Final Report

INTERNATIONAL ENERGY AGENCY
DEMAND SIDE MANAGEMENT PROGRAMME

TASK XIII: DEMAND RESPONSE RESOURCES

Project Participant Country Comparison Report

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Final Report

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Introduction

Australia. Denmark. Finland. Italy. Japan. Korea. Netherlands. Norway. Spain. Sweden. USA. Task XIII is fortunate to have such a diverse group of participants. This brings a wealth of industry knowledge and cultural experiences from many corners of the world. This collective wisdom will enable Task XIII to accomplish its mission: Develop toolkits that help facilitate the development and implementation of demand response resources in liberalized energy markets.

Task XIII is an International collaborative effort designed to help foster the development of demand response solutions in markets around the world. This is to be accomplished by leveraging the experiences of the participating experts from each country. However, In order to have an appreciation for the knowledge and experience from foreign markets, one must have a basic understanding of how that market operates and its general market demographics.

This paper will provide some comparative information about the participating countries and will give the reader some basic market information about each participating nation. This will lead to an understanding of how and why nations may chose to act in certain ways. From this, the reader will understand whether experience in other nations will correlate with actions in his or her own country. This paper is not intended to provide a detailed description of DR programs and/or pilot efforts of the participating countries. Though, it will provide a demographic overview of the participants so that it will be easier to comprehend how these efforts work in their countries.

Task XIII began in April 2004. At the time this paper was prepared, the project held two Expert Meetings (Valencia and Milan); hosted a few monthly project teleconferences; completed surveys that provided information on the participating countries project goals/objectives, basic market institutions and operating structures, and general market demographic data; and, exchanged countless telephone calls, emails, and research reports. During these discussions and information exchanges it became apparent that the project participants share a significant number of similarities. This realization will make it easier for Task XIII to produce useful toolkits and DR implementation recommendations for all project participants.

We are able to identify similarities in areas such as why the country was interested in utilizing demand response resources (DRR) (e.g. mitigate market power), common institutions (e.g. most nations had some sort of system operator and energy exchange), and most nations have some demand response market implementation or research project in place today, just to name a few. There are some differences amongst the project participants (e.g. some nations do not have access to the same granularity of market data as others), but the basic similarities amongst the participants greatly overshadow the differences.

This paper is organized into two sections:

SECTION 1: Energy Market Descriptions - Provides a general overview of each Task XIII participant. The descriptions include information on each country's basic market design, retail liberalization status, regulatory responsibilities, and general demand response activities.

SECTION 2: Market Data Tables - Contains data tables that provide demographic insight into each country and how it compares with the other project participants.

SECTION 1: Energy Market Descriptions

The below discussions describe the basic market operation and regulatory oversight process used in each participating country.

Australia (NEM):

Australia has one “national energy market” (NEM) that covers the populous east-coast states of Queensland, New South Wales, Victoria, South Australia, and Tasmania.

It should be noted that Western Australia, the Northern Territory, or Tasmania are not included in the NEM. Therefore, they are not included in any of the subsequent information or the data tables at the end of the report.

Created in December 1998, NEM provides a wholesale market for electricity and open access to transmission and distribution networks. The NEM is a gross pool market that has a regional market price for each of the five states that it covers. The NEM operates a 24-hour ahead market for 30-minute energy, ancillary services and spinning reserves. The National Electricity Market Management Company (NEMMCO) is responsible for dispatch and reliability management issues in the NEM.

Australia is a summer peaking system with a peak demands over 33,000 MW (based on the non-coincident peak of states participating in the NEM). The expected load growth is state specific with a range of 1.5% to 3.5% per year. They expect supply resources will grow around 2.6% per year over the next ten years.

Large energy users may deal directly with generators and the NEM for their supply, but nearly all consumers purchase electricity and related services from a retailer. Retail supply and distribution functions are provided by separate entities and this separation is a requirement. Historically, retailers operated in geographic areas defined by the distribution networks, but they recently began expanding and offering services in other distribution service territories as well.

From 1998 to mid-2004, multiple government agencies had various regulatory oversight responsibilities of the NEM. However, in July 2004 the transition to a single national regulator, the Ministerial Council on Energy (MCE), commenced. Among other things, the MCE is responsible for Energy Market Reform including evaluating what role demand response should play in the NEM. However, it should be noted that the MCE role is focused on policy development. Day-to-day implementation of these policies is allocated to the Australian Energy Market Commission (AEMC). The AEMC does not make or adjust rules to the NEM, it simply ensures that all participants comply with the rules that exist and facilitates debate on proposed rule modifications. In addition to these entities, there are several other entities that are focused on specific areas such as the Australian Energy Regulator, which is responsible for the economic regulation of the wholesale market.

Demand Response Resources are able to bid schedules into the NEM, but this option is rarely used because there are many rules to follow as a market participant to do so. Therefore, most DRR activity is currently provided by way of bilateral contracts between retail suppliers and the consumer. For example, some retailers monitor market prices and advise consumers of potential price spikes so that the consumer can load shed/shift. In 2004, NEMMCO estimated that the amount of "firm" demand response capacity was 157 MW in Queensland, 14 MW in NSW, and a total of 163 MW in remaining states. Additional "non-firm" capacity is available, but the numbers are not reported.

Australia has also conducted several paper trials to determine consumer and market behavior if more DRR participated in the wholesale market. The MCE is currently using these and other experiences to help guide them in making changes to the policy framework that would facilitate demand side participation in the NEM.

Italy:

Gestore della Rete di Tramissione Nazionale (GRTN) is the sole system operator for Italy. **GRTN** is a company which was established in April 2000 as part of the process of restructuring of the power system. The process was initiated by Legislative Decree no. 79/99, aiming at fostering liberalization and competition in a sector of strategic importance for economic development. The activities of GRTN concern electricity transmission on the high- and extra-high voltage grid (national transmission grid) that it operates under exclusive rights ("concession"). This responsibility is fulfilled through dispatching, i.e. the co-coordinated operation of power plants, national transmission grid, connected grids and ancillary services.

The shares of GRTN are held by the Ministry of Economy and Finance, exercising the shareholder's rights jointly with the Ministry of Production Activities, which also issues strategic and operational guidelines for GRTN. On 28th February last, GRTN merged with TERNA (the ENEL's group company owning the transmission grid) leading to the unification, under a sole agent, of the ownership and operations management of the grid.

In fulfilling its mission, GRTN:

- guarantees security, reliability, efficiency and continuity of the electricity service;
- plans transmission grid development projects;
- guarantees that all eligible applicants have access to the transmission grid under impartiality, neutrality and equality criteria;
- contributes to promoting environmental protection and security of transmission facilities.

The Reform of the Electricity Sector Legislative Decree no. 79 of 1999 implemented European Directive 96/92/EC on "common rules for the internal

market in electricity". The Decree laid the groundwork for the restructuring of the Italian electricity sector. The target of the Decree was to favor liberalization and competition between market players in a key sector of the national economy, so as to achieve benefits for Italian citizens.
Co-operation between European system operators is a pre-requisite for good functioning and security of the European power system. As part of its multilateral co-operation activities, GRTN participates in the following international associations:

UCTE - Union for the Co-ordination of Transmission of Electricity in Europe
ETSO - Association of European Transmission System Operators
SUDEL is the Association of Transmission System Operators in the South-East European Interconnected System.
OME – Observatoire Méditerranéen de l'Energie.
EURELECTRIC
CIGRE (International Council on Large Electric Systems)

GRTN:

- manages & operates the national power transmission grid;
- plans projects of development and maintenance of the grid, guaranteeing the continuity of electricity supply, and prepares a yearly security plan;
- connects all eligible applicants to the grid, without undermining the continuity of the service, in accordance with the technical rules and economic terms for access to and interconnection with the grid;
- manages power flows, guaranteeing the equilibrium between demand and supply;
- participates in transactions in the Power Exchange;
- sells electricity generated from renewable and so-called "assimilated" sources in the market;
- certifies power plants fed by renewable sources, issues the related Green Certificates and enforces compliance of producers and importers with the renewables obligation;
- manages & operates the power lines interconnected with neighboring countries and allocates import capacity;
- collects, processes and reports statistical data on the electricity sector

As a Group, GRTN set up two companies, of which it is the sole shareholder: AU (Acquirente Unico) and GME (Gestore del Mercato Elettrico).

Market Players

Italy operates one national energy market. The market is managed by Gestore del Mercato Elettrico (GME), that is a company set up by GRTN (the Independent System Operator) with the mission of organizing and managing

transactions in the Electricity Market under criteria of neutrality, transparency, objectivity and competition between producers, as well as of ensuring the management of an adequate availability of reserve capacity.
The operation of GME started on March 31, 2004 and gave rise to the first organized wholesale electricity market in Italy.

The creation of an Electricity Market responds to two specific requirements:
- encouraging competition in the potentially competitive activities of electricity generation and wholesale, through the creation of a “marketplace”;
- - favoring maximum efficiency in the management of electricity dispatching, through the creation of a market for the purchase of resources for the dispatching service.

The Electricity Market, commonly called **Italian Power Exchange-IPEX**, enables producers, consumers and wholesale customers to enter into electricity purchase and sale contracts. Market Participants connect to the Electricity Market trading platform through the Internet and enter into on-line contracts via secure-access procedures based on digital certificates.

The Electricity Market consists of:

a) two energy markets: the Day-Ahead Market (MGP) and the Adjustment Market (MA). In these markets, producers, wholesale customers and final eligible customers may sell and purchase electricity for the next day;
b) one Ancillary Services Market (MSD), where GRTN procures the dispatching resources that it requires for managing, operating and controlling the power system.

As part of the organization and management of the Electricity Market, GME is also responsible for the organization of the trading venues for Green Certificates (giving evidence of electricity generation from renewables) and of Energy Efficiency Certificates (so called "White Certificates", giving evidence of the implementation of energy-saving policy).

All non-residential consumers are currently eligible to choose their retail energy supplier from a list of approved competitive suppliers. After July 2007, all Italian consumers will be eligible to choose a supplier. In 2003 sales on the competitive market totaled 148.3 TWh, shared among 145 suppliers.
AU (Acquirente Unico - Single Buyer) is the company which is vested with the task of procuring electricity for captive customers (presently the residential customers) under criteria of continuity, security and efficiency of electricity supply, thereby passing the benefits from liberalization of the sector onto such customers. Acquirente Unico purchases electricity in the market on the best possible terms and resells it to distributors. A decree of the Minister of Production Activities of 19 December 2003 specified the ways in which Acquirente Unico

should procure electricity and assigned to it the role of power procurer for the captive market from 1 January 2004.
In accordance with the Decree, Acquirente Unico:

- may enter into contracts, including multi-year contracts, for an amount of electricity not exceeding one fourth of the overall demand of the captive market;
- participates in procedures for the allocation of transmission capacity for importing electricity from neighboring countries and, based on its capacity allocation, it enters into contracts with foreign suppliers;
- participates in procedures for the allocation of generating capacity for the purchase of the so-called CIP-6 electricity;
- purchases all the electricity of multi-year import contracts for captive customers;
- for covering the remaining part of demand, procures electricity in the electricity market, after signing prior contracts for price and quantity risk hedging.

Italy production capacity and system demand

The following table gives a frame of the electricity production in Italy in 2003. As it can be seen, thermal plants predominate and there is a strong dependence from imports, while nuclear generation is absent.

ELECTRICITY BALANCE IN 2003 [TWh]		
Total production		**279**
Coal	35,7	
Oil	52,5	
Natural gas	109,9	
Other fossil	26,8	
Hydro	43,6	
Other renewables	10,5	
Imports		**51**
Pumped storage		**10,5**
Losses		**20,5**
Final consumption		**299**

Enel Produzione contributed to 46.4% of the national production, followed by Edison S.p.A. with 9%. Edipower 7.6%, Endesa Italia 6.4%, Tirreno Power 2.3% and ENI Power with 2%.

The peak demand in Italy, 53,600 MW in December 2004, tends to be set during the winter months, but it is slowly migrating towards the summer period. Italy

currently expects annual demand growth rate in the range 2.9-3.4 % (GRTN projections up to 2014). All of the proposed supply side development projects would equate to about an 8% annual growth rate, but it is unlikely that all projects will be activated. It is assumed that the actual growth rate will be something less than 6% per year when considering that not all projects get built.

There are a few interesting developments in the various consumer classes:

- Residential: there is a decreasing utilization of water heating, but a rapidly increasing utilization of air conditioning.
- Commercial: dynamic growth, in large part due to growing use of air conditioning, is expected in the near term.
- Industrial: the major industrial consumers (e.g. chemical, oil, steel, and mechanical) are not expected to grow too rapidly in the future. However, light industries (e.g. food & drink) are expected to grow somewhat.

There are two regulatory agencies responsible for Italy's energy market. The Ministry of Productive Activities is responsible for establishing policy and operational guidelines for grid security and efficiency national electric system. And, the Regulatory Authority for
Electricity and Gas is responsible for ensuring a fair and competitive marketplace.

Demand Response in Italy

Italy has used regulated TOU rates for wires and energy charges for the last few decades, before the liberalization TOU rates were mandatory for High Voltage customers exceeding 500 kW of subscribed demand (threshold reduced to 400 kW for Medium Voltage customers). After liberalization it appears to be a tendency to flatten rates.
Consumers with demand greater than 3 MW can participate in the load curtailment program. Currently there are about 3,500 MW enrolled in this program, provided by about 250 customers.
Small consumers (with subscribed demand up to 30 kW, and maximum available demand up to 37.5 kW) have demand limiting meters that disconnect power when the contractual demand level is exceeded for a certain period of time. Power has to be manually restored by closing the breaker after having reduced demand under the limits.
The installation of about 30 millions of interval meters, to be completed by 2005, opens new scenarios for the implementation of Demand Response to wider groups of consumers: new day/night rates are offered by distributors and a discounted rate for shifted consumption is being proposed by the Regulatory Authority.

The Italian objectives for participating in Task XIII are:

- To develop and gain knowledge on how to evaluate the market value of DR, as a means to limit price spikes, counteract market power and optimize the whole system operation
- To know how best develop cost effective participation plans and mechanisms (including remuneration structures and innovative rates) that enhance price elasticity of demand
- To develop ways to estimate the economic potential of demand response

Japan:

Japan has ten (10) privately owned vertically integrated utilities. These utilities perform all of the roles that vertically integrated utilities have historically provided. For example, since Japan does not have a central system operator, each utility performs its own T&D and supply management services.

The nation does not have a central power exchange today, but they will have a power exchange by April 2005. Since they do not have a standard power exchange today, they do not trade power in standard packages. However, there is a robust bilateral market and the parties negotiate unique agreements that meet their specific needs.

Japan tends to be a summer peaking system with a summer peak of about 175 GW and a winter peak around 138 GW (based on 2001 usage figures). They expect annual load growth around 0.9% per year with an annual supply growth of about 22 GW over the next 10 years (or about 1.1% per year).

It is important to note that the demand for air conditioning is rapidly growing on an annual basis. Because of this, Japan tends to set new record demand peaks several times in one summer. This trend is not expected to slow down.

Japan began a market liberalization process in March 2000. Customers with demand greater than 50 KW will have the option of selecting a retail service provider in April 2005. April 2007, Japan will begin to consider full deregulation of the residential market. As of March 2004, there were 13 service providers registered.

The Agency for Natural Resources and Energy is responsible for Japanese energy security. This agency ensures fair and impartial energy markets, approves system tariffs, oversees the market liberalization process, and establishes environmental protection policies.

The Japanese market relies on the use of TOU rates and other demand side management efficiency measures to help with system load leveling. In fact in 1998, they estimated that peak shift effect under load adjust contract of 10 Electric Power Companies in 1998 was about 9 GW (5.4% of system peak).

Korea:

Since late 1990s, the government has introduced privatization and restructuring in the electricity, gas, and district heating industries under the plans for privatization of state-owned companies in order to facilitate market functions.

Korea has approximately 12 million residential customers, 2 million commercial customers, 0.3 million industrial customers and 1.5 million educational, agricultural, etc customers. Summer peak demand is approximately 47,400 MW and winter peak demand is approximately 46,100 MW.

The generation sector of KEPCO (Korea Electric Power Corporation) was spilt up into six generation subsidiaries, five of which are to be privatized within the next few years. The transmission, distribution and sales still owned by KEPCO.

Korea presently has significant retail competition - there are about 47 registered competitive suppliers.

Korea - The Basic Plan of Restructuring:

- Unbundling KEPCO's power generation, transmission, and distribution/retail sector by stages; introducing competition in the electricity business.
- Transmission network exclusively owned by KEPCO to guarantee fair compe tition and make sure a stable supply of electricity.

- An independent regulatory agency (Korea Electricity Commission) establishe d within MOCIE to protect consumer welfare, monitor market, and manage th e privatization process.

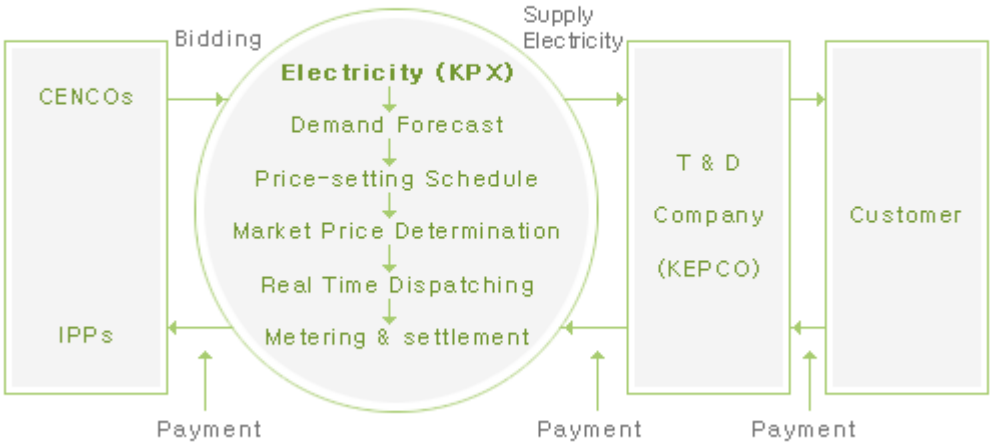
In Korea, establishment and operation of the electricity market is necessary along with the restructuring of the electric power industry to enable market participants to buy and sell electricity.

The CBP (Cost-based Pool) market is current market structure. The CBP market is up to one-day ahead trading, all generators are required to submit offers to the KPX (Korea Power Exchange) indicating the generating capacity available.

The KPX produces a Price-setting Schedule and calculate the marginal price (SMP/BLMP) under the principal of minimizing system variable cost. The Generation Companies (Gencos) trade electricity by bidding through the KPX (Korea Power Exchange). But DSM resources are not linked with CBP Market and considered in Long-term resources planning government.

Korea - The CBP (Cost-based Pool) Market:

< MARKET OPERATION STRUCTURE OF CBP >



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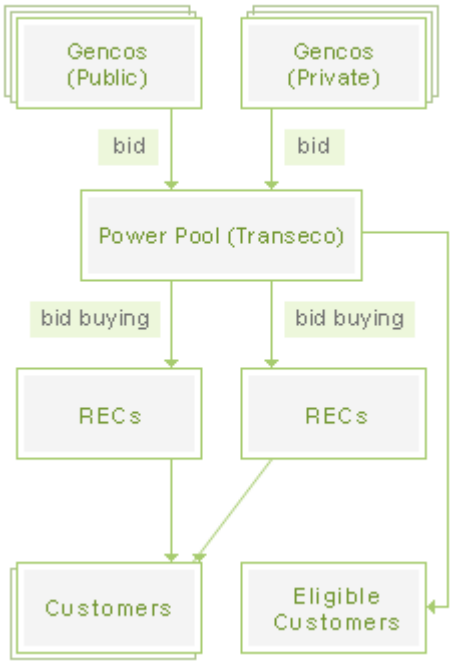

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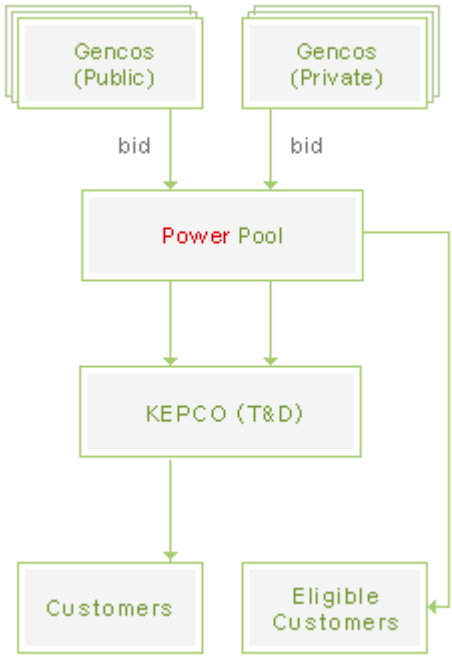


*www.mocie.go.kr

Korea - DSM Activities:

- **KEMCO**(Korea Energy Management Corporation)
  - DLC (Direct Load Control) : 1,023MW(about 460 Customers)
  - Rebate for the High-Efficiency Appliances or Facilities
  - District Heating Systems etc.

- **KEPCO**(Korea Electric Power Corporation)
  - DLC (Direct Load Control) : 1,0153MW(about 400 Customers)
  - TOU rate, midnight power service etc.

The governments (MOCIE) establish the policy of energy. The KEMCO and KEPCO are responsible for the implementation of energy management activities (DSM).

The generation companies (Gencos) trade electricity by bidding through the Korea Power Exchange, but the demand response resources are not presently linked with the electric market.

In 2004, KEMCO operated direct load control program of electric power which can cut an extra 1,023MW demand for emergency, separated from KEPCO. For the energy efficiency of electric power, the rebate programs for high efficiency devices such as lighting, motors, inverters and vending machines were newly designed and transformers and pumps were reviewed as new rebate items.

Korea - Composition of DSM (DR) Resources:

- Self-Responding DSM(DR) Resources
  - Customer's Self-Responding to price or tariff to reduce its own bill
  - Tariff Structure : Fixed , TOU
  - No incentives form levy, No settlements in the markets
  - Some incentives for infra implementation from levy

- Emergency DSM(DR) Resources
  - Present LM Programs : Power System Emergency Situations
  - Incentives from levy to customers : Bill-reductions and Hardware implementation cost support
  - Not linked with MOS/NEMS System

Netherlands:

The Netherlands has a central trading exchange that is operated by Amsterdam Power eXchange (APX). This exchange trades day-ahead hourly energy and spinning reserves as well as operating an intra-day balancing market. About 10-15 percent of the daily peak demand currently trades through this system. The rest is either native supply or exchanged in the long-term bilateral agreements.

TenneT manages the Netherlands transmission system. TenneT is a government institution that is responsible for grid reliability and security.

The Netherlands has opened its markets to retail deregulation. There are currently about 20 registered retail providers.

There is about 1730 MW worth of demand response capacity available in the Netherlands, of which about 1200 MW could come from the industrial sector. Today,

about 1000 MW of the total potential, primarily from the industrial sector, is currently being used. It is believed that the lack of proper technology (e.g. smart metering and communications) and incentive structures (e.g. consumers only see a peak and off peak price) is holding back maximum DR penetration. There is a general belief that if the imbalance market were visible to more consumers in real time, there would be additional incentives for DR penetration.

Their system peak demand of about 15,000 MW tends to be set during the winter months, thought it is important to note that the summer peak is rapidly approaching that of the winter peak due to an increase in residential and commercial air conditioning. The Netherlands' power system is expected to grow at a rate of about 2% per year. The Netherlands currently establishes reserve margin requirements between 5-10% of peak, but they are generally able to exceed this requirement on a regular basis.

At present, large electricity consumers are able to bid their consumption needs into the power market. Enterprising consumers are able to monitor their consumption relative the national energy imbalance market. These consumers then can take advantage of price swings created by real time system energy imbalance by load shedding. These consumers are then compensated for providing the balancing power they reduced relative to their supply schedule.

Nord Pool:

The Nordic power exchange, Nord Pool, includes four countries: Denmark, Finland, Norway, and Sweden. For the time being, it is the world's only multinational exchange for trading electricity.

Nord Pool facilitates:

- Elspot – a day-ahead power market for physical trade amongst its market participants
- Elbas – an intraday market for trading imbalances up to one hour before delivery. It is only implemented in Sweden, Finland and the eastern part of Denmark.
- Several financial products including futures and options.

The Nord Pool market is divided into local price areas. All transmission lines internally and between the local price areas are available for the market. The capacity of the transmission lines between areas are being distributed based on implicit auctioning.

Nord Pool includes a number of actors of different size where no one controls more than 20% of the generation in the overall marketplace, though it may be the case in some of the local price areas.

Roughly 40% of the total consumption in the Nordic area is traded at the Nord Pool Elspot market. The remaining 60 % is traded bilaterally either internally or with actors outside the Nord Pool area, e.g. in Germany, Poland and Russia.

In the EU research project EFFLOCOM the total load curve of the Nordic countries was analyzed. Some of the results found were:

- The peak loads has a very high degree of coincidence in the four Nordic countries active at the Nord Pool market.
- The peak load in the Nordic countries can be reduced by 3500 MW by peak cutting in only 25 hours per year and 6200 MW by peak cutting in 100 hours per year.

Denmark:

The transmission system operator in Denmark is called Energinet.dk. It was created early 2005 by the merger of the two former transmission system operators in Denmark, Elkraft System and Eltra, and the system operator of the natural gas network, Gastra. At the same time the ownership shifted from the Danish utilities to the Danish state.

There is no electric interconnection between Eastern and Western Denmark. Eastern Denmark is part of the Nordic synchronous grid area (Nordel) being AC connected with Sweden and DC connected with Germany. Western Denmark is part of the continental European synchronous grid (UCTE) having AC connections to Germany and DC connections to Sweden and Norway.

Commercial market players are responsible for balancing purchase and sales in the day-ahead market. In Eastern Denmark, they might at the day adjust by trading at the Nord Pool based Elbas balancing market. This is not an option in Western Denmark.

Real time balance in the system is maintained by the TSOs by use of the regulation power market. The Nordic TSOs collect all regulating power bids in one common merit order list. Consumers are also participating in this market by offering changes in their consumption as regulation services. The Nordic area is balanced as a whole taking transmission constraints into consideration. The cheapest available Nordic resources are applied for balancing. As there is no electrical interconnection and the areas are part of two different synchronous systems, Eastern and Western Denmark have separate control room facilities.

Denmark - Power Market Players:

With the Energy Act of 1999 the Danish power market gradually was liberalized. This included free supplier choice for all and an unbundling of the utilities.

The system operator, Energinet.dk, is responsible for both short-term and long-term security of supply in the main electricity supply system and for development of the energy system and the electricity market. Energinet.dk own and operates the 400 kV grid and the Danish parts of the interconnections with the neighboring countries.

Production is mainly from the central power plants (see table in next section) owned by the two large power companies Elsam and Energi E2, which may merge in the near future. They also own some smaller CHP plants, but Elsam has already been forced to sell off its smaller plants to improve the competition. With a possible merger in sight, this may be the case for Energi E2. The smaller so-called decentralized CHP plants are generally owned by local cooperatives and municipalities.

The Danish electricity consumers can actually choose an energy supplier from seventeen (17) retail energy suppliers operating in Denmark. Around 70 local distribution companies are responsible for providing the distribution services to all consumers in its service territory.

Danish Energy Agency, DEA (Energistyrelsen) is setting and enforcing policies related to the energy sector.

The Danish Energy Regulatory Authority, DERA (Energitilsynet) is the authority engaged in supervision and benchmarking of market actors in the Danish energy sector: electricity, natural gas and district heating.

Denmark - Production Capacity and System Demand:

The Danish power system is winter peaking with national demand of just over 6,000 MW. A forecast shows the demand for power will grow around 1.6% per year from 2003-2014[1]. Two more offshore 200 MW wind turbine parks will be installed around 2007. On the production side, no other larger new investments are announced. The reason is that even when fully discounting wind, Denmark (especially the Eastern part) still has a rather large overcapacity.

	Western Denmark	Eastern Denmark
Central power plants[1+3]	3516 MW	4050 MW
Decentral power plants[1+3]	1567 MW	545 MW
Wind power[2+3]	2374 MW	743 MW
Maximum demand[2+3]	3780 MW	2860 MW

Production capacity (including all kind of reserves) and maximum demand

The customer sectors industry, commerce & service and residential are nearly equall in size of electricity consumption while the last sector, agriculture, is quiet small but has anyhow a clear influence on the load curve in the Western region at the time of watering in early summer and drying at harvest time. Denmark has very little power intensive industry.

Heating is primary district heating (approx. 58% of all dwellings) mainly provided by large and small CHP plants. Second largest heat source by numbers is individual oil-based burners (18%) while individual natural gas burners (15%) come in third. Finally around 125.000 homes (6%) have direct electric heating[4].

[1] *Source: Dansk Energi – Årsstatistik 2003*
[2] *Source: Elkraft Web page*
[3] *Source: ELTRA Årsberetning*
[4] *Source: Energistyrelsens Energidata 2003*

Air conditioning has seen very little use outside offices, but is expected to achieve a higher penetration in the future. District cooling may be a competitor to electricity based cooling as seen in e.g. Stockholm, Sweden.

Denmark - Demand Response:

In Denmark, DR often also called price flexible consumption is defined as:

- Consumption which could be moved to another period with lower price.
- Reduction of consumption in periods where the marginal benefit of energy use is lower than the price, e.g. by substitution to another source of energy.
- Strategic load growth when the marginal benefit of energy use is higher than the price, e.g. by substituting another source of energy.

Time-of-use (TOU) tariffs were implemented for many types of customers in the 1980-ties. The time-of-use tariffs were predetermined and not directed towards the specific market conditions at any point in time. But the TOU tariffs gave an incentive to move consumption from peak hours to night-time. This contributed to a more economic utilisation of the available production capacity. At present TOU tariffs are not use very much due to introduction of the deregulated market.

From the end of the 1990-ties where the market model was introduced, real-time pricing became an option for especially larger customers. Observations of the demand curve shows that it has been virtually unchanged even though the underlying variations in market prices have been very dramatic from zero-prices to high spikes. The number of price spikes has been relatively low. All customers using more than 100.000 kWh per year are having meters with hourly meter reading. Anyhow, with few exceptions all large customers are buying electricity by different kind of flat fixed price contracts. The lack of flexibility and of incentives for customers to react in underlying contracts between the electricity suppliers and the customers are the main reason for very little price elasticity.

A few examples exists however where customers have taken advantage of the possibility of interrupting consumption in cases of high prices. A metal-industry (Birns Jernstoeberi) with an annual energy consumption of 100 GWh saved 35.000 USD by turning off 12 MW load for 7 hours where prices were up to 725 USD/MWh.

The system operator is conducting several demand response pilot projects currently in place. Some projects targeted load shedding/shifting residential and commercial electric heating and others allow larger consumers to bid their DR into the balancing markets. The most important pilots at present are:

> EFFLOCOM: This project evaluates the methods and impacts of direct load control of electric heating based on RTP. Enabling technology include hourly metering, communication by GRPS as well as customer WEB interface. The system is designed for automatic activation when the Nord Pool hourly Elspot prices exceed preset levels. The system might also be used at the balancing market. The initial 25 household pilot proved successful and consumers were satisfied. It is planned to increase the participation to around 3-400 households in the near future. In case the activity was extended to around 65.000 households, it is estimated the peak could be reduced by up to 250 MW on a cold winter day.

Elkraft Tender: The eastern TSO allows consumers to sell demand response. They were offered a capacity payment of 200,000 DKK/MW-Year ($35,000 USD / MW-Year) plus a payment of 1 DKK/KWH ($0.20 USD / KWH) when called. Elkraft signed 18 contracts of in total 31 MW emergency power and 3 MW consumption. The total potential for emergency power in eastern Denmark has been estimated to approx. 100 MW (including only plant larger than 250 kVA). Of this potential, it is estimated that one third could be synchronized to the grid without major investments. A large share of the estimated total potential has been activated by the activity. The estimated potential for flexible demand is 155 MW

Eltra project with Effektpartner: The western TSO negotiated a contract with Effektpartner to provide 25 MW of emergency power for the regulating power market. This project is intended to show that demand side aggregators can effectively operate and offer supply-like services to the wholesale market. For the TSO, the aggregation will also result in more manageable offer. The total potential for emergency power in Western Denmark is assumed to be at least of similar size as in Eastern Denmark.

In the end of 2004, the Danish TSO's (now merged) made a plan for developing DR in Denmark. The plan describes the Danish benefits of DR including:

- Better function of the market (more stable prices)
- Improved possibilities for implementing more wind power in the system
- Less need for use of power peak plants
- Economical benefits for customer as well as supplier
- Improved reliability of the electrical system.

The plan includes 22 activities divided on 14 R&D projects, 5 demonstration projects and 3 full scale projects.

The DR action plan in English can be downloaded from:

http://www.eltra.dk/media(16183,1030)/Nordel_-_Dansk_TSO-plan_GB_ny.pdf

Some of the largest distribution companies have decided to install electronic meters with hourly metering for all customers. New enabling technology for demand response will thus be available within the near future.

The Danish objectives for participating in Task XIII are:

- To learn about description and development of business models for DR (objective of task XIII that attracted Denmark to participate).
- To receive more knowledge on how to evaluate the value of DR concerning higher security on supply, minimizing market power from dominating producers and optimization of the whole system.
- To see accounts on the value of DR or every actor involved in DR.
- To participate and identify barriers for DR and how to overcome these barriers – e.g. how the actors could cooperate in the best way to overcome the costs by a kind of pooling of the best of the different actors involved.
- To obtain inspiration from the technology case studies and the technology catalogue to be developed.

Finland:

As noted previously, Finland belongs to NordPool. NordPool is a common power market for several Scandinavian countries including Denmark, Norway and Sweden. NordPool operates day ahead energy as well as financial energy markets.

Fingrid is the sole system operator in Finland. Fingrid is responsible for balancing the hourly supply and demand of energy. It does this by operating a balancing energy market and settling hourly imbalances with each market participant at the end of the operating day.

Like its Nordic neighbors, Finland tends to be a winter peaking system with a peak demand of just over 12,000 MW. They anticipate demand growth of about 2.5% per year and an annual supply growth of 1.8% per year.

All consumers in Finland have the ability to choose their energy supplier. If a consumer does not want to choose a competitive supplier, they can receive energy from the local distribution company at regulated rates. Large consumers have the option to purchase supply at NordPool.

The Finnish market is categorized into industry, service (e.g. office buildings, schools, hotels), and private consumption (e.g. residential). Industry represents about 50% of total energy consumption, of which about 80% comes from a few industries (e.g. pulp and paper, metallurgical, and chemical). The service sector, about 20,000 consumers, represents about 20% of the nation's consumption with the private consumption (and some miscellaneous consumers) making up the remaining 30%. It is interesting to note that the service sector and the industrial sector tend to receive their building heat from large district heating plants.

The private consumption group is divided into three categories: customers without electric heating, customers with electric heating, and agricultural customers. There are over 2 million customers in the "without electric heating" category. These tend to be row houses and/or apartment buildings which normally receive heating needs from the district heating plants. There are about 600,000 customers in the "with electric heating" category (e.g. single family homes). These customers tend to be on TOU rates. The homes also tend to have various technologies to help modulate energy usage (e.g. heating direct load control by the LDC and/or if a sauna is turned on, some other loads are dropped automatically). The technologies that are used have tended to lessen daytime consumption versus other Nordic nations.

There are three primary regulatory agencies in Finland: (a) Ministry of Trade and Industry, is responsible for developing energy market policy and legislation as well as coordination with the European Union; (b) The Energy Market Authority, is responsible for ensuring fair and efficient competition as well as approving the pricing of regulated services; and (C) The Finnish Competition Authority is responsible for increasing economic efficiency in the energy market by promoting competition and abolishing competitive restraints.

Finland has several different types of demand side efforts in place. For example, TOU rates are widely used which has generally caused a shift of electric heating to off peak hours. In addition, many utilities have used direct load control of electric heating for many years, though its use has declined since the introduction of retail liberalization.

A few more recent examples of DR activity are:

- There is about 1000 MW of industrial load shedding that participates in Fingrid's ancillary service market. These are ten year agreements (2005-2015) designed to provide capacity as new generation plants are being built (e.g. the next nuclear plant is expected to go on line in 2009).

- At least one supplier recently began offering a new commodity product based on day-ahead spot prices. The results of their effort won't be known until the end of the 2004/2005 heating season.

- Fingrid allows aggregated loads to bid in 10 MW blocks into the regulating (balancing) power market. However, consumers are not taking advantage of this opportunity.

Norway:

As noted previously, Norway is one of the Scandinavian members of the Nordic power exchange NordPool. The other participants are Sweden, Denmark, and Finland.

Statnett SF, the Norwegian transmission system operator, is responsible for construction and operation of the transmission system. Statnett currently owns about 87 percent of the transmission grid. In addition, Statnett is responsible for short and long term system planning issues

Norway currently receives nearly all of its energy (118 TWh annually) from hydroelectric power. Like other Nordic nations, Norway tends to set its system peak of just over 23,000 MW during the winter months. They system has an annual demand growth rate around 1-1.5% per year (250-350 MW) and a current supply growth rate around 0.5% per year (100 MW).

Norway began full retail access for all consumers in 1991. Since 1998, it has been possible for consumers to switch retail suppliers on weekly basis if they choose to do so. There are about 80 retail energy service providers in the market and they see about 300,000 switches per year or about 16% of the eligible consumers.

The Ministry of Petroleum and Energy has the overall regulatory responsibility for the energy sector. In addition, there are two subordinate agencies that play a major role: The Norwegian Water Resources and Energy Directorate (NVE) is responsible for granting power trading licenses, power system construction oversight, and system operator guidelines and tariffs; and, Enova SF, is responsible for promoting efficient energy use and renewable energy. They do this by providing subsidies and education for energy efficiency services and green power.

In 2001, Statnett, the Norwegian system operator, established an option market for reserves (RCOM) to help deal with shortages in reserves. Under this structure, consumers bid their demand response resources into this option market in exchange for a firm payment for their future availability to respond when call to do so.

In addition to this, SINTEF Energy Research, a national research laboratory, has implemented several demand response trial projects. A few examples are:

- Consumer flexibility by efficient use of ICT: This project evaluated the implementation of two-way communication devices that modulated the use of water heaters in relation to spot energy prices. The project demonstrated a 0.3 KWH reduction per household when activated. If this was extrapolated out to all Norwegian households, it could account for about 600 MW of DR capacity. However, the project also demonstrated some of the challenges this sort of effort is expected to encounter (e.g. technology interfaces and consumer sentiment).

- Regulating capacity from medium size consumers: In this project Statnett contracted with a few demand aggregators to provide 25 MW worth of capacity (via the RCOM noted above). The project was designed to test what it takes to market services to consumers and show that an aggregator can provide the balancing services needed by the system operator. The project has helped all market participants work though issues such as communication and process that will make this a useful resource in the future.

- Improving end user knowledge for managing loads and consumption: This project is focused on identifying consumer desires and knowledge levels related to energy usage. The project focuses on three large class case studies with four main work areas: *(1) Analysis of two-way communication and dynamic price-signals among households; (2) Analysis of motivation for enduring energy load and consumption-reduction among commercial customers; (3) Analysis of load-reduction using dynamic price-signals among commercial customers; and (4) Methodology design.* The project should be completed in late 2004.

Sweden:

The Swedish Transmission System Operator (TSO) Svenska Kraftnät (SvK) was created 1992. SvK is a state owned utility charged with maintaining and operating Sweden's national grid and overseas links. The grid encompasses the country's 400 and 220 kV power lines. SvK is also the system operator under the Electricity Act. This entails having the overall responsibility for electricity plants working together in an operationally-reliable way so that a state of balance between production and consumption of electricity can be maintained throughout the country.

The prerequisites for effective competition were created during the years prior to 1996, primarily enabled by:

- The point of connection tariff – which provides access to the grid
- The balance service – a neutral party which manages Sweden's electricity balance

- The power exchange – which provides the players with a visible electricity price
- Market-adopted methods for avoiding overload at constrained sectors (bottlenecks) on grid and on the overseas links.

In January 1996 after quite a lot of debate a new system of rules was introduced that made it possible for all consumers on the market to choose their supplier. The distribution companies hade to divide their companies so that the transportation business was separated from generation and trade. The network companies remained regulated monopolise.

Energimyndigheten (Sweden's Energy Agency) is responsible for regulation of distribution monopolies and for overseeing the functioning of the energy market and sales/prices.

Sweden - The Market Players:

There are roughly 200 electricity trading companies in the country, but only 20-30 of those are Balace Providers and actively marketing their offers to the public nationally. The majority of the electricity sales companies are small local entities. Many of them are retailers for one of the three major companies, Sydkraft (E ON), Vattenfall and Fortum.

There are also more than 200 local and regional network companies Sweden. They are responsible for providing transportation services to all consumers in its service territories. Network companies are prohibited by law from actively participating in electricity trade in any form (other than for the purpose of handling their own distribution/transmission losses). A part from being responsible for the transportation service, they are also responsible for metering and reporting of data to the different parties and to the national settlement system. At present customers larger than 80 Amp are requested to have hourly metering (will be reduced to >63 Amp by 2006). For the rest of the customers profiling in combination with annual meter reading is used. By 2009 all customer must have their meter read once every month. This new demand on the network companies has resulted in major investments in remote reading systems. Exactly what these new system will be capable of in tot clear at the moment – will there be two-way-communication? Will there be possible to apply more advance tariffs like critical peak pricing?

The generation side is dominated by Vattenfall, Sydkraft and Fortum. The generation capacity is mainly nuclear and hydro. The competition in generation is possible because of the extensive connections to our neighbouring countries, (approximately 9 000 MW).

Sweden - Production capacity and system demand:

The Swedish electricity system is winter peaking due to large amounts of electric heating throughout the country. The highest level of demand for a specific hour in Sweden was registered in January of the year 2004, when one of the morning hours registered demand for 26 900 MW's.

Generation in Sweden 2003, TWh

	Annual generation, TWh

Nuclear	53
Hydro	66
Industrial back pressure	5
Combined heat and power	8
Condensing Power, Fossil	0,6
Wind	0,6
Total	133

Since 2003 was a particular dry year the hydro generation was about 20% lower than normal. This is the reason Sweden this year had a net import of about 12 TWh.

On de capacity side Sweden have to rely on import for peak situations. The situation during the peak hour 2004 is as follows:

Generation on Sweden	22 935 MW
Import Norway	2 010
Import Finland	1 025
Import Denmark	55
Import Deutschland	75
Import Poland	300
Total consumption	26 900

Estimated maximum peak consumption is 28 800 MW (expect to happened every 10 year)

Electricity consumption in general has only increased slightly over the last ten years. Temperature corrected total net consumption in 1990 was 143.1 TWh. In 2003, the same figure was 145.6 TWh. In 2001 though, 151.4 TWh were consumed. The down swing from 2001 to 2003 is to a large extent attributed to the state of business in the country in general and in electricity intensive industries in particular. Sweden's energy consumption is expected to grow at a rate of approximately 0.5 per cent per year in the coming years.

Consumption in Sweden 2003 TWh

	Annual consumption, TWh
Industry	55
Transport	3
Residential services etc ✓ electric heating ✓ other domestic purpose ✓ common purpose	 23 19 30
District heating, refineries	4
Distribution losses	11
TOTAL	145

Sweden - Demand Responses:

In the fall of 2002, Sweden's TSO Svenska Kraftnät forwarded an investigation to the government proposing that the mean instrument to secure the balance between demand and supply shall be the electricity price, not administrative decided reserves. The importance to allow for "price spikes" and the need for more demand flexibility was emphasised. As a temporary solution it was also recommended that the public should be partly responsible for the capacity balance in the country until the year 2008. This resulted in a proposition which in turn meant that SvK in the period 2003-2008, with support from a temporary law, shall acquire a maximum of 2000 MWs in generation and demand reductions as capacity reserves. Besides that, SvK also acquires disturbance reserves at approximately 1200 MWs. The public's responsibility for the capacity balance is thought of as a temporary solution with the purpose of giving market participants time to adjust and prepare for taking necessary measures until 2008.

Although the Nordic countries' respective views on the capacity issue do not seem to differ too widely from each other, there are still some important differences. There is no solution exactly like the capacity reserves acquisitions in any of the other Nordic countries, for instance. On September 2nd of 2004 the Nordic ministers responsible for energy-issues have jointly declared the importance of shared Nordic principles. The ministers also emphasized that an increased flexibility in consumption would be an important part in the future energy and capacity balance.

The challenge we are facing right now is the need for preparation without sufficient incentives. The only incentive for market participants to keep enough capacity or creating enough demand flexibility is the risk of (or possibility for) price spikes. The problem this far is that we haven't experienced many spikes of importance yet, which probably is the reason that market parties show a low level of activity when it comes to preparing for such a situation. Some do even say that we need a severe crisis situation for the market participants to wake up. To some extent the problem could be likened to an insurance issue – nobody wants to sign up for an insurance if he or she does not identify some kind of threat or possible damage. The challenge for electricity companies, customers, system operators and the authorities is to make necessary preparations now, in order that we will be ready when a situation of scarce supply occurs. Even if the development goes in the right direction, it can not be ruled out that some kind of centrally acquired reserve (collectively financed insurance) will be needed for severe situations even after 2008, in that case hopefully on a Nordic level.

There needs to be a uniting force to make all efforts put into this field pay off. Surely, there are already different activities going on, but more needs to be done. To make the future solution operative and secure, all parties on the market need to contribute to make the market work with regards to capacity supply. Examples of links in the chain that need to work are: price establishment at Elspot (the spot market), design of financial contracts for hedging, incentives for keeping the balance, contract design between balance responsible companies and sales companies, contract design between sales companies and customers and, not the least important, technological equipment at customers' and network owners' facilities. It is also imperative that we strive for a joint Nordic solution where rules in the Nordic markets really give market participants incentives to act in the desirable way.

Examples of activities carried out in this area the last 4-5 years are:

- The project Industribud, which was initiated (and financed) by Sweden's Energy Agency along with Svenska Kraftnät, established potentials of several hundreds of MW's to be voluntarily bid into the spot market in peak demand situations by electricity intensive industrial facilities in the years 2001 and 2002. Some of those companies are still actively "selling back" their contracted electricity to the spot market when they can profit from doing so.

- Since 2001, Svenska Kraftnät have been acquiring so-called capacity reserves amounting to roughly 2000 MW's each winter period (December – February) in order to secure enough generation capacity in peak load situations in the country. Part of this reserve is in the form of demand reduction capacity. With this year's acquisition, the first aggregator in the Swedish market was contracted to provide approximately 40 MW's at the order of Svenska Kraftnät.

- Several studies have been performed on the theoretical potential for demand reductions in Sweden. Right now, Elforsk (the jointly owned research company/broker for Sweden's electricity industry) runs a few interesting studies on consumer attitudes towards demand reductions and responses to critical peak pricing. The results are very encouraging. www.marketdesign.se Results from those studies will be integrated with the materials provided from Sweden to the IEA Task XIII.

- As mentioned earlier there are right now large investments in remote meter reading technology carried out in Sweden. This will open up new possibilities for Demand Response.

It is also important to be aware of the fact that a large proportion of the load already is exposed to the spot-market-price. We do not have any exact figures but a rough estimate is that 30 % of the consumption is on contracts that are directly linked to the spot-price (spot-price in combination with a portfolio of financial hedging contracts).

Sweden – The Objectives to Participate in Task XIII:

The purpose of Sweden participating in this project is to prepare the Nordic electricity market for a situation where the centrally administered capacity reserves are kept at a minimum.

Spain:

Spain currently operates a central financial market managed by the Operador del Mercado Espanol de Electricidad (OMEL). OMEL supports day-ahead and intra-day hourly energy markets. They are currently exploring development of financial products for long term trading (e.g. futures). OMEL is also exploring ways to create a joint market with Portugal.

Spain – Electric Industry Structure:

There is a single electric market for Spain and Portugal called MIBEL.

There are 4 large generation utilities (Iberdrola, Endesa, Union Fenosa, and Hidrocantabrico). They operate competitively since the electric market was deregulated.

The Spanish transmission grid is (mostly) owned and managed by Red Electrica de Espana (REE). REE also manages intra-day balancing and ancillary service markets (e.g. regulation, voltage, & black start). REE, in cooperation with the government, is also responsible for establishing the Spanish reserve margins. The current minimum reserve margin is 10%.

The Spanish electric market has eleven (11) distribution companies and 65 trader agents. The trader agents sell retail energy to consumers. These firms may be affiliated with other market actors or they may be independent companies. Retail trader agents supply 30-35% of the power consumption.

Spain – Regulatory agencies:

There are two key regulatory agencies in Spain: The Department of Industry and Economy is responsible for the organization and operation of power sector (e.g. it helps establish minimum quality and security standards). National Commission of Energy (CNE) supervises the electric sector competence, objectivity, and transparency.

Spain – Market Operator:

As previously noted above the economic management of the electric market is carried out by the Operator del Mercado Espanol de Electricidad (OMEL). OMEL is responsible for the management of both the Daily and Intra-daily hourly energy Markets. It also handles the settlements and reports the payments and collections to be carried out in accordance with the final energy prices from market trading.

Spain – Demand Response Activities:

The Spanish power system tends to peak at around 38,000 MW during the winter months. Spain currently projects demand growth of 2.5 – 3% per year, but they also expect supply to increase by 12-14% by 2007 (though some significant delays may occur).

Spain has an interruptible program that currently has an estimated capacity of about 2600 MW. Spanish consumers are also able to participate in the day-ahead wholesale market (directly or via a trader agent), but the participation is very low.

The objectives for demand response are to cover generating capacity deficits of the system, and to help delay/defer electric generation and grid system investments. The current reserve margin target for Spain is 10%.

Spain – DR Product / Rate:

Currently the only way to participate actively for the consumers is to use the Interruptibility System, in which consumers obtain a discount for partial interruption of load in periods established by REE.

The requirements for consumer participation are:

- To be supplied under a general tariff for high tension service.
- To offer an interruptible load (Pmax) greater that 5MW. In the case for off-peninsular systems smaller powers can be admitted.
- To have adequate measurement hardware.

Four types of interruption options are available:

Type	Maximum Interruptibility	Notice Time
A	12 hours	16 hours
B	6 hours	6 hours
C	3 hours	1 hours
D	45 minutes	5 minutes

United States of America:

USA - Background:

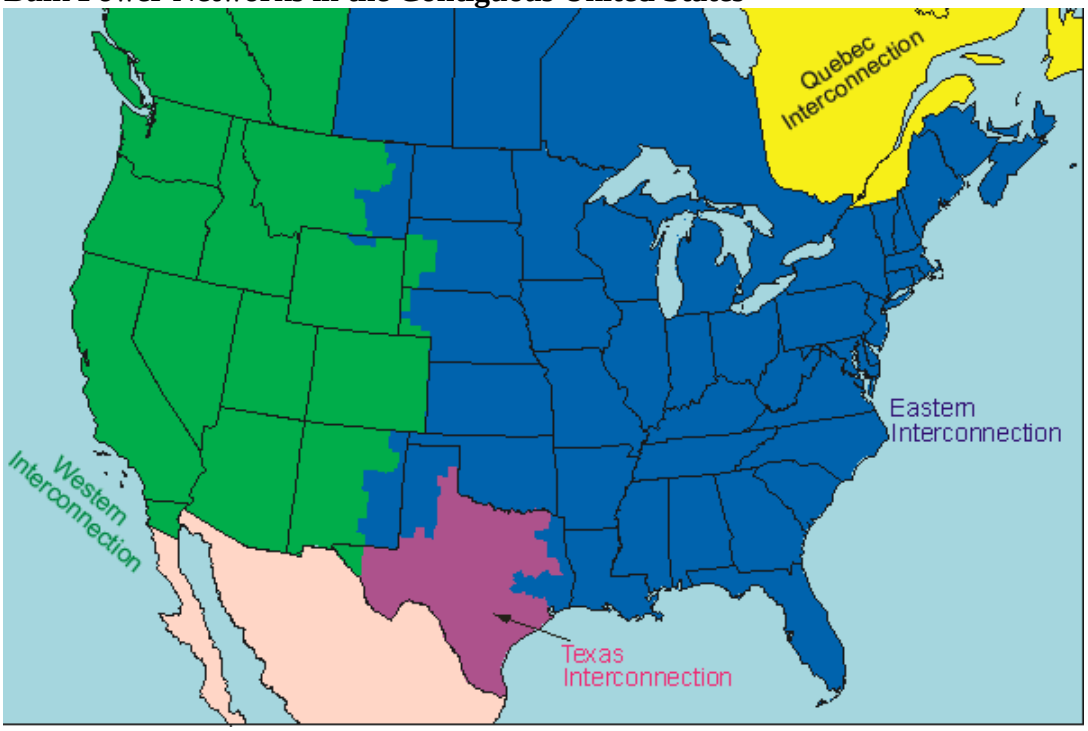
The United States has multiple energy markets and market operating structures. Some parts of the country operate with central power exchanges and system operators, other parts operate under the traditional vertically integrated utility model, and a third category is owned and operated by federal or local governments.

As a general rule, the Federal Energy Regulatory Commission (FERC) has regulatory authority for transmission and wholesale power related functions. Each state's public utility commission (PUC) has regulatory authority for distribution and retail power related services. FERC helped facilitate the deregulation of the wholesale power market in the early 1990's and some state legislatures and PUCs established rules for full or partial retail deregulation. However, it should be noted that a large majority of the country does not have retail choice today.

USA - Bulk Power System:

The US bulk power system has three major networks: 1) the Eastern Interconnected system, covering the area east of the Rocky Mountains; 2) the Western Interconnected System, covering the area west of the Rocky Mountains, and 3) the Texas Interconnected System, consisting of most of Texas.

Bulk Power Networks in the Contiguous United States

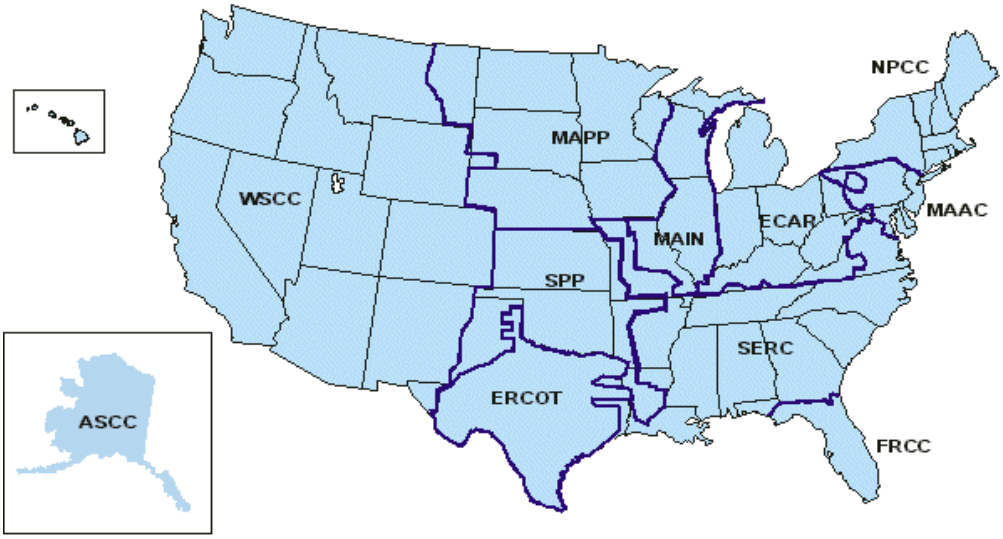


Source: Energy Information Administration, Electric Power Industry Overview, http://www.eia.doe.gov/cneaf/electricity/page/prim2/chapter7.html

The North American Electric Reliability Council (NERC) is responsible for the overall reliability, planning, and coordination of the interconnected power systems. NERC is

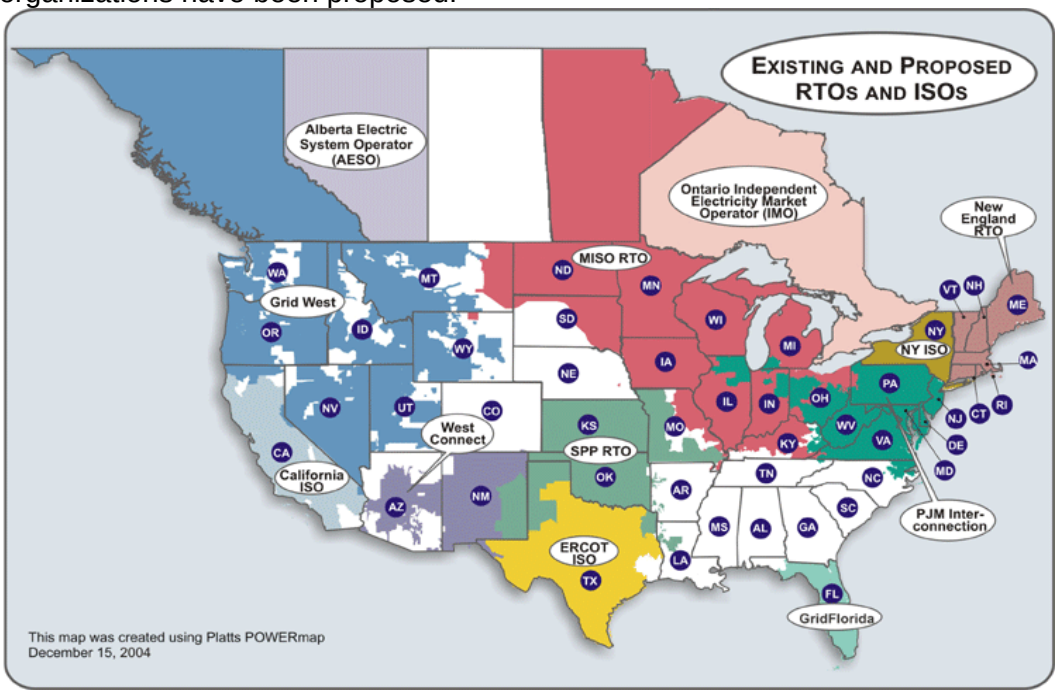
composed of ten regional councils which cover the 48 contiguous US states and parts of Alaska, Canada, and Mexico.

North American Electric Reliability Council Regions for the United States



Source: Energy Information Administration, Electric Power Industry Overview, http://www.eia.doe.gov/cneaf/electricity/page/prim2/chapter1.html
Note: The Alaska Systems Coordinating Council (ASCC) is an affiliate NERC member.

In many parts of the US, regional system operators manage the day-to-day operation of the transmission system and administer the wholesale energy marketplace. System operators include: ISO-New England, PJM Interconnection, New York ISO, Midwest ISO, California ISO, and the Electric Reliability Council of Texas. Additional organizations have been proposed.



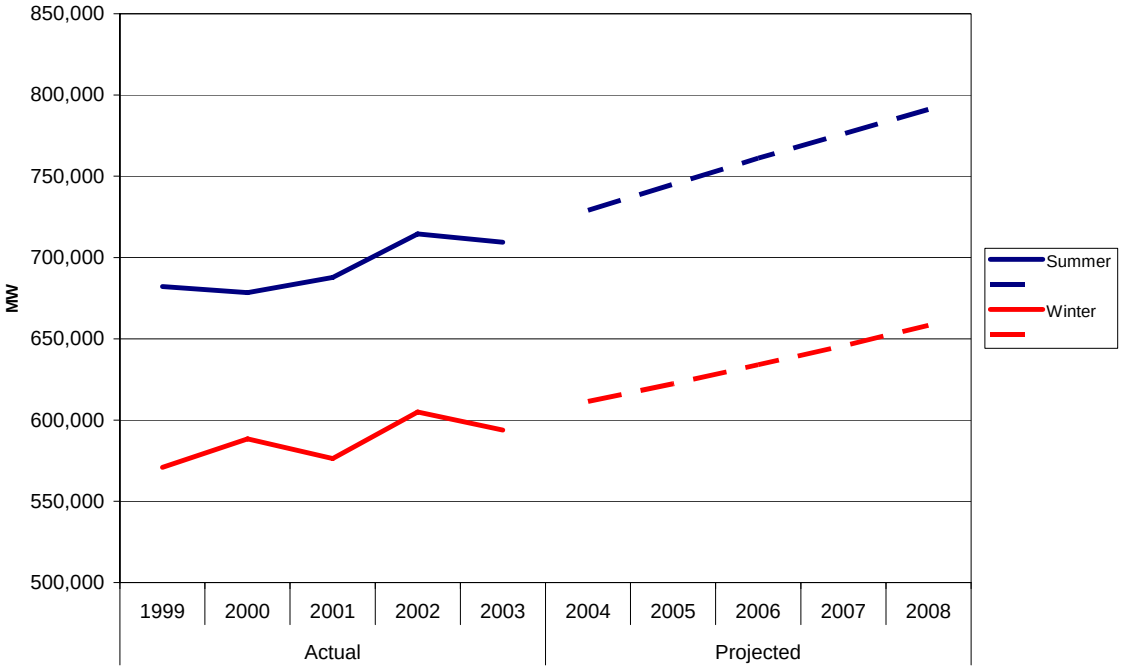
Source: Federal Energy Regulatory Commission, http://www.ferc.gov/industries/electric/indus-act/rto.asp

USA - Peak Demand:

Total Peak Demand

In 2003, total peak demand for the continental United States was 709,375 MW. Since 1999, peak demand has grown at a rate of 1% per year. Going forward, the US Energy Information Administration (EIA) projects that peak demand will grow at an annual rate of 2.2%, reaching 791,063 by 2008.

US Peak Demand



Data source: Energy Information Administration, Electric Power Annual 2003

Peak Demand by Region

Projected demand growth rates vary by region, with the highest growth rates projected for Florida (FRCC) and the Mid-Atlantic region (MAAC).

(See Table on next page)

US Non-coincident Peak Load by NERC Region

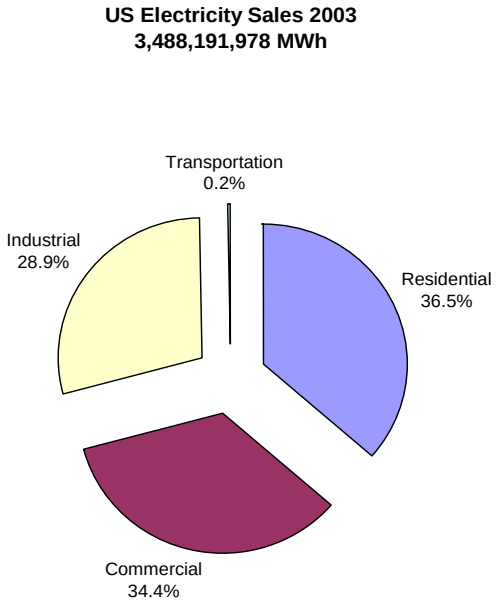
Peak Load, Actual and Projected, 2003 through 2008 (Megawatts)

North American Electric Reliability Council Region	Actual	Projected				
	2003	2004	2005	2006	2007	2008
Summer						
ECAR	98,487	102,423	104,765	107,689	109,852	112,007
ERCOT	59,996	61,432	62,906	64,416	65,962	67,545
FRCC	40,475	42,705	43,753	44,826	45,896	46,897
MAAC	53,566	56,886	58,056	59,126	60,170	61,224
MAIN	56,988	57,868	58,667	59,717	60,469	61,325
MAPP (U.S.)	28,831	29,244	30,116	30,857	31,329	31,956
NPCC (U.S.)	55,018	57,535	58,624	59,336	60,038	60,720
SERC	153,110	157,961	161,634	165,151	168,830	172,099
SPP	40,367	40,089	40,813	41,076	41,585	42,429
WECC (U.S.)	122,537	122,870	125,687	128,864	131,882	134,861
Contiguous U.S.	**709,375**	**729,013**	**745,021**	**761,058**	**776,013**	**791,063**
Winter						
ECAR	86,332	87,972	89,268	91,131	93,128	95,558
ERCOT	42,702	43,556	44,427	45,316	46,222	47,146
FRCC	36,841	45,418	46,546	47,692	48,769	49,944
MAAC	45,625	45,471	46,215	46,955	47,690	48,420
MAIN	41,719	42,409	43,336	43,955	44,487	45,206
MAPP (U.S.)	24,134	24,628	25,035	25,419	25,742	26,178
NPCC (U.S.)	48,079	47,986	48,532	49,040	49,504	49,896
SERC	137,972	141,176	143,675	146,565	149,327	152,227
SPP	28,450	28,469	28,825	29,065	29,504	30,088
WECC (U.S.)	102,020	104,393	106,525	108,857	111,206	113,575
Contiguous U.S.	**593,874**	**611,478**	**622,384**	**633,995**	**645,579**	**658,238**

Source: Energy Information Administration, Electric Power Annual 2003

Sales by Customer Class

Residential customers account for 36.5% of US electricity sales, followed by commercial customers with 34.4%, industrial customers with 28.9%, and transportation customers with 0.2%.



Data source: Energy Information Administration, Electric Power Annual 2003

USA - Rates and Revenues:

Rate Design

Rate designs vary by utility and by customer class. In most cases, residential rates are simple, fixed kilowatt-hour charges. Commercial and industrial rates are more complex, often incorporating demand charges and, for larger customers, time variable pricing. Many utilities offer time-of-use rates as an option even where the standard rate is fixed.

Typical rate designs are set out in the table below.

Typical Rate Designs

Customer Class	Rate Components
Residential	Customer charge (per month) Energy charge (per kWh); fixed
Commercial	Customer charge (per month) Demand charge (per kW) Energy charge (per kWh); varies by season or TOU

Industrial	Customer charge (per month) Demand charge (per kW) Energy charge (per kWh); varies by TOU or by hour

In states that have adopted electric competition, rates are divided into wires charges and supply charges. Wires service is provided by the local utility and rates for that service are regulated by state public utilities commissions. Supply service is offered by competitive firms and the prices charged by those firms are not regulated. In most competitive states, a "default" supply service is available from the utility for customers that have not chosen a competitive supplier. Prices for this service are typically based on wholesale market prices.

Average rates

Average rates vary by region and by customer class. US average rates range from 8.7 ¢/kWh for residential customers to 5.13 ¢/kWh for industrial customers.

Average Rates by Class, 2003
(Cents ¢/kWh)

Residential	Commercial	Industrial	Transportation	All Sectors
8.7	7.98	5.13	7.58	7.42

Data Source: Energy Information Administration, Electric Power Annual 2003

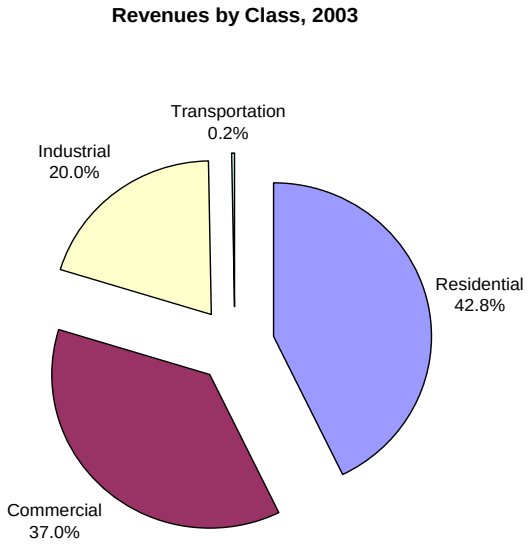
Revenue by Customer Class

Residential customers account for the largest share of electric revenues, followed by commercial customers and then industrial customers. Total revenue by customer class is set out below.

Total Revenues by Class, 2003
($ million)

Residential	Commercial	Industrial	Transportation	All Sectors
110,779	95,772	51,716	531	258,798

Data Source: Energy Information Administration, Electric Power Annual 2003



Data Source: Energy Information Administration, Electric Power Annual 2003

Heating and Cooling Degree Days

The US as a whole averages 4,524 heating degree days per year and 1,215 cooling degree days.[2] However, the number of heating and cooling degree days varies significantly by region.

Heating and Cooling Degree-Days by Census Division (°F)

	New Engl.	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mnt	Pacific	United States
Heating	6,612	5,910	6,498	6,750	2,853	3,603	2,286	5,209	3,226	4,524
Cooling	418	655	708	928	1,964	1,549	2,448	1,244	704	1,215

Source: Energy Information Administration, Annual Energy Review 2003
Note: Data does not include Alaska and Hawaii

USA - Customer Information:

[2] *In the United States, degree days are defined as deviations from a mean daily temperature of 65° F.*

Number of USA Customers by Customer Class

The number of customers, and the mix of customers by class, varies significantly by state and region. The states with the most customers are California, Texas, and Florida. The number of customers by state and region are set out below.

Customers by Sector, Region, and State, 2002

Region/ State	Residential	Commercial	Industrial	Other	Total
New England	**5,910,739**	**725,257**	**25,469**	**33,638**	**6,695,103**
CT	1,402,609	141,298	5,802	5,281	1,554,990
MA	2,524,532	335,483	13,347	17,156	2,890,518
ME	716,248	65,540	279	4,223	786,290
NH	559,939	90,572	3,260	3,577	657,348
RI	418,193	49,106	2,335	1,915	471,549
VT	289,218	43,258	446	1,486	334,408
Mid-Atlantic	**15,468,005**	**2,051,823**	**53,011**	**52,160**	**17,624,999**
NJ	3,251,136	429,038	13,397	10,996	3,704,567
NY	7,203,703	981,570	10,524	32,538	8,228,335
PA	5,013,166	641,215	29,090	8,626	5,692,097
E. North Central	**18,847,686**	**2,131,707**	**71,708**	**86,423**	**21,137,524**
IL	4,857,000	511,306	5,181	30,754	5,404,241
IN	2,605,762	300,488	17,960	10,466	2,934,676
MI	4,188,117	486,714	14,772	9,410	4,699,013
OH	4,793,084	543,357	28,098	21,073	5,385,612
WI	2,403,723	289,842	5,697	14,720	2,713,982
W. North Central	**8,429,973**	**1,163,260**	**45,295**	**123,574**	**9,762,102**
IA	1,259,526	178,152	4,005	18,296	1,459,979
KS	1,157,820	194,996	12,885	13,646	1,379,347
MN	2,117,928	232,919	5,026	16,568	2,372,441
MO	2,527,727	331,088	9,640	14,868	2,883,323
ND	294,291	48,085	1,604	6,066	350,046
NE	741,478	125,026	10,642	44,789	921,935
SD	331,203	52,994	1,493	9,341	395,031
South Atlantic	**22,985,038**	**2,937,529**	**75,510**	**192,849**	**26,190,926**
DC	205,352	26,504	1	127	231,984
DE	349,069	41,639	556	871	392,135
FL	7,506,268	929,629	23,238	74,144	8,533,279
GA	3,588,926	440,687	9,921	31,950	4,071,484
MD	2,037,791	223,927	8,174	1,879	2,271,771
NC	3,741,959	543,212	11,645	18,973	4,315,789
SC	1,836,612	286,840	5,136	16,232	2,144,820
VA	2,887,425	322,498	5,449	45,627	3,260,999
WV	831,636	122,593	11,390	3,046	968,665
E. South Central	**7,462,236**	**1,169,306**	**18,757**	**60,956**	**8,711,255**
AL	1,970,678	326,065	6,160	14,326	2,317,229

KY	1,814,989	247,957	6,246	22,701	2,091,893
MS	1,198,383	193,145	4,455	10,100	1,406,083
TN	2,478,186	402,139	1,896	13,829	2,896,050
W. South Central	**13,256,381**	**1,908,682**	**150,394**	**235,576**	**15,551,033**
AR	1,201,823	151,692	25,021	12,355	1,390,891
LA	1,848,588	225,718	15,435	21,027	2,110,768
OK	1,542,470	205,371	15,884	18,672	1,782,397
TX	8,663,500	1,325,901	94,054	183,522	10,266,977
Mountain	**7,578,328**	**1,032,878**	**37,059**	**146,746**	**8,795,011**
AZ	2,095,776	225,026	6,376	24,585	2,351,763
CO	1,873,269	255,890	8,139	80,443	2,217,741
ID	561,610	96,316	6,437	3,692	668,055
MT	413,182	80,475	680	15,626	509,963
NM	749,590	112,524	1,420	13,030	876,564
NV	857,619	119,387	1,849	1,648	980,503
UT	799,194	92,103	8,624	4,617	904,538
WY	228,088	51,157	3,534	3,105	285,884
Pacific	**15,894,583**	**2,064,740**	**115,631**	**100,497**	**18,175,451**
CA	11,916,573	1,556,991	84,295	65,066	13,622,925
OR	1,474,289	216,668	11,460	12,187	1,714,604
WA	2,503,721	291,081	19,876	23,244	2,837,922
Alaska & Hawaii	**615,490**	**92,252**	**2,485**	**9,402**	**719,629**
AK	239,822	37,681	1,842	5,476	284,821
HI	375,668	54,571	643	3,926	434,808
US-Total	**116,448,459**	**15,277,434**	**595,319**	**1,041,821**	**133,363,033**

Source: Energy Information Administration, Electric Power Annual 2002

USA Industrial Customers

The major electricity consuming sectors include chemicals, metals, and paper. Electricity consumption by industry sector is set out below.

Net Demand for Electricity by Industry Sector, 1998

NAICS Code	Sub-sector and Industry	Net Demand for Electricity (million kWh)
311	Food	67,390
312	Beverage and Tobacco Products	8,242
313	Textile Mills	29,907
314	Textile Product Mills	5,193
315	Apparel	5,271

316	Leather and Allied Products	762
321	Wood Products	22,603
322	Paper	124,087
323	Printing and Related Support	15,051
324	Petroleum and Coal Products	54,137
325	Chemicals	215,008
326	Plastics and Rubber Products	53,777
327	Nonmetallic Mineral Products	39,948
331	Primary Metals	168,620
332	Fabricated Metal Products	51,646
333	Machinery	28,355
334	Computer and Electronic Products	40,291
335	Electrical Equip., Appliances, and Components	16,229
336	Transportation Equipment	58,089
337	Furniture and Related Products	8,730
339	Miscellaneous	11,814
	Total	1,025,149

Source: Energy Information Administration, Manufacturing Energy Consumption Survey, 1998; http://www.eia.doe.gov/emeu/mecs/
Note: Net demand is the sum of purchases, transfers in, and total onsite generation, minus sales and transfers offsite. It is the total amount of electricity used.

USA Commercial Customers

The commercial sector includes non-manufacturing businesses such as office buildings, restaurants, and hotels. The table below shows the number and size of commercial buildings by activity.

Commercial Buildings by Activity, 2003

	Number of Buildings (thousand)	Total Floor space (million sq. ft.)	Mean Square Feet per Building (thousand)
All Buildings	4,859	71,658	14.7
Principal Building Activity			
Education	386	9,874	25.6
Food Sales	226	1,255	5.6
Food Service	297	1,654	5.6
Health Care	129	3,163	24.6

Lodging	142	5,096	35.8
Mercantile	657	11,192	17
Office	824	12,208	14.8
Public Assembly	277	3,939	14.2
Public Order and Safety	71	1,090	15.5
Religious Worship	370	3,754	10.1
Service	622	4,050	6.5
Warehouse and Storage	597	10,078	16.9
Other	79	1,738	21.9
Vacant	182	2,567	14.1

Source: Energy Information Administration, 2003 Commercial Buildings Energy Consumption Survey. http://www.eia.doe.gov/emeu/cbecs/cbecs2003/introduction.html
Note: Preliminary Data

USA Residential Customers

The residential sector includes single-family homes and apartment buildings. Electricity is consumed primarily for space heating, water heating, air conditioning, lighting, refrigeration, cooking and clothes drying.

USA Residential Appliance Saturation

	1980	1984	1987	1990	1993	1997	2001
				(millions)			
Number of Households	82	86	91	94	97	101	107
				(percent of households)			
Air-Conditioners							
Central	27	30	34	39	44	47	55
Individual Room Units	30	30	30	29	25	25	23
None	43	40	36	32	32	28	23
Electric Appliances							
Clothes Dryer	47	46	51	53	57	55	57
Clothes Washer	74	73	75	76	77	77	79
Computer, Personal	NA	NA	NA	16	23	35	56
Dehumidifier	9	9	10	12	9	NA	11
Dishwasher	37	38	43	45	45	50	53
Evaporative Cooler	4	4	3	4	3	NA	3
Fan, Ceiling	NA	NA	NA	NA	54	61	65

Fan, Whole House	NA	8	9	10	4	NA	NA
Fan, Window or Ceiling	NA	35	46	51	60	NA	NA
Freezer, Separate	38	37	34	34	35	33	32
Oven, Microwave	14	34	61	79	84	83	86
Pump for Swimming Pool	3	NA	NA	5	5	5	6
Pump for Well Water	NA	NA	NA	15	13	14	13
Range (stove-top burner)	54	54	57	58	61	60	60
Refrigerator (one)	86	88	86	84	85	85	83
Refrigerator (two or more)	14	12	14	15	15	15	17
Television Set (any type)	98	98	98	99	99	NA	NA
Television Set (b/w)	51	43	36	31	20	NA	NA
Television Set (color)	82	88	93	96	98	99	99
Waterbed Heaters	NA	10	14	15	12	8	5

Source: Energy Information Administration, Regional Energy Profiles: Appliance Report, http://www.eia.doe.gov/emeu/reps/appli/us_table.html

USA - Demand Response:

Utilities in the US have a long history of providing load management programs. These include time-based pricing (primarily TOU), interruptible rates, curtailment programs, and direct load control programs. The most active of these have been direct load control programs, particularly of customer HVAC and DHW systems. Many utilities continue to have these programs in place.

There is a rapid evolution underway from load management concepts and programs to those that reflect the concept of demand response, and the new capabilities that new technologies provide to utilities, system operators, customers and other actors in electricity markets. These demand response efforts fall into two categories: price responsive and emergency/reliability.

Information regarding the US experience with time-base pricing is available in a 2004 report published by the Lawrence Berkeley National Laboratory: *A Survey of Utility Experience with Real Time Pricing*. That report is available on the web at: http://eetd.lbl.gov./ea/emp/drlm-pubs.html.

Today, some System Operators offer demand response programs through which demand resources can offer their capacity to the market. This is typically done through a market participant, e.g., a utility, demand response aggregator, or competitive retail supplier.

Information regarding the demand response programs offered by the New York, New England, and PJM (mid-Atlantic region) Independent System Operators is available on the web at:

New York ISO
http://www.nyiso.com/services/documents/groups/bic_price_responsive_wg/demand_response_prog.html

ISO New England
http://www.iso-ne.com/Load_Response/

PJM Interconnection
http://www.pjm.com/services/demand-response/demand-response.html

The two states that have been most active on demand response are New York and California.

The New York State Energy Research and Development Authority (NYSERDA) offers programs that cover a portion of the cost of demand response enabling technology such as advanced meters and load control equipment. Information regarding NYSERDA's programs is available at: http://www.nyserda.org/programs/demandresponse.asp

Information regarding demand response efforts in the state of California is available from the California Energy Commission at:
http://www.energy.ca.gov/demandresponse/index.html

********** End of SECTION 1 **********

SECTION 2: Market Data Tables

This section provides some quick reference data tables. Note: some of the data in SECTION 1 is from more recent reports than the data contained in the tables below – however, the below tables provide comparisons which help the reader gain an understanding of how the various countries compare and are included here for that reason.

Market Structures:

Country	Power Exchange	System Operator	Retail Choice
Australia	Yes (NEM)	Yes (NEMCO)	Yes
Denmark	Yes (NordPool)	Yes (Energy Net Denmark)	Yes
Finland	Yes (NordPool)	Yes (Fingrid)	Yes
Italy	Yes (GME)	Yes (GRTN)	Yes and No depending on size
Japan	Yes (in April 2005)	No	Yes and No depending on size
Korea			
Netherlands	Yes (APX)	Yes (TenneT)	Yes
Norway	Yes (NordPool)	Yes (Statnett SF)	Yes
Spain	Yes (OMEL)	Yes (REE)	Yes
Sweden	Yes (NordPool)	Yes (Svenska Kraftnät)	Yes
USA	Yes and No depending on region	Yes and No depending on region	Yes and No depending on state rules

Peak Demand:

Country	Summer (MW)	Winter (MW)
Australia	33,659	28,960
Denmark	5,645	6,552
Finland	8,000	12,100
Italy	53,105	53,600
Japan	1,750,000 (2001 data)	1,380,000 (2001 data)
Korea	-	-
Netherlands	12,500	15,046
Norway	-	23,050

Spain	34,986	38,037
Sweden	-	26,800 (2000 data)
USA	-	-

Expected Growth Rates:

Country	Average Demand Growth Rate (Annual %)	Average Supply Growth Rate (Annual %)
Australia	1.5 – 3.5	2.6
Denmark	1.5 – 2.5	0.8 – 1.1
Finland	1.8 – 2.5	1.8
Italy	0.4 - 4	5.5 - 8
Japan	0.9	1.1
Korea	-	-
Netherlands	2	-
Norway	1 – 1.5	0.5
Spain	2.5 – 3.2	3
Sweden	0.5%	-
USA	-	-

Consumers (number of meters)

Country	Commercial	Industrial (Includes agriculture if provided)	Residential	Other
Australia	1,220,046	(Included in commercial total)	7,749,047	-
Denmark	374,600	30,200	2,990,500	15,800
Finland	199,000	174,000	2,587,000	-
Italy	3,700,000	1,600,000	28,100,000	
Japan (2001 data)	450,000	300,000	76,000,000	
Korea	-	-	-	
Netherlands	300,000	20,000	6,000,000	
Norway	260,000	N/A	2,000,000	
Spain	556,779	109,417	22,205,414	64,059
Sweden	-	-	-	
USA	-	-	-	

General Retail Rate Structures:

Country	Regulated Markets	Unregulated Markets
Australia		
Denmark	All consumers are able to choose a supplier and the local distribution company provides distribution services to all consumers located in the service territory.	TOU Rates: Successfully for some customer categories provided an incentive to move consumption from peak to off peak hours. After deregulation of the market, the TOU tariff is nearly not in use any longer. Real time pricing rates: The RTP tariff is used by few large customers.
Finland	All consumers are able to choose a supplier or they default to the local distribution company.	Distribution charge options (paid to local distribution company): 1. Standard = MWh + fixed charge 2. Demand tariff = MWh/MW + fixed charge 3. TOU rates Standard Energy Charge (paid to energy supplier): 1. Firm: normally for small consumers without electric heating 2. TOU: normally for electrically heated homes, commercial, and industrial buildings 3. Spot + margin: normally for industrial consumers
Italy	Distribution charges are the same for regulated and non-regulated consumers. Residential Consumers = Fixed charge (per customer year) + demand charge (based on KW level subscribed by customer) + Energy consumed Commercial & Industrial = Energy consumed (generally based on 4 time slice TOU structures: peak, high load, medium load, off	Distribution charges are the same for regulated and non-regulated consumers. Residential consumers are not currently eligible to choose a private supplier. Eligible C&I consumers negotiate bilateral contracts with suppliers. These contracts generally follow the basic TOU structure used in the regulated market, but the time slices may be slightly different.

	peak)	
Japan	Demand charge plus energy charge	Consumers negotiate energy rates with their supplier. Energy and wires charges are paid directly to the supplier.
Korea		
Netherlands	Consumers have the ability to choose an energy supplier and the local distribution company provides distribution services.	Large consumers generally operate directly with the wholesale market. Medium consumers are metered quarterly and use load profiled based contracts. Small consumers are generally charged based on peak and off peak usage levels.
Norway		
Spain		
Sweden		
USA	Many different rate structures are used in the USA. 1. Multiple variations of demand plus energy charges 2. TOU rates 3. Real time pricing rates 4. Other	Consumers negotiate energy rates with their supplier and pay the distribution company for wires charges.

********** End of SECTION 2 **********