including: Integrated Resource Planning and Demand-side Management in Europe: Present Status and Potential Role"(UNIPEDE 1994) and "European B/C Methodology for DSM and energy efficiency services programs" (SRC International 1994)

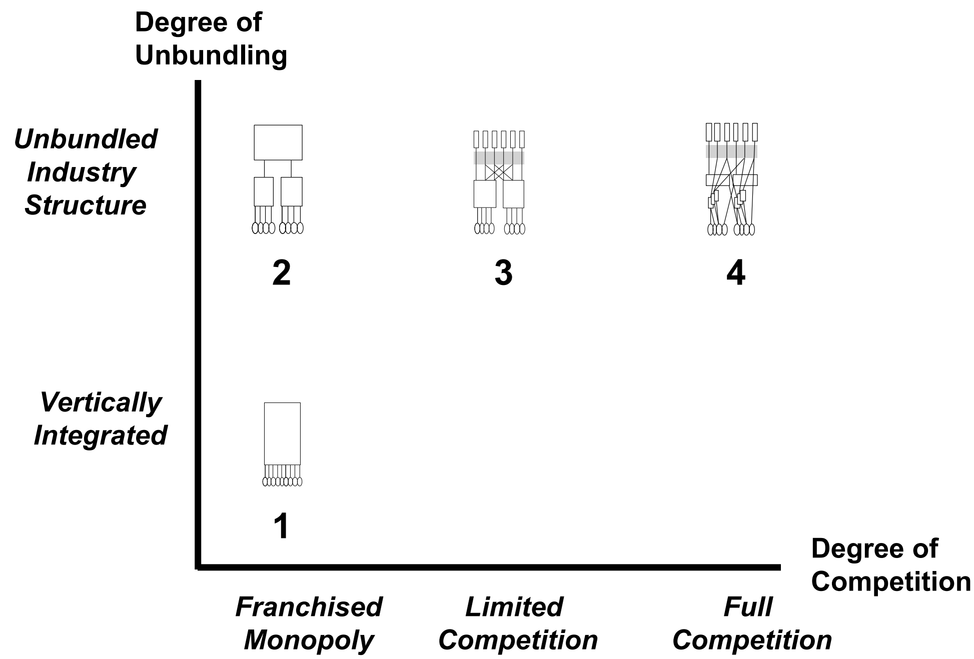


Figure 3 provides an overview of the generic utility-market situations as these are mapped into the two dimensions The degree on vertical integration and the degree of competition. What follows is a more detailed description of each generic situation.

Table 3 Overview of Four Characterization Models

Characterization model	Most similar to situation in[a]

[a] Many of the countries mentioned as examples are currently moving towards or planning some form of liberalization and restructuring of their energy markets and electricity supply industry.

Model 1 — Vertically integrated, regulated monopoly	• Franchised energy market • Single entity responsible for all utility functions • Government regulation	France, Italy, Korea, Japan
Model 2 — Unbundled monopoly	• Separated generation and distribution functions • Franchised energy market • Transmission linked to either generation or distribution functions • Government regulation	the Netherlands, Denmark, Spain Australia
Model 3 — Unbundled, limited competition	• Separated generation, transmission and distribution functions • Open access to transmission and distribution grid • Competition to supply large customers • Government regulation of franchise market and of transmission and distribution functions	Sweden, Finland, England & Wales, New Zealand, USA
Model 4 — Unbundled, full competition	• Separated generation, transmission and distribution functions • Open access to transmission and distribution grid • Competition to supply all customers • Government regulation of transmission and distribution functions	Norway

As shown in Table 3, the models range from vertical integration and monopoly (model 1) to unbundled structure and full competition (model 4). Each model is not designed to fit one country's market structure, utility industry structure or regulation in particular, but rather represents a close correspondence with the situations in each country represented.

Model 1 — Vertically Integrated Monopoly

Model 1 describes a situation where all activities of the utility company in a given area, i.e., generation, transmission, distribution, wholesale and retail supply are undertaken by one company. Characteristics of model 1 include the following:

- Industry is franchised and contains very little competition
- Utilities have the obligation to serve customers within their own region

- Government regulates utility industry profit to prevent monopoly abuse.

Model 1 is most similar to the situation in France, Italy. In addition the model can be found in Belgium, Greece, and Israel.

Model 2 — Unbundled Monopoly

Model 2 represents a step away from vertical integration towards a more unbundled structure, although monopoly status is maintained in generation and distribution. Model 2 includes the following characteristics:

- Several generation companies serving (independent) distribution companies, and possibly also major industries
- The utility industry is franchised, a generation company has the exclusive right to supply customers within its franchise area and the distribution companies have a monopoly to serve customers in their respective areas
- Transmission may be linked to either generation or distribution
- The economic interests of generators and distributors are different. This may complicate the implementation of integrated planning relative to Model 1.

Model 2 is most similar to the Netherlands, Denmark, Austria, Spain, Switzerland and Germany and some Australian States at present (e.g. New South Wales and Queensland). Some of these countries have extensive examples of DSM activities (especially Denmark, Spain and the Netherlands).

Model 3 — Unbundled, Limited Competition

Model 3 introduces competitive options for large customers. The model is characterized by:

- Separated generation and distribution
- Transmission either separated or linked to either generation or distribution
- Many independent generators
- Generators have open access to transmission and distribution grid
- Competition to supply wholesale customers, i.e., supply companies and industrial customers.

Model 3 is most similar to the situation in Sweden, England and Wales, Finland and will be a transition stage in the Eastern Australian States.

Model 4 — Unbundled, Full Competition

Model 4 represents the full step away from monopoly and vertical integration towards a unbundled structure with a competitive energy market with direct access for all customers. Model 4 is characterized by:

- Full access to transmission and distribution, i.e., all customers have the possibility to choose supplier

- Competition among energy generators and suppliers (energy trade function)
- Commodity energy market
- Regulated monopolistic control of transmission and distribution
- Emergence of independent energy sales companies enter the market (energy traders and brokers)
- Energy price is determined in the marketplace.

Model 4 is most similar to the situation in Norway and is intended to be the future situation in Sweden, Finland, UK, some US states and in the Eastern Australian States.

3. RELATIONSHIP BETWEEN INTEGRATED PLANNING AND UTILITY-MARKET SITUATIONS

This section discusses how the approaches, as described in previous sections and in Appendix A and B have been applied and might vary with supply characteristics, market conditions, regulatory situations, pricing and tariff structures, government policies, and institutional contexts.

3.1 Overview

As has been discussed elsewhere,[a] there are major changes taking place, particularly in the electric utility supply business. Until recently, the various functions of the electricity supply industry (namely, generation, transmission, distribution and retail supply) were regarded as being natural monopolies. Frequently, all of these functions were carried out within vertically integrated, monopolistic utilities.

Major structural transformation of the ESIs

However, in many countries the electricity supply industry (ESI) is undergoing, or may soon undergo, a structural transformation. This restructuring involves separating out the ESI functions into individual businesses and exposing some of these businesses to market competition. Typically, generation and retail supply are regarded as being open to competition, whereas the transmission and distribution 'wires' businesses are still seen as being natural monopolies. In several countries, another element of the industry restructuring involves the privatization of utility businesses where these are currently government-owned.

Changes in the justification and motivation for utility businesses to perform integrated planning

The impact of these major structural changes fundamentally alters the context in which integrated planning can be carried out. The changes specifically alter the justification and motivation for utility businesses to undertake DSM and energy efficiency. The changes may also establish new roles for governments and non-utility businesses to facilitate and participate in the delivery of DSM and energy efficiency programs.

At the same time as this restructuring is occurring, climatic and environmental concerns are resulting in requests for more vigorous work to improve end-use energy efficiency.

This section highlights key impacts on how integrated planning is likely to be approached in different utility-market situations. This includes focusing on the traditional situation (e.g., vertically integrated, franchised monopoly) as well as situations that are emerging from changes as summarized above. As part of this study is also reviewed a series of integrated planning case studies which illustrate unique aspects of integrated planning.

[a] See e.g., Subtask IV/2 "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options" for an update on changes in industry structure and ownership, market type and regulation in 15 OECD countries. A similar review is provided in the 1996 Annual Report of the IEA DSM program.

3.2 Unique Aspects of Integrated Planning — Case Studies

As part of this study is reviewed in detail selective examples of how different methods for integrated planning have been applied in different situations. Each application is selected to focus on how the approach to integrated planning may vary with utility-market situation. In particular is illustrated how the approach deals with particular issues or problems formed by the specific situation. Examples of issues include:

- How to estimate the Flexibility Value of DSM — i.e., the value of DSM as Modular Resources
- How to estimate market penetration of DSM programs (including market research)
- How to assess the relationship between DSM and power system Reliability
- How to assess the different risks and uncertainties related to DSM options
- Dynamic vs. static approach to estimating avoided costs (including T&D costs)

Appendix A provides detailed descriptions of alternative approaches to integrated planning, as these have been applied in practice.[a] Each case study is selected to achieve several objectives, including:

- To describe a particular approach taken to integrated planning
- To focus on how to overcome some unique aspects of the integrated planning process (e.g., how to value flexibility in integrated planning).

In some cases the examples represent state-of-the-art in applying specific analytical techniques in an innovative way. In other cases the examples are selected for its application in a unique situation.

The information is collected through extensive interviews with energy planners and key decisionmakers in the electricity business industry. For each case study, the following information is provided (where available):

- Summary description - case study synopsis and quick contacts
- "Quick start" suggestions - significance of approach and relationship to IRP issues
- Situation analysis - where this case study fits in the overall IRP approach
- Sequence of analysis - Objectives, data inputs, modeling, and computerization (with references)

[a] As part of Experts meetings, Experts have performed focus groups to identify which planning approaches they felt as being most applicable to apply in different utility-market situations. The experts have been divided into four different groups to discuss planning approaches in different situations.

- Results
- Resource requirements - time, staff, CPU, financial
- Evaluation — evidence of success relative to objectives, recommendations, lessons learned

The integrated planning case studies included in this study are:

Value of power system reliability impacts from demand options (Southern Electric System, USA)

This case study illustrates a unique approach to value of power system reliability impacts from demand options. The Southern Electric System (SES) (which serves the Southeast region of the United States) used the Monte Carlo Frequency and Duration (MCFRED) program to estimate an optimum reserve capacity margin for the power system. Recognizing that conventional production costing and reliability models, which use convolution techniques to simulate system operations, do not consider the chronology of unit outage rates and loads and also do not adequately model pumped storage hydro, conventional hydro, and interruptible load programs. In response, SES developed a program to estimate expected unserved energy (EUE). Using projections of future load growth, probability distributions of load forecast uncertainty, and hydro and weather variations, generating unit outage variations (as embodied in the distribution of times to repair (TTR) and times to fail (TTF) for individual system generating units), estimates of customer value of service, and a variety of other assumptions, SES estimated a level of EUE at which the change in cost of outage was equal to the change in cost of increased generating unit cost. In this analysis, SES used the Monte Carlo analytical technique to determine the EUE for a variety of random system operation conditions. Combining this with analysis of loss of load hours (LOLH) statistics, SES identified a short-term optimum reserve margin which specifically accounted for weather variability and uncertainty in load forecast. The optimal reserve margin thus determined is a good indicator of system reliability.

The technique applied by SES to determine system reliability is an extremely useful tool in the integrated resource planning (IRP) process which combines several resource and demand options each of which have uncertainties associated with them.

Flexibility Value of DSM (Tennessee Valley Authority, USA)

This case study illustrates a unique approach to assess the flexibility value of DSM options. The Tennessee Valley Authority (TVA) used two flexible resource options; call options or purchase of power, and flexible construction of power plants to meet future customer energy needs. The need to introduce flexible resource options was driven by the changing resource planning environment as markets become increasingly competitive. Thus in their analysis, they place greater emphasis on future prices, rather than cost, of electricity as a planning criteria.

TVA used the staged decision and Black-Schloes models to evaluate the investments for the two options. The two models provide a revised form of net present value analysis by exclusively accounting for the flexibility in the planning process. The results indicated that the flexible resource options have much higher benefits than inflexible options. TVA has thus issued RFP's for call options and have received several responses from other utilities. They have also initiated the process of procuring sites and conducting preliminary analysis for construction of power plants in the future.

Estimation of market penetration (Jersey City Power and Light, USA)

This case study illustrates a unique approach to estimation of market penetration from DSM options. Jersey Central Power and Light Company (JCP&L) developed a comprehensive set of demand-side management (DSM) programs designed to reduce energy demand and manage customer load. The objective of these programs was to reduce customer spending on electricity while ensuring that DSM program costs and the associated loss of revenue are recovered, and reduce the need for capacity expansion. This was all developed in the context of regulatory requirements to pursue DSM. In developing these plans, JCP&L considered a number of factors which determine load growth, load shapes, technology characteristics, market saturation, adoption rates, avoided energy and capacity costs, growth rates, and program design and implementation costs. Cost recovery mechanisms were determined in accordance with state regulations. Metering and verification programs were instituted to estimate savings from DSM programs. The metering program was the basis for determining rebates for performance-based DSM programs, and for estimating both savings and revenue loss.

One unique element of JCP&L's planning process is the designed use of evaluation results as a method of establishing market penetration estimates. The successful approach taken by JCP&L to estimate market saturation and adoption rates for different technologies, and the metering and verification programs are pertinent to IRP analysis which considers the adoption of various supply- and demand-side options to optimally meet energy needs.

Treatment of uncertainty in integrated planning (Pacific North West Power Planning Council, USA)

This case study illustrates a unique approach to treatment of uncertainty in integrated planning. The Pacific Northwest Power Planning Council (the Planning Council) represents a regional planning concern providing electric power in the Pacific Northwest region of the United States (including the states of Idaho, Montana, Washington and Oregon). This includes municipal and public power utilities such as Bonneville Power Administration. Unlike many individual utility resource plans, this regional perspective, which includes a number of distribution utilities, provides a comprehensive view of balancing resources and is “grounded” on the overall objective of ensuring “that the Pacific Northwest will have adequate, efficient, economical and reliable electricity supply well into the next century”[1].

The hallmark of the plan was the consideration of a wide range of scenarios that addressed issues of: environmental concerns particularly regarding hydroelectric resources, and the recognition of the impending need to acquire a relatively significant amount of new generation to meet expanding loads. Additionally, the plan was designed to shorten the lead time to bring new resources into production. The selection of resources which can be acquired relatively quickly and in small increments provides a good hedge against uncertainty particularly in the years between the decision to build or acquire electricity and its actual delivery.

In addition to the forecast scenario analysis, the Planning Council also conducted iterative analyses on key areas of market uncertainty (beyond the forecasts). A series of resource portfolios were developed to identify the areas of greatest sensitivity. The four portfolios were:

- Load uncertainty
- Unavailability of nuclear or coal plants

- Conservation uncertainty
- Natural gas uncertainty

This allowed the Planning Council to assess the impact of various resource plans based on these various portfolios within each of the forecast scenarios.

The end result was the development of a comprehensive action plan which details the specific activities and their preferred timeframe. It includes the acquisition of additional generation resources (primarily low-cost hydro electric and cogeneration) and an aggressive effort aimed at improving efficiency levels of regional building stock.

Identification of priority action fields (BKW, Switzerland)

Until now Swiss utilities have realized various DSM activities in certain customer segments, but there was no systematical search for potentially successful DSM-market sectors. In the DSM-PAF-project a practical methodology for utilities for DSM-market screening, analysis and valuation was developed. The methods and instruments are easy in application, understandable and possible to extend. The project is focused on small and medium customers of the industrial and commercial sector.

Community Energy Planning (BC Hydro)

Community Energy Planning (CAP) reflects the integration of community and energy planning to build more liveable communities, which are more energy-efficient and make better use of infrastructure of all types. Specific to utilities, the use of CAP provides the ability to better plan for infrastructure needs, such as transmission and distribution system requirements. This relationship between urban form and energy use has been a point of interest for British Columbia Hydro (BC Hydro). Since BC Hydro is a provincially-owned electric utility it has a larger obligation to address the social good of the region it serves.

BC Hydro recently completed a study looking at the potential impacts of CAP in Surrey, one of its local communities. Surrey is an area adjacent to the City of Vancouver and contains a current land use mix of residential and commercial properties. Surrey also is a rapidly growing area where energy needs are projected to require upgraded services. Using the community of Surrey, BC Hydro analyzed the impacts of CAP to guide future growth and better establish and plan for electricity infrastructure needs.

Standard Offer program (Public Service Electric and Gas)

Public Service Electric and Gas Company (PSE&G) offers a unique demand-side management program which rather than paying customers for energy savings using rebates or other standard incentives used by utilities, pays customers for actual energy savings at specific time periods. The program known as the “Standard Offer” pays customers fixed amounts based on the energy saved. Savings during Summer peak periods for electricity, and Winter peak periods for gas, are rewarded at higher levels than savings during off-peak periods. The savings achieved by customers are verified using a verification protocol considered to be the most comprehensive and rigorous procedure developed anywhere in the US. The other unique feature of this program is related to the administration of the program. Any customer, energy service company, or third party can participate in the Standard Offer program and be paid by PSE&G for measured savings. In 1992, PSE&G floated a subsidiary, the Public Service Conservation Resource Corporation (PSCRC) to facilitate customer participation in the program. The PSCRC was founded with the dual mission of promoting a competitive environment for energy services by financing eligible energy saving opportunities, and at the same time, earning a profit on its investments in energy efficiency projects. The founding of the PSCRC and the payment of money based on measured customer energy savings during specific periods makes the Standard Offer program one of the most unique utility DSM program in the US.

The Standard Offer program is available to individual customers in all customers sectors and segments. However, to qualify for the program, the customer, or the ESCO/third party, must guarantee to save a specific amount of energy over a contract period which can be 5, 10, or 15 years. The minimum acceptable proposal must constitute at least 100 kW of "Summer Prime Period Average Demand" reduction (noon to 5 PM, weekdays, June through September, excluding holidays) for existing construction, and 50 kW of Summer Prime Period Average Demand reduction for new construction. (for gas use, the minimum reduction is 25,000 therms during the gas peak period, November to April, which is the winter heating season). Since the primary objective of the program is to avoid the need for additional capacity, participant requirements are based on peak kW savings, though customers are paid on a cents/kWh basis, based on the time that energy savings are achieved.

The high level of reduction required for program eligibility automatically excludes residential customers and many small commercial customers. To address this shortcoming, the program allows the pooling of customers to meet the minimum kW reduction. Thus the PSCRC or the ESCO/third party can pool several customers to implement energy saving projects which add up to meet the minimum eligibility requirement. This is unique to the Standard Offer program. This feature of the Standard Offer program ensures that all customer, small and large, can participate in the program.

This unique and innovative approach taken by PSE&G to buy energy savings and thus reduce the need for system capacity additions is pertinent to the IRP analysis which considers the adoption of various supply and demand-side options to optimally meet energy. The Standard Offer program not only reduces energy demand, but also fosters a competitive market for energy saving services.

The program was developed in 1989 and formally begun in mid-1993. The cumulative data for 1993-1994 indicate energy savings of 230,219 GWh, with lifecycle energy savings of 2,098,000 GWh, and capacity savings of 58.51 MW, at a total cost of $1,102,037.

3.3 Variation in Approaches to Integrated Planning

The differences between integrated planning approaches undertaken by various countries are usually expressed through variations in their energy market structure, energy industry structure and industry regulation. Some of the differences in approach to integrated planning include:

Differences are usually expressed through variations in energy market structure, energy industry structure and industry regulation

- Variation in planning objectives — integrated planning is in some situations performed as an instrument to develop national energy policy, in another situation the objective of an integrated planning process can be corporate strategic planning or an energy provider

- Variation between the elements included in analysis — The elements to be included in the integrated planning process varies, in some situations only selective elements are performed (such as forecasting or risk assessment), while in other situations a full integrated planning approach is undertaken

- Variation between relative emphasis of elements — e.g., in some situations, an optimal resource development plan is the objective, and as such all elements are potentially equally important. In another situation an assessment of prices and risk exposure is the most important, and price forecasting and risk assessment may be the only interesting elements.

This emphasizes the need to understand the utility and market situation, since this serves to detail the types of objectives to pursue. For example, the case study for the Tennessee Valley Authority (TVA) reflects the changes in the market to purchase wholesale power and the resulting need for assessing and valuing flexibility. In comparison, the case study from British Columbia Hydro serves to detail the provincial need to assume a public policy position and use a community planning technique to optimize the system resources.

3.4 Integrated Planning — Two Key Categories

If integrated planning is classified following a framework[a] — by who and why the planning effort is carried out. In this context two key types of integrated planning are identified:

- Public policy based
- Business based.

3.4.1 Public-policy-based Integrated Planning

Public-policy-based integrated planning refers to a case where the utility industry and/or government entities can be involved to balance the above collective interests (1) and individual interests (2) and to identify key elements in an overall best resource allocation. The involvement of the utility industry is motivated by the industry assuming a larger public policy responsibility.

From a government or national perspective, the objectives reports to be more strongly focused on social policy goals to guide industry regulation. The specific tools used to perform this analysis need to be more focused on the implications of policy decision, rather than specific actions. The entire IRP analysis from this policy perspective may become more macro-economic. A utility's perspective would go in the opposite direction. It will be more focused on short term financial goals and less on long term efficiency, and detailed analysis of specific actions will be critical. This recognizes the increased risk faced by individual businesses.

Focused on social policy goals to guide industry regulation

The case study examples which best reflect a public-policy-based planning approach include:

- Pacific Northwest Planning Council — describes a modified process which was designed to solicit and incorporate input from the range of affected stakeholders beyond the utility. It treated the planning process on a more regional basis and looked at ways of minimizing the utility and societal risks associated with constructing new generation.

[a] Similar to the Subtask IV/1 report "Review and Documentation of Utility Structure and Characteristics of Participating Countries." This report establishes a framework for discussing and understanding the role of DSM and energy services programs. (IEA DSM Program 1995).

- British Columbia (B.C.) Hydro — focuses on a process which includes community planning approach to optimize the necessary energy infrastructure needs.

3.4.2 Business-based Integrated Planning

"Business-based" integrated planning refers to this efforts being part of the corporate planning effort. For example, the energy company may use integrated planning — or elements of integrated planning — to identify corporate strategies consistent with corporate objectives.

Since competitive markets place utilities under pressure to cut costs, integrated planning for utilities in this environment will generally focus on identifying least cost solution that are robust and incorporate future uncertainties. A key objective is the need to lower unit energy prices to remain competitive, and some utilities report to actively use elements of the integrated planning process to identify new products and services to offer in a more competitive environment.

Tennessee Valley Authority (TVA) — Option value theory in resource planning

An example of addressing this risk is using option value theory in resource planning. Some utilities have recognized that risk cannot be avoided, so they should try to mitigate it using financial instruments that are commonly used in the world markets. This will lead to more projects with shorter lead times, because the long lead time that is necessary for many generation investments increases the risk that the value of the investment will decrease. Utilities are also less likely to commit to building new resources just because an optimization model indicates the need in a given year. The case study example reflecting the flexibility value of DSM as exhibited by the Tennessee Valley Authority (TVA) serves as a good example. TVA uses call options or flexible construction practices to advance resource options. This approach permits TVA to place greater emphasis on future prices rather than costs of electricity as a planning criteria.

Both types of integrated planning can be relevant in all utility-market situations,[a] however the latter more likely to be most relevant in situations of unbundled completion and the former in situations of vertically integrated franchised energy markets. All elements of integrated planning is likely to be included in the former, while the latter type of integrated planning is likely to include only elements of this planning process.

3.5 The Role of Integrated Planning

What follows is a brief summary of the role of integrated planning as it relates to the generic utility-market situations described above.

3.5.1 Vertically Integrated, Franchised Monopoly

In a vertically integrated, franchised monopoly (model 1), integrated planning is often perceived as one of the most suitable approaches to identify and implement energy policy objectives. Various forms of integrated planning has been used to assess the economically optimal development of the energy sector and the power sector in particular.[b] Many or all of the elements described in Appendix A and B are observed as being relevant in this utility-market situation. There are often observed collaborative processes between the

[a] There are also likely to occur intermediate versions of integrated planning.

[b] See Subtask IV/2 Report "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options" for examples and a further discussion.

utility, industry regulators, government and other stakeholders, particularly in North-America. This process is likely to contribute to improving the public acceptance of resource plans.

Forecasting is likely to be an internal process within the utility, including both demand and supply. The time horizon is likely to be both long-term and short-term and segmentation is detailed. Models are likely to be both technical and econometric (e.g., MEDEE) and may include sophisticated probabilistic techniques. One of the key challenges is to gain access to detailed data. The utility is likely to be the primary source of information. This may change if utility-ownership changes, e.g., through privatization of the vertically integrated monopoly.

DSM assessment is likely to include a feedback from a market response (e.g., to tariffs). The need for tools depends very much on regulation and incentives provided through regulation. DSM objectives are however likely to be kept also after possible privatization. There is a wish to avoid price subsidies from DSM. This suggests a much greater reliance on the Rate Impact Measure test as an important economic perspective. Tools for assessing DSM options are likely to include technical and economic potential through engineering judgment, as well as a B/C analysis for screening options — primarily using a total resource or payback criteria.

The objective of the integrated planning process is to perform a screening of possible options. For those utilities who have some experience in developing resource plans, this points to the growing trend of focusing on new technology options. Those options which seem to be more mature are likely to be modified to reflect marketplace changes and the role of trade allies. The exercise is mainly perceived as a rate design and evaluation of how rates will impact demand. Risk analysis is performed through scenario analysis. Avoided costs are equal marginal costs which again are equal to customer tariffs. Calculating T&D avoided costs (and DSM programs for deferring grid upgrades) are a more complex issue. Environmental externalities are (1) internalized through compliance with emission standards, (2) through assessment and evaluation of impacts in the resource selection process.

The need to internalize costs for environmental externalities provides some difficulties to utilities operating as unbundled monopolies. In the United States, the benchmark for incorporating environmental externalities remains the 1990 Clean Air Act Amendment (CAAA) and its resulting compliance regulations. The CAAA requires utilities to submit compliance plans. This points to the need to include emission limits specified by the CAAA for Phases I (1995-1999) and II (2000 and beyond). The limits will vary by utility. As an example, Southern Indiana Gas and Electric Company translated an SO_2 allowance price of $125 per ton as part of its production cost inputs.[a] This requires utilities to identify a proxy value of SO_2 allowance prices by examining market conditions and assessing the resulting estimated emissions output from plants remaining in the IRP.

The case study of Jersey Central Power and Light Company presents a good example of a vertically integrated, franchised monopoly which is starting to re-position itself in the market. The utility must still respond to regulated DSM and IRP requirements but is starting to apply the Rate Impact Test as an increasingly important economic perspective. Additionally, the utility is working to link market penetration estimates from prior programs as a proxy for DSM program adoption all in an effort to cost-effectively use available data to reduce market risks.

[a] Southern Indiana Gas and Electric Company, 1995 Integrated Resource Plan, November 1995.

Illustrative Example — United States

Impetus and justification for IRP in the US

Integrated Resource Planning (IRP) emerged in the US from the aftermath of State regulatory commission reviews of the prudence of investing in expensive baseload generation plants. As noted above, many utilities choose to build large baseload plants (primarily nuclear and coal) based on demand forecasts that diverged from what actually occurred. These reviews resulted in the disallowance of billions of dollars of investment. As a result, the State commissions believed that greater regulatory oversight of the planning process was necessary. Utilities also believed that greater oversight might be beneficial since then the Commission would have a certain amount of responsibility for the decisions that were made.

States first instituted review of the demand forecasting process, as this was originally seen as the “culprit” of the planning process. State reviews expanded to the resource planning side, then evolved to “Least Cost Planning.” Least Cost Planning brought forth the idea that utilities should consider not only supply additions, but also demand-side options such as load control and (potentially) energy conservation. This concept evolved into the current concept of Integrated Resource Planning (IRP).

The objectives of IRP, as practiced in the US, are several fold. First, the planning process should consider all resource options open to the utility, including demand side management and non-utility generation source. Second, the IRP process should be both open and inclusive, and incorporate the diversity of public opinion on how best to meet future energy needs. Finally, the process should be one of balancing multiple objectives and choosing a resource strategy that best meets the requirements of multiple stakeholders and perspectives.

The traditional regulatory framework offered a strong financial incentive to invest in supply-side resources. IRP seeks to mitigate the incentive to favor supply and make demand-side options equally profitable. The outcome of IRP may be deferral of new capacity in favor of demand-side resources or the use of electricity instead of natural gas, for example, in end-use technologies in instances where the cost to society is lessened.

IRP is a public process involving utility, regulatory and third party intervenors such as public interest groups and environmental advocates. DSM collaboratives are an element of IRP that bring together a host of utility and non-utility stakeholders to discuss resource decisions. Collaboratives are a uniquely North American process and, while time consuming, have been a positive alternative to litigation.

Examples of analytical methods and processes used to performing the steps of integrated planning in North-America and the US are included in Appendix A.

Illustrative Example — France

In France, the fundamental role of marginal cost based pricing is apparent in the approach to integrated planning. A sophisticated system for not only determining but also transmitting to customers the time-varying costs of power enables the customer to make economically efficient decisions to reduce consumption or defer to off-peak periods. EDF’s electricity prices in France are set according to published tariffs for customers up to 40 MW, which apply to all parts of France. Individual contracts may be negotiated for larger customers on a non-discriminatory basis. The efficacy of time-differentiated pricing and tariffication is evident in the evolution of the national load curve, which has improved gradually over the past 30 years to an all-time high of 0.9.

3.5.2 Unbundled Monopoly

In a situation of an unbundled monopoly (model 2), integrated planning methodology can also be implemented as an effective mean to identify and reach energy policy objectives. The success of the implementation of integrated planning in this situation depends largely upon how close collaboration is established between the unbundled utility functions. The integrated planning process is further complicated relative to model 1 (above) because costs and benefits often occur with different entities. The industry regulator faces a potentially more complex situation since distinctly different utility entities must be monitored.

Forecasting is likely to be performed by the distribution company primarily for budgeting purposes and to increase utilization of assets (grid). A key issue is improvements in utilization of assets as a response to rate changes. The generation company receives and correlates forecasts received from distributor, this is often used to predict how contracts may reduce risk.

The distribution company is typically responsible for DSM assessments. Most customers are likely to be captive and distributors may co-operate with generators to perform DSM assessment and implementation.

Integrated planning — siting of T&D and generation resources can be more complex because of unbundling of utility business functions. Generation utility performs a generation capacity expansion plan (and export/imports) based on demand forecast (with and without DSM). Avoided costs can be a discounted kWh price, a key issue in this planning process is where you bring in kWh prices vs. DSM impacts

In the unbundled monopoly situation, some of the most recent examples of successful implementation of integrated planning exist, i.e., as planning has been practices in Holland and Denmark.

Illustrative Example — Denmark

In Denmark, with effect from March 1st, 1994 IRP is addressed in the electricity supply act. The production side must in co-operation with the distribution companies develop a collective electricity supply plan. The plan is produced and reported to the Danish Energy Agency every second year.[a] The law demands that the distribution companies map the electricity demand and the technical potential for electricity savings in their supply area together with the associated costs. Secondly, they must develop a 20 year plan for more efficient electricity use within their supply area showing different alternatives. The required implementation means must also be defined as well as their impact over a time horizon. In addition, the distribution companies must make sure that the mapping is consistent and the planning of the energy use is coherent.

The integrated planning process is largely performed through a collaborative effort and includes both the district heating and electric side of the system. There is placed large emphasis also on non-economic trade-offs between multiple objectives. These include

- Environmental impacts — compliance with emission allowances for SO_2 and NO_x as well as the power/heat sectors' contribution to national CO_2-targets

[a] The plans are coordinated though the ELKRAFT and ELSAM collaborations on Zealand and Jutland/Fyn respectively, and the first set of plans developed according to the integrated planning principle has been submitted in January 1996.

- Security of supply — such as reliance on multiple fuels and high quality of heat and power supply

- Competitive positioning — such as low total and marginal price of generation, security of demand for generation capacity, capability to adapt to both qualitative and quantitative changes in the energy market

- Perspectives to the future — such as the possibility to adapt to changed external constraints (such as environmental), assure that most measurable parameters move in the right direction over time, system adaptability to new technology alone the whole energy chain as this is expected to become available, recognize an expected increased interest in resource conservation, and national competitive positioning of selected solutions

- Political commitments — i.e., to ensure compliance with existing such as the commitment to increase the use of biomass to a level multiple times the existing, and secure demand for small-scale CHP and wind-generation

These objectives are approached in two steps. The first phase seeks to identify the least cost balance of demand and supply side options to achieve CO_2 commitments. This activity includes to identify the costs and CO_2-impacts from a series of measures, including

- Fuel substitution on existing system
- Establish new high efficiency fossil fueled system
- Increased use of biomass
- Wind generation
- Upgrade transmission and distribution efficiency
- Increased CHP generation
- Electricity conservation
- Heat conservation

The second phase establishes a series of scenarios to be evaluated — qualitatively and quantitatively — based on the criteria above. Three scenarios are developed — a reference scenario, a conservation scenario, and a balanced scenario — and they are discussed individually and compared.

3.5.3 Unbundled, Limited or Full Competition

In the situation of unbundled, limited or full competition (models 3 and 4), the elements of integrated planning — as performed by energy utilities — are likely to become more decentralized and business oriented. There is more focus on energy commodity price forecasting, risk assessment, risk control, and the results from the planning process often are proprietary. There is a stronger need to separate between and understanding the functions of business-based and public-policy-based integrated planning. Energy utilities can be less expected to undertake public policy functions as part of their ordinary (commercial) corporate activities. Integrated planning is still perceived as a tool to specify main guidelines for energy policy and to consider longer-term aspects of energy supply, diversification of primary energy sources, energy conservation strategies, environmental issues, etc. Such integrated planning functions can be carried out for the whole energy sector and for the power sector, in particular to identify and assess impacts from fuel substitution issues.[a]

The roles of the key actors in an integrated planning process will vary distinctively in a situation of unbundled, limited or full competition. It is therefore useful to discuss the elements of integrated planning separately for each key actor, these include:

- Distribution business — Forecasting is needed for network planning and operation, to predict distribution tariffs, customer load profile, estimation of losses, and on geographical conditions. DSM is viewed as a potential for deferral of grid investments and as distribution tariff instrument

- Supplier/generator — Forecasting is needed to plan purchases and own generation. Must estimate costs of T&D for own purchases/sales. Price forecasts become more important (i.e., to estimate pool prices and prices of competitors). Planning models for estimating and communicating risk exposure is increasingly important. There are data problems since the supplier/generator is likely to only have detailed data for own customers. Methods and tools for this situation are only available to a limited extent. A key issue is that the supplier/generator does not know the number of customers, there must be a much more focus on customer needs and market research techniques to quantify such. DSM is likely to be bundled with tariffs and customer contracts, i.e., it will be part of service packages provided by the successful supplier to specific customers with a commercial motive (customer retention /attraction). There will be a need for B/C screening for own activities, increased need for market research, in some situations in co-operation with own distribution company

- Transmission Company — Responsible for transmission system operation. DSM may will for example include to forecast the needs for interruptible loads available for spinning reserve requirements. There will be a need for long-term forecasts to calculate transmission tariff and for transmission expansion planning

- Government — Integrated planning techniques are likely to be performed for national energy policy purposes, e.g., as a benchmark for energy market performance and least cost allocation of energy resource options. Tools for controlling and monitoring competition and natural monopolies (grid) is necessary, as well as tools for evaluation impacts from government policy

Local Integrated Planning

In a situation of unbundled, limited or full competition, integrated planning may successfully fill a more decentralized function. This is e.g., illustrated by the possibility for the energy utility to carry out an integrated plan for a limited area and to co-ordinate energy infrastructure development with other infrastructure development in urban, suburban and rural settings. The example from British Columbia Hydro, Canada (BC Hydro) illustrates this.[b] Local integrated planning[c] can help energy businesses to reduce capital expenditures

[a] Examples of this use of integrated planning is further discussed in Subtask IV/2 Report "Inventory of Available Methods and Processes for Assessing the Benefits, Costs, and Impacts of Demand-Side Options" and in Appendix A.

[b] See Appendix A of this report. There exists other examples of local area integrated planning from North-America, Europe and elsewhere.

[c] Local integrated planning is known under various names, including "Targeted Area Planning", "Local Area Investment Planning", "Distributed Resources Planning."

or improve customer service. Some of the key benefits from applying integrated planning to a local area include:[a]

- Can improve utilization of T&D system assets while increasing grid reliability — This is likely to lead to reduced cost per unit of electricity delivered, and deferred or avoided capital expenditures

- Can provide risk insurance — in a period of great uncertainty caused by restructuring, it may make sense from a risk reduction perspective to defer capital expenditures. E.g., may compensation not be clarified in case of grid ownership transfer

- Can provide experience with modular technologies — this can be an important competitive advantage as economies of scale benefits and cost in general are decreasing

- Adds flexibility — as more modular resources can be added, a utility is likely to be in an improved position to adapt to future changes

- Maintain profitable load — one result of assessing demand options more closely is to discover potential loss of energy load to other competing fuels. Load retention programs may be developed as appropriate.

Illustrative Example — Norway

In Norway, there is no requirement of the electric utilities to perform integrated planning, and utilities assume a very limited public policy responsibility. Power capacity expansions are left to be decided by power market prices, and there are few attempts to develop a plan for optimal allocation of resources. However, elements of integrated planning are being performed. Utilities, e.g., are using planning tools to assess the size and type of risk and to manage this risk according to corporate objectives. Price forecasting techniques involved in this process are becoming increasingly important.

[a] See "Local Integrated Resource Planning: A New Tool for a Competitive Era", Strategic Issues Paper, E Source Inc. 1995

4. CONCLUSIONS AND RECOMMENDATIONS

There are significant differences and variations between utility market situations regarding the role and function filled by the integrated planning effort, i.e., why and who carries out the integrated planning effort. However, many of the technical elements of integrated planning can be found across most utility-market situations. The relative emphasis of these elements in the integrated planning effort varies

This study classifies integrated planning following a framework[a] — by who and why the planning effort is carried out. In this context two key types of integrated planning are identified and characterized:

- Public policy based — Public policy based integrated planning refers to a case where the utility industry and/or government entities can be involved to balance the above collective interests and individual interests and to identify key elements in a resource allocation consistent with energy policy objectives, such as reaching a CO_2 emission target. The involvement of the utility industry is justified by the industry assuming a larger public policy responsibility.

- Business based — "Business based" integrated planning refers to this efforts being part of the corporate planning effort. For example, the energy company may use integrated planning — or elements of integrated planning — to identify corporate strategies such as e.g., to develop new products and services to increase profit margins and customer loyalty.

To meaningfully discuss the role of integrated planning across different utility-market situations, this study has developed a limited set of generic situations that are based on a robust framework.[b] A summary of conclusions regarding the possible relationships between integrated planning and utility-market situation is provided in Table 4.

Table 4 Relationship between integrated planning and Utility-Market Situation

Characterization model	Likely Type and role of integrated planning

[a] Similar to the Subtask IV/1 report "Review and Documentation of Utility Structure and Characteristics of Participating Countries." This report establishes a framework for discussing and understanding the role of DSM and energy services programs. (IEA DSM Program 1995).

[b] A similar approach of designing generic situations has been applied in other studies, including: Integrated Resource Planning and Demand-side Management in Europe: Present Status and Potential Role"(UNIPEDE 1994) and "European B/C Methodology for DSM and energy efficiency services programs" (SRC International 1994)

Model 1 — Vertically integrated, regulated monopoly	• Often perceived as suitable approach to identify and implement energy policy objectives • Various forms of integrated planning has been used to assess the economically optimal development of the energy sector and the power sector in particular • Many or all of the integrated planning elements are observed as being relevant • Often observed collaborative processes between the utility, industry regulators, government and other stakeholders (particularly in North-America) • Integrated planning process is likely to contribute to improving the public acceptance of resource plans.
Model 2 — Unbundled monopoly	• Can be implemented as an effective mean to identify and reach energy policy objectives • Success depends largely upon close collaboration between the unbundled utility functions • Integrated planning process is further complicated because costs and benefits often occur with different entities • Industry regulator faces a potentially more complex situation since distinctly different utility entities must be monitored
Model 3 — Unbundled, limited competition Model 4 — Unbundled, full competition	• The elements of integrated planning — as performed by energy utilities — likely to become more decentralized and business oriented • More focus on energy commodity price forecasting, risk assessment, risk control, • Results from the planning process often are proprietary • Separate and understand the business-driven functions and public-policy-driven functions of integrated planning • Energy utilities less expected to undertake public policy functions as part of their commercial corporate activities • Still perceived as a tool to specify main guidelines for energy policy and to consider longer-term aspects of energy supply, diversification of primary energy sources, energy conservation strategies, environmental issues, etc. • Can be used to identify and assess impacts from fuel substitution issues

5. BIBLIOGRAPHY AND REFERENCES

Association for the Conservation of Energy, Least-Cost Planning in the European Community, prepared for the Commission of the European Communities, Directorate General for Energy, February 1991.

American Public Power Association 1992, Demand-Side Management and Public Power, The Quiet Revolution, Findings from a Survey of Publicly Owned Utilities, American Public Power Association, Washington, DC

Australia and new Zealand Minerals and Energy Council IRP Study Management Committee, Least Cost Energy Services for Australia, April 1994

Borison A., and G. Balachandran, "Choosing Options", Public Utilities Fortnightly, December 15, 1992.

California Public Utilities Commission and California Energy Commission (CPUC/CEC). 1987, Standard Practice Manual, Economic Analysis of Demand-Side Management Programs, P400-87-006, California Energy Commission, Sacramento, California.

Caramanis M., " Investment Decisions and Long-Term Planning under Electricity Spot Pricing", IEEE Transactions in Power Apparatus and Systems, PAS-101 (12), December 1982.

Castillo Bonet M., Comparative Evaluation of the State of the Art in Capacity Expansion Planning Programs for Power Systems, Optimal Systems modeling, Inc. Report TR/ES-84012, Newton, M.A., February 1984.

CIGRE 1994, "Relationship between power system planning and factors affecting the electricity demand", CIGRE SC 36 "Power system planning and development", Report no. 37.94 (WG11)08(E)

CIGRE 1996 "IRP in different business environments", final report from Working Group 37-11

Cohen S., et.al. 1990, A Survey of State PUC Activities to Incorporate Environmental Externalities into Electric Planning and Regulation, LBL-28616, Lawrence Berkeley Laboratory, Berkeley, California.

R.F. Chow and P.S. Owens, Ontario Hydro, "Collingwood Targeted DSM Project: Inception to Program Design", presented to the Canadian Electrical Association, Distribution Systems Planning #15, Ottawa, Ontario, (September 27, 1994, and revised August 1995)

Davidson A., 1991, "Integrated Resource Planning - Should Utilities Invest in Energy Efficiency Rather than in New Suppliers?" Oxford Institute of Energy Studies.

Danish Ministry of Energy, 1990, Energy 2000 - A Plan of Action for Sustainable Development, Copenhagen, Denmark, April 1990.

De Almeida A., et. al, Integrated Electricity Resource Planning, Kluwer Academic Publishers, Boston, 1994.

EPRI, 1987, Cost-Benefit Analysis of Demand-Side Planning Alternatives, Electric Power Research Institute, EM-5068, February 1987.

EPRI 1990, Least-Cost Planning in the United States: 1990, EPRI Report CU/6966, Electric Power Research Institute, Palo Alto, USA, May 1990.

EPRI 1991, Environmental Externalities: An Overview of Theory and Practice, EPRI Report CU/EN-7294, Electric Power Research Institute, Palo Alto, USA, May 1991.

E Source Inc. 1995 "Local Integrated Resource Planning: A New Tool for a Competitive Era", Strategic Issues Paper, E Source Inc. 1995

Faruqui A., et. al., 1990, Impact of Demand-Side Management on Future Customer Electricity Demand: An Update, EPRI CU-6953, Electric Power Research Institute, Palo Alto, California, September.

Ford A. and J. Geizner, 1990, "Adding Uncertainty to Least Cost Planning: A Case Study of Efficiency Standards in the Northwest," Energy Policy. V. 18, N. 4, 331-339, May.

Gellings, Clark and Dilip Limaye 1988 Strategic Marketing for Electric Utilities, Fairmont Press Inc.

Gellings, C. and J. H. Chamberlin 1987 Demand Side Management: Concepts and Methods, Fairmont Press Inc.

Goldman C., and M. Hopkins, 1991, Survey of State Regulatory Activities on Least Cost Planning for Gas Utilities. National Association of Regulatory Utility Commissioners, Washington, D.C.

Government Pricing Tribunal of NSW, Price Regulation and Demand Management, September 1994

Halberg, 1991, "European Experiences - Euroelectric Report", International Conference on Demand-Side Management and Least Cost Planning, Copenhagen, October 23-24, 1991.

Hennicke P., "Least-Cost Planning in the FRG: Concepts and Experiences", Wuppertal Institute for Climate, Environment and Energy.

Hill L., et. al, 1991, Integrating Demand-Side Management Programs into the Resource Plans of U.S. Electric Utilities, Oakridge National Laboratory, January 1991.

Hirst E., 1990, Guidelines for a Good Integrated Resource Plan, Public Utilities Forthnightly, March 29, 1990.

Hirst E., and J. Reed, eds. 1991, Handbook on Evaluation of Utility DSM Programs. ORNL/CON-336, Oak Ridge national Laboratory, Oak Ridge, Tennessee.

Hirst E., and C. Sabo, 1991, Electric Utility DSM Programs: Terminology and Reporting Formats. ORNL/CON-337. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Hirst E. 1995 "Marginal Cost of Service Analysis: A Powerful Marketing Tool For Electric Utilities," Oak Ridge National Laboratory, ORNL/CON-251, February 1988.

Hobbs B.F., "The 'Most Value' Test: Economic Evaluation of Electricity Demand-Side Management Considering Customer Value", The Energy Journal, Vol. 12, 2, 1991.

Hoch L. J. and Regina Roberts, "Towards a DSM Cost-Effectiveness Test for Australian Utilities", Proceedings of the First National DSM Conference, Melbourne, Australia, May 1992.

Hohmeyer O., 1989, Social Costs of Energy Consumption, Springer-Verlag, Berlin, 1988.

IEA, 1989, Electricity End-Use Efficiency, International Energy Agency, Paris.

IEA, 1994, Electricity Supply Industry — Structure, Ownership and Regulation in OECD Countries, International Energy Agency, Paris.

IEA DSM Program 1994 "Annual Report 1994", report published by the IEA DSM program.

Johansen, S.E. and D.T. Hoog, 1994, "European B/C Analysis Methodology for DSM and energy efficiency services programs — Phase I: Framework", report presented at the EU-SAVE Conference: The SAVE Program: Overview and Future, Florence, 26-28 October, 1994

Kahn A., "An Economically Rational Approach to Least-Cost Planning", The Electricity Journal, June 1991.

Krause F., and J. Eto, 1988, Least-Cost Planning: A Handbook for Public Utility Commissioners, Volume 2,

Limaye D., 1991, "Integrated Resource Planning: Developing Least-Cost Utility Strategies", International Conference on Energy Consulting, Graz, Austria, September 1991.

Lucas N., and Papaconstaninou D., Electricity Planning under Uncertainty Risks, Margins and Uncertain Planner, Energy Policy, June 1982.

Lyons, P.K. 1996 "EU Energy Policies in the mid-1990s" EC Inform (April 1996)

Mitchell C., 1992, "Integrated Resource Planning Survey: Where the States Stand", The Electricity Journal, May 1992.

Mickle C., and I. Brown, 1990, Least Cost Planning in the European Community, Association for the Conservation of Energy, London.

Moen J., "Regulation and DSM, Catalyst or Troublemaker", Proceedings from IEA Korea International Conference on DSM, November 4-5, 1993, Soul, Korea.

Moskovitz D., et. al., 1991, Increasing the Efficiency of Electricity Production and Use: Barriers and Strategies, American Council for an Energy Efficient Economy, Washington, D.C., November 1991.

Nadel S., 1990, "Electric Utility Conservation Programs: Lessons Learned from a Decade of Experience" Proceedings of ACEEE 1990 Summer Study on Energy Efficiency in Buildings, Vol. 8, pp. 179-206.

Nadel S., et. al., 1992, Financial Incentives for Utility DSM. American Council for an Energy Efficient Economy, Washington, D.C.

NARUC, 1988, Least-Cost Utility Planning Handbook - A Handbook for Public Utility Commissioners, Washington, D.C.

National Grid Management Council, Demand Management Opportunities in the Competitive Electricity Market, Australia, June 1994

Newcomb, J. and W. Byrne "Real-Time Pricing and Electric Utility Industry Restructuring: Is the Future out of Control" E Source Strategic Issues Paper, SIP V (April 1995)

Nilsson H., "DSM and Energy Efficiency", Unpublished Paper, NUTEK, S-117 86 Stockholm, Sweden.

Ottinger R., et.al., 1990, Environmental Costs of Electricity, NY: Pace University, Oceana Publications, 1990.

Raab J., and M. Schweitzer, 1992, Public Involvement in Integrated Resource Planning: A study of Demand-Side Management Collaborative. ORNL/CON-334. Oakridge National Laboratories, Oakridge, Tennessee.

Rabl V., 1992, "DSM: What's Happening Today." Presented at Resource and Investment Planning Forum: Integrated Resource Planning for the 1990's, Opportunities, Challenges, and Responses. Atlanta, Georgia, 17 March 1992.

Rosenblum B., and J. Eto, 1986, Utility Benefits from Targeting Demand-Side Management Programs at Specific Distribution Areas, EPRI EM-4771. Electric Power Research Institute, Palo Alto, California.

Ruff L., 1987, The Basic Economics of Utility Least-Cost Planning and Demand-Side Management, Northeast Utilities, October 1987.

Ruff L.E., "Least-Cost Planning and Demand-Side Management: Six Common Fallacies and One Simple Truth", Public Utilities Fortnightly, April 28, 1988.

Schweitzer M., et. al., 1990, Key Issues in Integrated Resource Planning: Findings from a Nationwide Study, Oakridge National Laboratory, February 1991.

Schweppe F.C., et al., Spot Pricing of Electricity, Kluwer Publishing, Norwell, MA., 1988.

Synergic Resources Corporation, SRC/COMPASS ® — Comprehensive Market Planning and Analysis System, User Guide, Bala Cynwyd, PA, 1993.

SRC International, 1996, European B/C Analysis Methodology for DSM and energy efficiency services programs Guidebook, SRC International, Copenhagen

Stoll H., 1989, Least-Cost Electric Utility Planning, John Wiley & Sons, New York.

Swisher J. and Ren Orans, A New Utility DSM Strategy Using Intensive Campaigns Based on Area Specific Costs, " Proceedings of ECEEE Summer Study: the Energy efficiency Challenge for Europe (Stockholm, European Council for an energy efficient economy, June 1995)

National Association of Regulatory Utility Commissioners, Washington, D.C. The Demand-Side: Conceptual and Methodological Issues.

UNIPEDE, Least-Cost Planning in the Electricity Supply Industry: Experiences in the United States and Europe, Ad Hoc Group on Least-Cost Planning, march 1992.

UNIPEDE, Taropt, 1994, Integrated Resource Planning and Demand-Side management in Europe: Present Status and Potential Role, Economics and Tariffs Study Committee 60.04, Taropt.

Wolf T. and C. Mickle, Integrated Resource Planning in Europe, prepared for Greenpeace International, October 5, 1992.

6. GLOSSARY OF SELECTED TERMS

Access Charge — A charge for access to a utility's transmission or distribution system. It is a charge by the network owner to a supplier or a customer for the right to send electricity over the wires.

Achievable Potential — Estimate of the amount of energy and economic savings that would occur if all cost-effective, energy-efficient options promoted through DSM and energy efficiency programs were adopted.

Aggregator — An entity that aggregates customers into a buying group for the purchase of a commodity service. Entities such as buyer cooperatives or brokers may perform this function in a restructured power market. This is opposed to marketer which will be defined as an entity that represents different suppliers.

Appliance Efficiency Standards — A government initiative that sets a minimum energy efficiency requirement for new appliances brought to market.

Audit — Inspection of a house, building, or industrial process by an expert who makes recommendations for ways the customer can more efficiently use energy.

Avoided Cost — The incremental cost that a utility would incur to produce or purchase an amount of power equivalent to that saved under a DSM program, and/or the incremental cost that a utility would save by deferring or eliminating the need to construct additional generation, transmission or distribution capacity through the implementation of a DSM program.

Bilateral Contract — A direct contract between the power producer and user or broker outside of a centralized power pool or POOLCO.

Bill Inserts — Written material (e.g., program announcement, newsletter, publication notice, etc.) enclosed in utility bills mailed to customers.

Broker — A retail agent who buys and sells power for customers or generators, without taking own risk or financial position. The agent may also aggregate customers and arrange for transmission, firming and other ancillary services as needed.

Capacity — Refers to the maximum output of a power plant or a power system (usually expressed in MW); or the maximum load, which can be carried by an element (kW) of a transmission or distribution system.

Capacity (Wires Businesses) — The quantity of power that can be transferred through a transmission or distribution system.

Captive Customer — A customer who does not have economically realistic alternatives to buying power from the existing local utility, even if that customer had the legal right to buy from competitors.

Co-op — This is the commonly used term for a rural electric cooperative. Rural electric cooperatives generate and purchase wholesale power, arrange for the transmission of that power, and then distribute the power to serve the demand of rural customers. Co-ops typically become involved in ancillary services such as energy conservation, load management and other demand- side management programs in order to serve their customers at least cost.

Contestable Customers — Electricity customers who will have the opportunity to choose how their electricity needs will be met. They may take their supply from the retail supplier operating in their area, or buy from other retail suppliers, or from a generator, or from the wholesale pool. (See also Captive Customers, Non-contestable Customers).

Contracts for Differences (CfD) — A type of bilateral contract where the electric generation seller is paid a fixed amount over time which is a combination of the short-term market price and an adjustment with the purchaser for the difference. For example, a generator may sell a distribution company power for ten years at 6/kWh. That power is bid into Poolco at some low /kWh value (to ensure it is always taken). The seller then gets the market clearing price from the pool and the purchaser pays the producer the difference between the Poolco selling price and 6/kWh (or vice versa if the pool price should go above the contract price).

Corporatization — Formation of a public enterprise into a corporation under corporations legislation, usually with publicly owned shares.

CPI minus X — A form of price regulation whereby adjustments to the regulated electricity business (e.g., the wires business) so that prices are limited to change in the Consumer Price Index (CPI) less a productivity Improvement factor (X).

Cream Skimming — Activities in which the most profitable opportunities for demand management or conservation are taken up first, leaving the less profitable opportunities for later (or never).

Demand Bidding — Customers with dispatchable loads may become market participants and inform the PoolCo of the capacity of each generating unit and/or dispatchable load for each trading interval of the trading day, as well as the price they are prepared to receive for dispatching their demand for each period of the bid period. The submission of dispatch bids are preferably made using an electronic communication system, and the PoolCo makes the market clearing taking customers' dispatchable demand bids into account

Derivatives — A specialized security or contract that has no intrinsic overall value, but whose value is based on an underlying security or factor as an index. A generic term that, in the energy field, may include options, futures, forwards, etc.

Direct Access — The ability of a retail customer to purchase commodity electricity directly from the wholesale market rather than through a local distribution utility. (See also Retail Competition)

Dispatch — The centrally coordinated process of loading generators in order to meet the total customer load.

Distributed Generation — A distributed generation system involves small amounts of generation located on a utility's distribution system for the purpose of meeting local (substation level) peak loads and/or usually displacing the need to build additional (or upgrade) local distribution lines.

Distribution — The delivery of electricity to the retail customer's home or business through low voltage distribution lines.

Distribution Utility (Disco) — The regulated electric utility entity that constructs and maintains the distribution wires connecting the transmission grid to the final customer. The Disco can also perform other services such as aggregating customers, purchasing power supply and transmission services for customers, billing customers and reimbursing suppliers, and offering other regulated or non-regulated energy services to retail customers. The "wires" and "customer service" functions provided by a distribution utility could be split so that two totally separate entities are used to supply these two types of distribution services.

DSM Measures — Actions taken at customer site (e.g., installation of energy-efficient equipment) to modify the amount or timing of energy consumption.

DSM Programs — Organized activities that are intended to affect the amount and timing of customer energy use.

Economic Potential — Estimate of the possible energy savings assuming that all energy-efficient options will be adopted and all existing equipment will be replaced with the most efficient whenever it is cost-effective to do so, without regard to market acceptance.

Efficiency Standards — Refers to a range of government initiatives that set minimum energy efficiency requirements for new appliances (appliance efficiency standards) or new construction (building standards).

Eligible Market — Any set of customers or participating units that qualify for a program based on the program's participation criteria.

Energy Service Company — A firm that specializes in providing energy efficiency services, as well as other related services (e.g., maintenance) for a fee. Typically, this firm enters into contractual agreements with utility companies to assist in planning, implementation/delivery, monitoring and evaluation of DSM programs. (commonly abbreviated ESCO)

Energy Services — Energy services are the services required to convert a supplier’s energy available at the customer’s premises (“the commodity”) into something of real value to the customer. The term “energy efficiency services” refers to the services required to specifically ensure that conversion of energy at the customer’s premises is as efficient as possible, given technical and financial constraints

Feebates — Energy efficiency promoted through direct financial mechanisms such as tax credits or subsidies for efficient technologies and surcharges for inefficient technologies. The feebate usually offers a rebate for products above a designated efficiency standard and a fee for products below it.

Forwards — A forward is a commodity bought and sold for delivery at some specific time in the future.

Franchise Customers — See Captive Customers

Franchise right — The exclusive right to sell a product/service in an area.

Free Drivers — Customers who take DSM-program-recommended actions because of the program, but who do not participate directly in the program (e.g., they do not claim rebates).

Free Riders — Customers who would have adopted program recommended actions even without the program and who participate directly in the program (e.g., they claim rebates).

Fuel Substitution — Substitution of one form of energy (gas, electricity, oil, etc.) with another form of energy for a particular end use. Conversion of a gas-fired furnace to electric induction heating is an example.

Fuel Substitution Programs — Programs which encourage change from one fuel to another for a particular end-use.

Futures Market — Arrangement through a contract for the delivery of a commodity at a future time and at a price specified at the time of purchase. The price is based on an auction or market basis.

Hedging Contracts — Financial contracts which provide a means for pool participants to reduce their exposure to the variability of spot prices for bulk electricity purchased trough the wholesale pool, thereby offering a measure of stability to participants' cashflows.

IOU — An investor owned utility. A designation used to differentiate a utility owned and operated for the benefit of shareholders from municipally or publicly owned and operated utilities.

IPP — Independent Power Producer. An private entity that operates a generation facility and sells power to electric utilities for resale or to retail customers.

IRP — Integrated Resource Planning is a planning process to consistently assess a variety of demand and supply resources to meet customer energy service needs at the lowest, reasonable economic cost, subject to utility-specific or government-specific objectives

ISO — Independent System Operator. A neutral operator responsible for maintaining instantaneous balance of the grid system. The ISO performs its function by controlling the dispatch of flexible plants to ensure that loads match resources available to the system.

Leasing — Equipment, such as lighting or water heaters, may be leased to a customer at low rates. This equipment may be directly installed, or bought by the customer to be installed at a later date.

Load Control — Actions taken by a utility to switch on and off the supply to customer's' equipment or appliance to an agreed pattern. The switching can be done mechanically through a switchboard mounted time clock-based switch, or through signals carried by the powerlines.

Load Shifting Programs — Programs which aim to move energy consumption from one time to another (usually from the on-peak to off-peak periods during a single day).

Lost Revenues — Revenues not collected from sales lost as a direct result of DSM programs promoting energy efficiency and/or load management.

Marginal Cost — In the utility context, the cost to the utility of providing the next (marginal) kilowatt-hour of electricity, irrespective of sunk costs.

Market Clearing Price — The price to all generators for bulk electricity purchased through the wholesale pool. It is set as the highest price bid by a generator which is actually dispatched. With demand bidding, the market clearing price can also be set by demand bids if these are the highest of all bids used. The market clearing price can e.g. change half-hour hourly, hourly, or bi-hourly, depending on pool arrangements and the bids made.

Municipal Utility — A provider of utility services owned and operated by a municipal government.

Natural Monopoly — A situation where one firm can produce a given level of output at a lower total cost than can any combination of multiple firms. Natural monopolies occur in industries which exhibit decreasing average long-run costs due to size (economies of scale). According to economic theory, a public monopoly governed by regulation is justified when an industry exhibits natural monopoly characteristics.

Network Owner — Any business which owns the transmission and/or the distribution network.

Network Services Charges — The charges that are made by the network owners for "carrying" electricity from the supply point (usually a generator busbar) to the customer's property. There are two types of network services charges - one made by the high voltage transmission business, and the other made by low voltage distribution business.

Non-contestable Customers — Customers with a maximum demand above the limit for contestability but who cannot be economically supplied by any party other than their current retail supplier. If the limit for contestability is reduced low enough, most residential customers became non-contestable because of the high transmission costs (e.g. for re-metering) involved in transferring them to another retail supplier, as compared with the revenue receivable. (See also Captive Customers, Contestable Customers)

Operation & Maintenance Costs — Non-capital, equipment-related expenses that continue over the life of the equipment; they include fuel costs as well as costs for maintenance and service of equipment (Also referred to as O&M Costs).

Options — An option is a contractual agreement that gives the holder the right to buy (call option) or sell (put option) a fixed quantity of a security or commodity (for example, a commodity or commodity futures contract), at a fixed price, within a specified period of time.

Participant Costs — Expenses associated with taking part in a DSM program paid by the customer and not reimbursed by the utility or government.

Participant Test — Evaluation of the cost-effectiveness seen from the participant perspective rather than the utility perspective. The cost component of this test is the participant's cost of purchasing the equipment, or other expenditures necessary to participate. The benefits side of this test consists of incentives (rebates) provided by the utility and the participant's bill savings.

Participants — Units used by a utility to measure participation in its DSM programs. Some unit examples include customers, households, equipment, floor area, and kW-connected.

Participation Rate — Ratio of the number of participating units in a program to the number eligible for the program, with both the numerator and denominator defined in the same units.

Payback — The amount of time required for an investment cost to be recovered based on the benefit stream received (usually undiscounted).

Performance-Based Regulation (PBR) — Any rate-setting mechanism which attempts to link rewards (generally profits) to desired results or targets. PBR sets rates, or components of rates, for a period of time based on external indices rather than a utility's cost-of-service.

Poolco — Poolco refers to a specialized, centrally dispatched spot market power pool that functions as a short-term market. It establishes the short-term market clearing price and provides a system of long-term transmission compensation contracts. It is regulated to provide open access, comparable service and cost recovery. A poolco would usually make ancillary generation services, including load following, spinning reserve, backup power, and reactive power, available to all market participants on comparable terms. In addition, the Poolco may also provide settlement mechanisms when differences in contracted volumes exist between buyers and sellers of energy and capacity.

Portfolio Management — The functions of resource planning and procurement under a traditional utility structure. Portfolio management can also be defined as the aggregation and management of a diverse portfolio of supply (and demand-reduction) resources which will act as a hedge against various risks that may affect specific resources (i.e., fuel price fluctuations and certainty of supply, operational reliability, changes in environmental regulations, and the risk of health, safety, and environmental damages that may occur as a result of operating some supply resources).

Ratepayer Impact (RIM) Test — The Ratepayer Impact Test is designed to measure the impact of a DSM program on the utility's average tariff. This test is often thought of as the non-participating ratepayer's (tariff-payer's) cost test. The cost components of this test include the utility's program administration (or overhead) costs, incentive costs, any direct expenditure by the utility to purchase conservation equipment, and the utility's lost revenue. The benefit side of this test consists of the utility's avoided cost.

Rebate — Money given to customers, homebuilders, or other trade allies who make equipment choices to help defray the incremental cost of DSM measures.

Replacement — The installation of new equipment in place of worn out or obsolete equipment (i.e. at the end of the old equipment's useful life).

Reserve Margin — The amount of capacity a utility has available in excess of its system peak load, expressed in MW or as percentage of the peak.

Retail Supply Business — The business of purchasing electricity at bulk supply points and selling it to retail customers. The electricity may be physically transported over a distribution system owned by another party, and payments made for the use of that system.

Retrofit — Replacement or upgrading of equipment before it reaches normal retirement age.

Societal Test — Benefit/cost test which includes total resource costs and external benefits such as residual environmental impacts. Costs include DSM measure costs and program costs. Benefits include avoided supply costs and environmental benefits.

Sunk Cost — In economics, a sunk cost is a cost that has already been incurred, and therefore cannot be avoided by any strategy going forward.

Technical Potential — Estimate of possible energy savings based on the assumption that existing appliances, equipment, building-shell measures, and industrial processes will be replaced with the most efficient commercially available units regardless of costs.

Technology procurement programs — Technology procurement programs facilitate development and commercialization of new technologies or solutions. A procurement program usually involves active collaboration between one customer and many manufacturers. For example, manufacturers compete in providing new equipment or solutions matching specifications for an upfront guaranteed delivery (and potential profit). Procurement programs have been applied in defense, transportation, housing, power generation and heavy industry sectors.

Telemarketing — Telephoning a large sample of customers to obtain their interest in participating in a DSM program. Customers are targeted based on previously identified information (e.g., participation in past programs, city codes, telephone area codes, previous market surveys, etc.).

Third party — Third party refers to all non-utility and non-government actors involved in DSM activities. Third parties include manufacturers and retailers of energy efficient equipment or ESCOs

TRC Test — The Total Resource Test evaluates the impact of DSM programs on the total customer bill for energy services, including participants and non-participants. The cost components include the utility's program administration (or overhead) costs and the cost of buying the actual conservation measures Incentive costs are not included. The benefits consist of the utility's avoided cost.

Unbundling — Disaggregating electric utility service into its basic components and offering each component separately for sale with separate rates for each component. For example, generation, transmission and distribution could be unbundled and offered as discrete services.

Utility Cost Test — This test assumes that the utility's objective is to minimize revenue requirements. The cost components of this test include the utility's program administration (or overhead) costs, incentive costs, and any direct expenditure by the utility to purchase DSM equipment. The benefits consist of the utility's avoided cost.

Utility Costs — All expenses (administrative, equipment, incentives, marketing, monitoring and evaluation, and other) incurred by a utility in a given year for operation of a DSM program.

Vertical Integration — A type of organizational structure where a single authority has control over two or more of the three major functions of electricity supply: generation, transmission and distribution (including both the retail supply business and the 'wires' business).

Wholesale Power Market — The purchase and sale of electricity from generators to resellers (who sell to retail customers) along with the ancillary services needed to maintain reliability and power quality at the transmission level.