EXAMPLES OF OTHER TRADING REGIMES

AN INFORMATION PAPER BY THE COMMISSION FOR ENERGY REGULATION

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1 Introduction 3
2 The Argentine Electricity Market 4
2.1 Spot Market 4
2.2 Dispatch 5
2.3 Settlement 5
3 The Australian Electricity Market 6
3.1 Spot Market 6
3.2 Dispatch 7
3.3 Settlement 8
4 The Chilean Electricity Market 9
4.1 Spot Market 9
4.2 Dispatch 10
5 The Greek Electricity Market 11
5.1 Spot Market 11
5.2 Dispatch 11
5.3 Settlement 11
6 The New Electricity Trading Arrangements (NETA) of England and Wales 13
6.1 Spot Market 13
6.2 Dispatch 13
6.3 Settlement 14
7 The New Zealand Electricity Market 15
7.1 Regulatory Structure 15
7.2 Prices 16
7.3 Dispatch 16
7.4 Settlement 16
8 The Nordic Market (Norway, Sweden, Finland and Denmark) 17
8.1 Physical and Financial Markets 18
8.2 Dispatch 19
9 The Ontario Electricity Market 20
9.1 Spot Market 21
9.2 Dispatch 21
9.3 Settlement 21
10 The Pennsylvania New Jersey Maryland (PJM) Market 22
10.1 Day-Ahead and Spot Markets 22
10.2 Pricing 22
10.3 Dispatch 22
11 The Portuguese Electricity Market 24
11.1 Balancing Market 25
11.2 Dispatch 25
12 The Spanish Electricity Market 26
12.1 Market Format 26
12.2 Dispatch 27
13 Additional Useful Links 29

1 Introduction

The purpose of this report is to provide a high-level introduction to electricity trading systems in other countries. The CER has not evaluated any of the following systems, they are merely presented in a basic format to stimulate thought and debate regarding the market review.

The CER is undertaking a review of the electricity trading arrangements, as required in The Policy Direction (Trading in Electricity) issued by the Minister for Public Enterprise to the CER on 27 July 1999. This review will result in a set of electricity trading arrangements which will apply to a fully opened electricity market, with the high level principles of the future market decided early in 2003.

On the 21st November 2002 the Commission for Energy Regulation published a paper regarding Choices for Irish Electricity Trading Arrangements (CER/02/216), which represents the beginning of the consultation process for the wholesale market review. The choices paper provides three options for trading arrangements (status quo, decentralised market and centralised market). The paper also discusses two important institutional and structural issues (generation adequacy and market dominance) and options to resolve these issues.

This paper, Examples of Other Trading Regimes, presents the following markets at a high level:

- Argentina
- Australia
- Chile
- Greece
- NETA – England and Wales
- New Zealand
- Nordic market
- Ontario
- Pennsylvania New Jersey Maryland
- Portugal
- Spain

2 The Argentine Electricity Market

Of the electricity produced in Argentina, approximately 93% is traded in Mercado Electrico Mayorista (MEM), the rest being negotiated in the Patagonian system (6%) and other small isolated systems (1%).[1]

Compañía Administradora del Mercado Mayorista Eléctrico S.A. (CAMMESA), the market and system operator, operates the MEM. [2] It has three primary tasks:

- dispatch;
- determining fixed charges and other fixed fees added to spot, seasonal, and contractual prices to cover the full costs of transmission; and
- ensuring adequate reserve capacity.

Generators, distributors and large consumers, are allowed to sell/purchase electricity in the MEM. There are two basic markets for trading electricity in the MEM:

- the bilateral contract market; and
- the spot market.

Seasonal and spot prices are established directly in the wholesale market, while contractual prices are affected indirectly by the wholesale market. Generators can sign contracts with distributors or large customers, in which schedules of delivery, power levels and prices may be freely negotiated between the parties.

The independent market operates as a form of net pool, however distribution companies buy from the MEM at a seasonal price, which is a forecast of spot prices for the coming "season" of 6 months duration. The companies are permitted to recover this in tariffs to final consumers.

The Argentine system operates based on cost declaration rather than on price bidding. Cost declarations are valid for six months and cannot be changed unless unexpected fluctuations on fuel prices occur. Fuel cost declarations are subject to verification and cannot exceed 115% of a reference price established by CAMMESA.[3] CAMMESA sets its reference prices, which are adjustable monthly, based on plant type.

2.1 Spot Market

Electricity not covered under bilateral contracts is traded in the spot market. The spot market price is the price set by the marginal firm on the system at each hour, i.e., the system marginal price.

Capacity Charge

The actual price received by the generators for their service during business days, peak hours (from 6 a.m. to 11 p.m.) is actually larger than the system marginal price due to

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[1] For information on Argentina please refer to the following: EIA, Electricity Reform Abroad and U.S. Investment, Section 4. The Transformation of Argentina's Electricity Industry, 1997, http://www.eia.doe.gov/emeu/pgem/electric/ch4.html; National Economic Research Associates; Analysis of the reform of the Argentine Power Sector: Final Report; Kent Anderson, Hethie Parmesano, Stephen Powell, Graham Shuttleworth; January 1998; and University of Chicago, Department of Economics; On the Efficiency of the Argentinean Electricity Wholesale Market; Pedro Jobim Alves Ferreira; May 30, 2002.

[2] The President of the board of directors is the Secretary of Energy and has veto power over board decisions.

[3] Generators are required to submit their actual fuel contracts to the dispatcher on a regular basis.

the addition of a capacity charge of US$ 10/MWh, to the cost of the marginal turbine. This was implemented to help generators cover fixed costs.

Seasonal Market
Seasonal prices are set every 6 months and reviewed every 3 months. They are a forecast of the spot price, which enable distributors to set stable tariffs. Any differences between payments made to generators in the spot market and receipts from the seasonal price are recoverable in subsequent seasons.

2.2 Dispatch

All dispatch occurs on a least-cost declaration basis. This means that the system operator CAMMESA dispatches the most efficient generators capable of meeting the demand at each hour, regardless of the existence of contracts.[4] CAMMESA determines the cost of generation for each generator and then dispatches the cheapest power first until demand has been satisfied. Generally it is the highest cost producer whose power is dispatched that determines the price that is paid to each generator.

Generators are paid for providing operating reserve and ancillary services, the cost of which is paid by customers of the MEM through extra charges. In addition:

- all generators who run in peak hours get a capacity payment;
- some generators receive a payment even if they do not run, on the basis of their forecast output in extra dry years. This payment is intended to provide generators with a stream of income to ensure their availability in low water years;
- no generator receives both payments for the trading period in question.

2.3 Settlement

Settlement in MEM is a two-stage process. Bilateral contracted volumes are deducted from the metered generation and metered demand. These are settled bilaterally. Any differences are then settled through the pool. Large customers and generators settle any uncontracted volumes at the spot price, whereas distributors settle at the seasonal price and differences are addressed on a rolling basis.

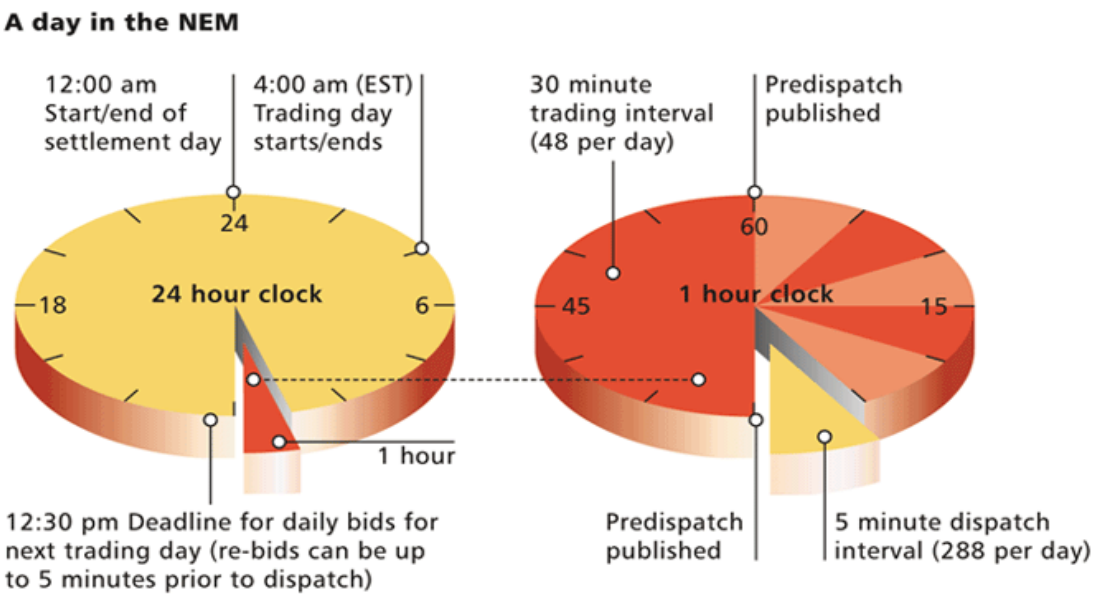
[4] Therefore, if a generator that has, an obligation to deliver electricity to a customer under contract but is not dispatched must subsequently purchase the power required through the spot market.

3 The Australian Electricity Market

The Australian electricity market[5] has a wholesale market for trading in electricity between generators and suppliers (meaning retailers for the purposes of this paper), in which all the electricity output from generators is pooled, and then scheduled to meet electricity demand.[6] The trading regime is a gross pool.

In the centrally coordinated dispatch process, the National Electricity Market Management Company Limited (NEMMCO), which operates the wholesale market, continually balances electricity supply and demand requirements by scheduling generators to meet demand. Generators compete by making bids for supplying energy to NEMMCO. These bids are made up of prices and quantities and can be changed according to a set of bidding rules.

A Day in the National Electricity Market (NEM) of Australia



Source: An Introduction to Australia's National Electricity Market: The White Book[7]

NEMMCO selects the generators required to produce power based on the most cost-efficient supply solution to meet specific demand, as determined on the basis of generator bids. Demand varies from State to State and throughout the day. Each region has a separate price calculated for each dispatch interval.

3.1 Spot Market

A spot market sets the price where supply equals demand.[8] Power is traded on a 5-minute basis within each half hour. NEMMCO calculates the spot price using the price

[5] The Australian Electricity Market described here refers to those states that operate under the NEM – National Electricity Market. These are Queensland, New South Wales, Australian Capital Territory (Canberra), Victoria and South Australia.
[6] Please refer to www.neca.com.au for further information on market rules and regulations.
[7] NEMMCO http://www.nemmco.com.au/publications/whitebook/operating.htm

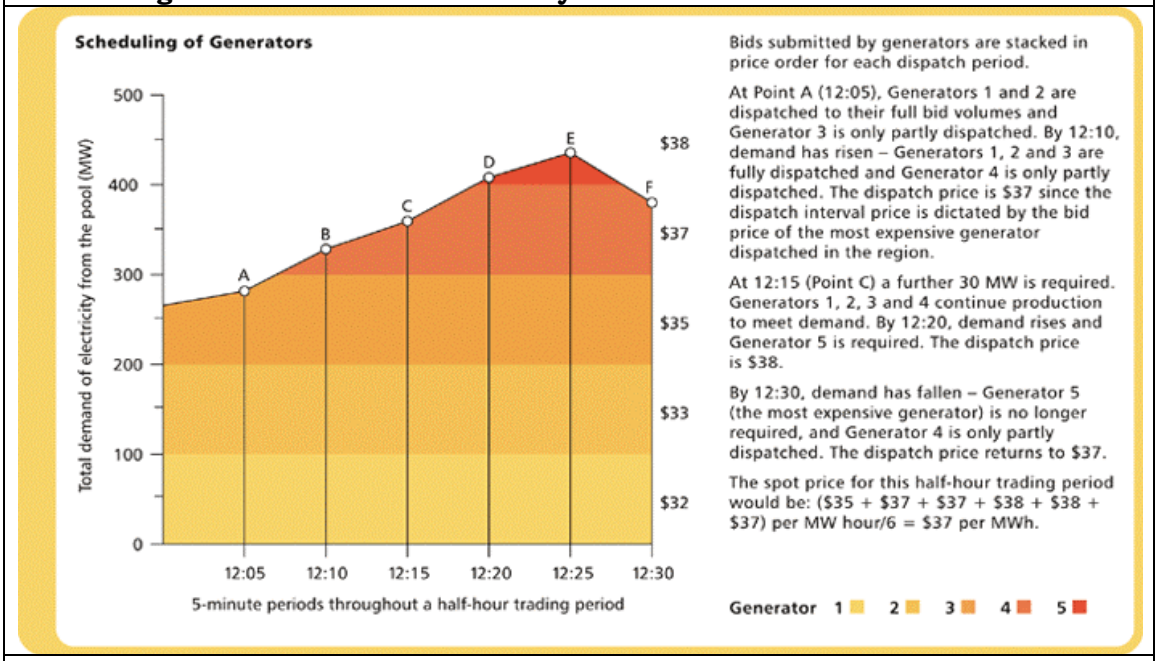
offers and bids for each half-hour period. (A half-hourly spot price is determined by getting an average of the six dispatch prices, referred to above, calculated during each half-hour period.) This price is used as the basis for billing participants, suppliers and generators and wholesale end-users, for energy traded. Parties also hedge the spot price.

There is a price cap that puts a ceiling on the level at which generators can bid in the market. This effectively sets a maximum spot price. This price cap is automatically triggered when the grid interrupts customer supply in order to regain balance in the system. In this situation the spot price is considered to represent the "Value of the Lost Load" (VoLL).

3.2 Dispatch

Scheduling is the process that balances supply and demand. NEMMCO determines which generators will dispatch into the market, at what time and at what volume on the basis of generator operator bids. This creates a dispatch based on cost-efficiency. Dispatch instructions are sent to each generator at five-minute intervals to schedule the amount of power to be produced.

Scheduling in the Australian Electricity Market



Source: An Introduction to Australia's National Electricity Market: The White Book[9]

The dispatch price is a proxy or representation of the marginal cost of the highest bid generator dispatched and running. Other factors, including available interconnector capacity, system load, plant outages, frequency control, voltage control, testing and transmission outages, can also have an effect on the dispatch price.

Bids are stacked in order of rising price to meet demand. As energy demand increases, more expensive generators are dispatched and run. The scheduling of generators may

[8] http://www.nemmco.com.au/publications/whitebook/spot.htm
[9] NEMMCO http://www.nemmco.com.au/publications/whitebook/operating.htm

be constrained by the capacity of the interconnectors/transmission lines between the regions. When this happens, higher price generators within the region will be dispatched to meet this demand. This is one reason that the spot price varies between regions.

Under the Code, NEMMCO has the responsibility for ensuring that the system is operated in a safe, secure and reliable manner. It operates and controls the key technical characteristics of the system, for example, frequency, voltage, network loading and system re-start. The Code allows NEMMCO to purchase these services under ancillary service agreements. Payments for ancillary services are broken down between the following: payments for availability; enabling usage; and compensation for the provision of the services. Market customers and generators pay for the associated costs for the services. These services are procured under competitive tender where possible.

3.3 Settlement

The process and procedures, which determine financial payments, i.e., billing and settling of amounts of electricity sold to and purchased from the pool, is called settlement. Accounts are issued on a weekly basis. Under the Code, NEMMCO has a prudential responsibility to the market to monitor and manage the risks regarding the solvency of market participants.

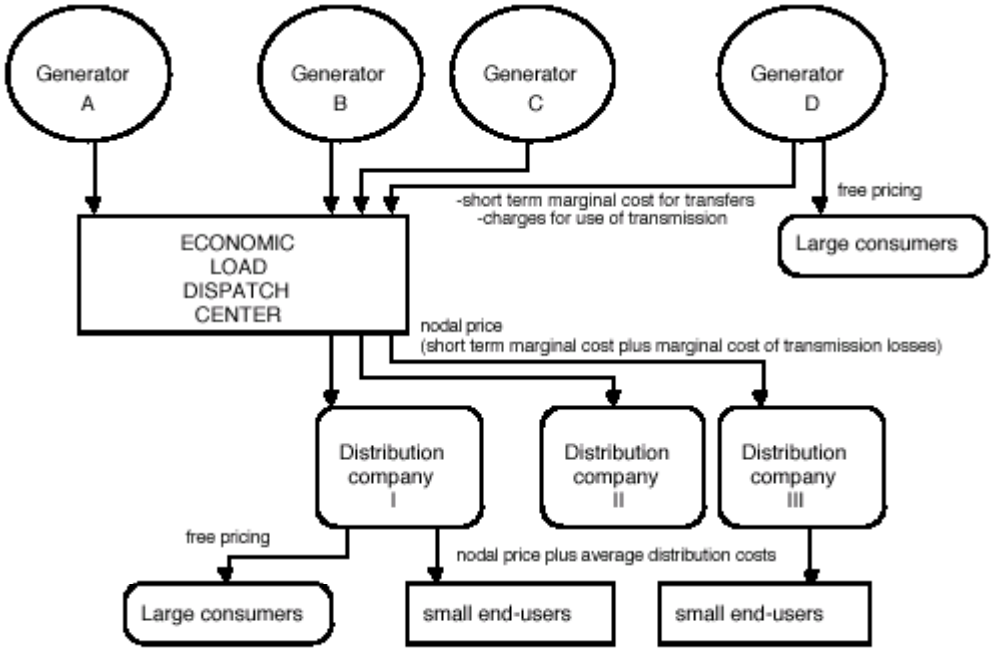
Generator settlement
Settlement price = energy produced x spot price x transmission loss factor

Market customer settlement
Settlement price = energy consumed x spot price x transmission loss factor

4 The Chilean Electricity Market

The Chilean Central Interconnected System (SIC) centre for economic load dispatch (SIC CDEC[10]) operates the SIC interconnected system. The market is known as the Wholesale Electricity Market (WEM). It combines elements of a bilateral contracts market and a pool depending on whether the customer is eligible or not.

Chilean Pricing System



Source: Transmission Open Access in Chile (Hugh Rudnick, 1994).[11]

The market in Chile is mainly based on two types of contracts, bilateral contracts and pool contracts. Generators compete to sell firm capacity or energy under bilateral contracts to large eligible consumers (consumption>2MW).

However, they can only sell to the distribution companies under regulated spot prices based on node prices.[12] The distribution companies act on behalf of the regulated market. The deregulated market represents around 27% of the demand.

4.1 Spot Market

[10] The Economic Load Dispatch Center (CDEC) is the central authority determining the operation of the electrical system and of the electricity trading pool. Only generators belong to CDEC. The CDEC is responsible for the short-term (daily and weekly), as well as the medium-term (monthly and annual) coordination of the system.

[11] http://www2.ing.puc.cl/~power/paperspdf/Harvard94.pdf

[12] "Node prices are adjusted every six months using indexation formulas with pre-defined variable ranges. Node prices must fall within a 10% range of deregulated prices." Inter-American Development Bank: Sustainable Development Department.
http://www.iadb.org/sds/doc/1822eng.pdf

Spot prices are set at each node of the interconnected system and are based on the weighted average of short run marginal costs (SRMC) of generation for the entire system optimised over a 12- or 48-month horizon (which accounts for reservoir levels, plant availability, thermal plant operating costs, new capacity and rationing).

A capacity component is added by using a 50-MW gas turbine increment and transmission losses are included.

Regulated prices are determined by taking forecasts of the short run marginal cost at each node over a period of 12 or 48 months. The forecasts incorporate the costs of optimisation of the system.

4.2 Dispatch

The system is dispatched based on an economic merit order that is pre-programmed for the entire system in hourly units. Each interconnected system has an economic load dispatch centre (CDEC), which has the responsibility for dispatching generating units onto the system. The CDEC must ensure the reliability and security of the transmission system, equal access rights, and least cost system operation.

5 The Greek Electricity Market

In Greece the transmission system operator is called the Hellenic Transmission System Operator (HTSO) and has the responsibility for both system and market operations. Only participants under the Power Exchange Code are entitled to buy and sell electricity in the market. [13] There is a requirement under Greek Electricity Law that all suppliers must also be generators and must own adequate generating capacity. [14]

The market, called the System Trading Arrangements (STA) is a form of centralised pool which all electricity is purchased and sold through.[15]

Parties enter into Contracts for Differences (CfDs) to remove the financial uncertainty of paying or being paid the single market price derived by the centralised market. A CfD is a financial contract with a strike price and a MW quantity. Differences between the single market price and the strike price are resolved under the contract. The contracts are independent of the HTSO.

5.1 Spot Market

The STA has a single and separate market for each hour, in which a single market price (SMP) is determined. The SMP in each hour is derived, in principle, by the marginal offer cost (or bid) of an additional MW of electricity produced. The SMP is a unique price set for the entire transmission system in every hour.

The hourly price and participants quantities are determined *ex post* on the basis of actual generator availability and load conditions. Parties purchase or sell at the SMP.

There are restrictions on offer prices in so much as the offer prices for each generation unit must reflect the actual and auditable variable and start-up costs of that unit.

5.2 Dispatch

The HTSO derives a day ahead load forecast based on generators offers and exporting purchasers requests for exports to be scheduled. From this data, anticipated generation quantities, forecast SMPs and international interconnector schedules are calculated by the HTSO and provided to participants. This process determines the merit order for the actual dispatch.

Dispatch is made on the basis of offers submitted to the HTSO by generators. Generators are dispatched on the basis of least cost and in a manner, which manages any constraints in the transmission system. This does not take into account any contract positions, as contracts are financial, rather than physical, in nature.

5.3 Settlement

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[13] All electricity delivered to or taken from Greece's interconnected transmission system is bought and sold through the STA.

[14] A Supplier must own adequate generating capacity to cover its load. It must also provide long-term confirmation as to necessary reserve capacity and availability of necessary transmission resources.

[15] Detailed Definition and Description of Electricity System Trading Arrangements in Greece, 16th October 2000. www.rae.gr/K7/index.htm.

All electricity generated or consumed is settled by the HTSO. However, in conducting settlement each supplier and generator is treated as a separate entity. This means that ownership and/or contractual relationships are not considered when the HTSO carries out settlement of STA transactions.

By dispatching generation in this manner and not on the basis of contractual positions, it is possible for the HTSO to conduct a least cost dispatch of the full available capacity of generation. This may not be the case were the HTSO to dispatch only the capacity available net of contractual obligations to customer load.

6 The New Electricity Trading Arrangements (NETA) of England and Wales

The New Electricity Trading Arrangements (NETA) introduced in place of the mandatory England and Wales Pool is based on bilateral trading between generators, suppliers, traders and customers and a balancing mechanism (sometimes referred to as a net pool). Parties make bilateral contracts and any excess or deficit from long term positions can be adjusted in the shorter term market. After the event *ex post* positions which are found to be out of balance are charged at imbalance prices which are derived in the Balancing Mechanism.[16]

In order to ascertain the physical balance of the system, participants notify the TSO (National Grid Company (NGC)) of expected physical position for each half hour trading period (i.e. their planned generation output and metered demand). The final submissions of physical positions take place as the balancing mechanism opens.

6.1 Spot Market

A number of *ex ante* power exchanges (physical spot markets) have been set up to allow participants to trade and adjust their contract positions ahead of the hour of trading. In addition, forward and futures markets are developing in response to the requirements of participants. These markets allow contracts for electricity to be struck up to several years ahead.

6.2 Dispatch

Participants self-dispatch based on their physical nominations which have been submitted to the system operator. The TSO runs a shorter-term market called the balancing mechanism.

When all final physical nominations have been received by the TSO at 'gate closure' (originally 3½ hours before real time but this decreased to one hour on the 28th June 2002) the balancing market opens. The balancing mechanism is a short term market run by the TSO in which it accepts bids and offers made by a wide range of participants, including generators, suppliers and customers. Nobody is obliged to make bids or offers. The TSO, accepts bids to increment or decrement load or generation to enable it to balance the transmission system in the short term. The TSO also has balancing services under forward contract.

The position of all participants is determined as regards whether their metered output or consumption of electricity matches their contracted position. There are two prices in the NETA imbalance market and the price charged for being out of balance depends on whether participants are over or under-contracted (long/short).

The different prices are an attempt to reflect the additional costs incurred by the TSO in instructing generators (supply), suppliers or customers (demand) to change production or consumption at short notice in order to balance the system.

The TSO also accepts bids and offers from the balancing mechanism to address congestion management by dispatching generation in different locations.

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[16] Review of Electricity Trading Arrangements Background Paper 2: Feb. 1998: OFFER. www.ofgem.gov.uk.

6.3 Settlement

The majority of demand settlement is between contracted parties. Participants whose contracted positions do not match their metered volumes of electricity, are found to be out of balance and must purchase if they have a deficit or sell if they have an excess, at the system buy or sell price respectively. The balancing mechanism generates these prices. Settlement also covers the payment of the accepted balancing mechanism offers and bids by the TSO.

7 The New Zealand Electricity Market

The New Zealand wholesale market, the NZEM, opened in 1996. NZEM is a voluntary, self-regulating market. Virtually all electricity is bought and sold through the NZEM. The total generation capacity is 9000MW with winter peak of approximately 7600MW. The North Island accounts for two-thirds of demand. However, the surplus capacity lies in the South Island.[17]

7.1 Regulatory Structure

The market is self-governing in the sense that responsibility for the NZEM rules rests entirely with the industry participants. Regulatory oversight is limited to a check that the rules developed by the market participants are consistent with general competition law and will meet the government's desired outcomes for the sector, as expressed in the Government Policy Statement on energy.

Although, strictly speaking the market is "voluntary", in practice, virtually all major producers and consumers of electricity are market participants.

Key institutions associated with the NZEM include:

- The Market Surveillance Committee, which monitors compliance with the Rules and advises the NZEM Board accordingly. The Rules provide for market participants to be fined by the market (rather than the Government) if they are found to be in breech of the rules.

- M-co, the 'Market Administrator', which:

    - provides administrative support to the market generally, including the management of the rule change process,
    - acts as the key source of information for the market. (M-co is responsible for calculating and publishing NZEM final pricing.) and
    - acts as the Clearing Manager, producing invoices for electricity purchased, notifications for electricity sold, and calculating constraint payments.

- Transpower - the grid owner/operator, responsible for maintaining electricity quality and security of supply over the transmission network, in accordance with common quality standards determined in conjunction with market participants. Transpower schedules generation and provides dispatch services.

- The Reconciliation Manager - responsible for calculating the market participant's share of the electricity entering/exiting the grid, adjusted for losses. The information is passed on to M-co as Clearing Manager for billing.

There are 48 half-hour trading periods per day. In each trading period, prices are determined for each injection/withdrawal node within the New Zealand electricity system. (There are in excess of 500 nodes.)

[17] Please refer to the following websites for further information: the market administrator (www.nz.m-co.com); and the market NZEM (www.nzelectricity.co.nz).

7.2 Prices

Prices are set *ex post* on the basis of actual demand and actual dispatch for each node for each trading period. The nodal prices reflect:

- the marginal cost of generation (determined by offers submitted by generators);
- the cost of providing reserve; and
- losses associated with the transport of electricity around the grid.

Final prices are calculated one day after physical dispatch and are made available by 12pm of that day.

There are also "forecast prices" calculated up to 35 hours ahead of the start of any half-hour trading period and recalculated in real time up to two hours before the specific trading period. They are used to signal prospective prices so generators and purchasers can plan their consumption and offering strategies. Dispatch prices, calculated at the time of dispatch and published up to four hours ahead of real time provide an additional, more accurate, indication of final prices.

7.3 Dispatch

Every 2 hours, pre-dispatch schedules are published with day-ahead plans. Participants can revise bids/offers up to 2 hours before dispatch. Dispatch also includes reserve and reactive power requirements.

A number of ancillary services (including various classes of reserve) are obtained through a market run in conjunction with the energy market. The energy and reserve markets are co-optimised (i.e., energy and reserve is obtained on the basis of least total cost, taking into account the cost of providing both energy and reserve.) In practice, the demand side provides much of the reserve.

Other ancillary services are secured via contracts with Transpower.

7.4 Settlement

Market participant accounts are settled monthly. The Reconciliation Manager calculates the quantity of electricity bought and sold by each market participants, and adjusts volumes for losses using Transpower data.

The Reconciliation Manager delivers the reconciled information, in table format, to the Clearing Manager. The Clearing Manager then applies final published prices and calculates the amounts due to and from market participants.

Settlement takes place on the 20th day of the month. Generators are paid when all cleared funds have been received from the purchasers.

8 The Nordic Market (Norway, Sweden, Finland and Denmark)

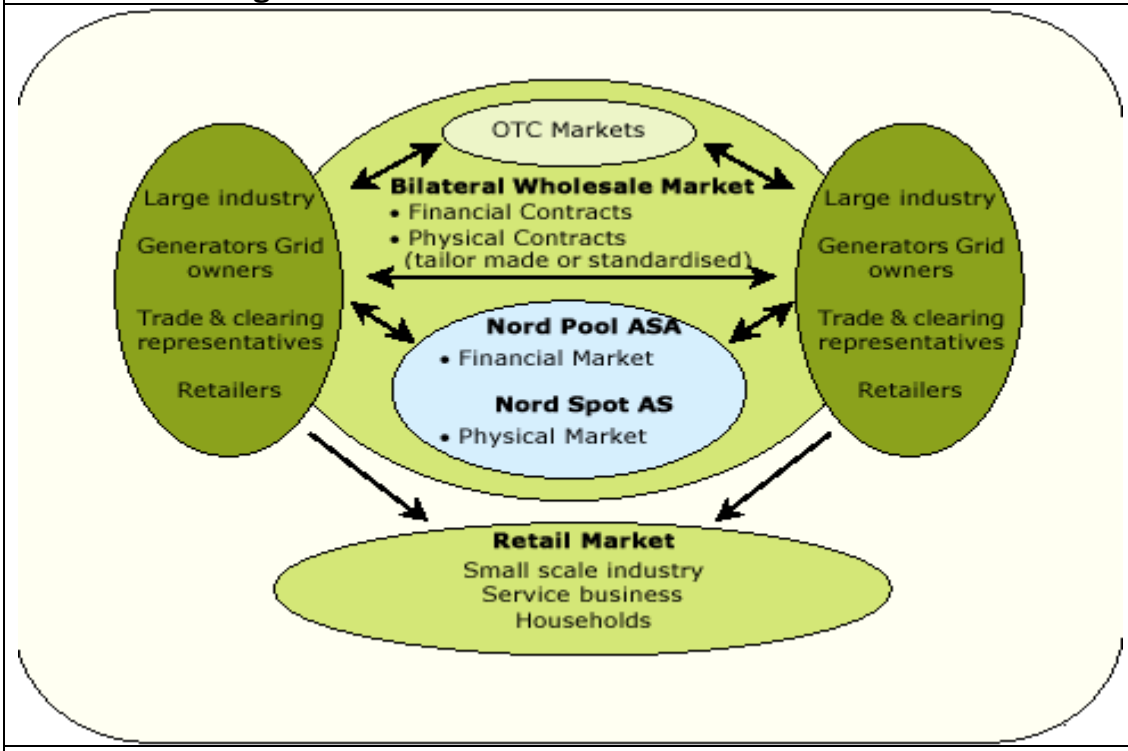
The Nord Pool trading market is a form of voluntary or net pool, which allows for physical bilateral contracts. Electricity can be traded through the pool or outside of the pool through bilateral contracts between market participants. Generators, distributors, suppliers, industrial customers, traders and brokers can all become members of the pool. The five transmission system operators (Norway, Sweden, Finland and two in Denmark) co-operate to facilitate trade and promote competition.

With the exception of Denmark, the Nordic power market is 100% open. In the retail market, large-scale end-users usually negotiate and enter into contracts with suppliers. Examples of common contract types include:

- contracts where the price may be changed at short notice;
- fixed price contracts – one or two year;
- spot contracts which contain the spot price plus an uplift without a price cap;
- price cap contracts which are based on the spot price and include an uplift, but are subject to a price cap.

At present, approximately 30% of total annual Nordic consumption is traded through the Nordic Power Exchange's spot market. The total annual trade in financial contracts is estimated at 3,500 TWh (about 9 times Nordic annual generation / consumption).[18]

Nord Pool Trading Market



Source: Nord Pool Market Presentation Nordic Power Markets (April 2002).[19]

[18] Source: Nord Pool Market Presentation – Nordic Power Markets {April 2002} www.nordpool.no
[19] www.nordpool.no

Nord Pool operates the following marketplaces and market services:

- a spot market for physical contracts - the Nord Pool Spot AS;
- a market for financial derivatives (futures, forward, and option contracts);
- clearing services are carried out at the Nordic Electricity Clearing House ASA (NECH) for financial electricity contracts.

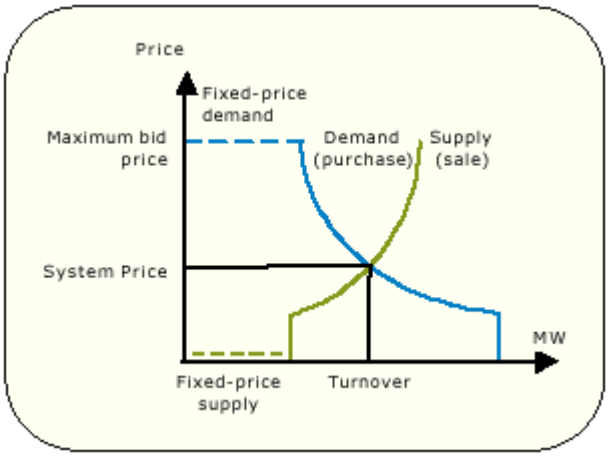
8.1 Physical and Financial Markets

Elspot

The Nordic Power Exchange's spot market is called Elspot. The market is a day ahead spot market for market participants operating inside the pool. Physical power contracts for delivery the next day are traded. Market participants bid for purchase and sale of power contracts of one-hour duration for all 24 hours of the next day.

On the day ahead all buy and sell orders are gathered for each power-delivery hour and an aggregate demand curve and an aggregate supply curve are created on the basis of these bids. The point of intersection of the curves determines the spot price for each hour. The spot price is also known as the System Price. The spot market's System Price is the reference price for futures and forward contracts and the Over the Counter (OTC) or bilateral wholesale market.

Nord Pool Trading Market



Source: Nord Pool Market Presentation Nordic Power Markets {April 2002).[20]

Elbas

Due to the time lag between Elspot price-fixing and delivery (which can be of up to 36 hours), participants may desire to trade to improve their balance of physical contracts. Contracts can be traded 24 hours a day in the Elbas market up to one hour before delivery. This market is presently limited to Sweden and Finland.

Eltermin

The financial market for price hedging and risk management through the use of futures and forwards contracts is know as Eltermin. By purchasing power derivatives participants can hedge purchases and sales up to four years in the future. Nord Pool's

[20] www.nordpool.no

financial market is effectively in competition with the bilateral market and provides price information for future time horizons. Futures and forward contracts are continuously trading as is the case in other commodity markets.

Contracts for Difference

Market participants, who use financial market derivative contracts to hedge spot market prices, remain exposed to the risk that the system price will be different from the actual area price of their spot purchases or sales. The spot system price is identical to individual spot area prices only if there are no transmission constraints between spot bidding areas. CfDs allow market participants to create a hedge, even when the market is split into price areas.

8.2 Dispatch

Market participants submit price/volume offers and bids for each hour of the day to the pool. These do not have to relate to any particular generating sets, although their location may be important if transmission constraints arise. Generators self-dispatch on the day, taking into account their commitments under bilateral contracts and Nord Pool trades, as notified to the system operator. Any differences between the notified quantities and actual metered volumes are settled at the prices emerging from the balancing markets in each country discussed below.

The spot market is also used to address potential grid congestion i.e., insufficient transmission capacity in a sector of the grid. The market is separated into separate bidding areas that can become separate price areas if the interconnected lines become congested. If there are no such constraints, the spot system price is equal to the spot price. If contractual flow exceeds a grid capacity limit, two or more zonal prices, referred to as area prices, are calculated for each affected spot market delivery hour. The spot price in the pool sets the equilibrium price. There is rarely a single price for the entire market. Once spot market prices and volumes are determined for each area, the market is in balance according to predicted generation and loads, however this may and does change in real time. Therefore, some mechanism for real time balancing is also required.

The real time market in each country serves as a tool for system operators to balance generation to load at any time during real time operations and provides a price for participants' power imbalances. Bids/offers for the real time market are submitted to the relevant TSO after the spot market has closed. Real time market offers/bids are for increased generation or reduced consumption and decreased generation or increased consumption. Both demand-side and supply-side bids are posted, stating prices and volumes. Real time markets are organised by TSOs; market participants must be able to commit significant power volumes on short notice. TSOs balance the power system based on priority ordered lists of these bids.[21]

The cost of ancillary services is borne by all final users of electricity and is included as a separate tariff on all electricity consumption. The respective TSO's contract for these services with the generation plant.

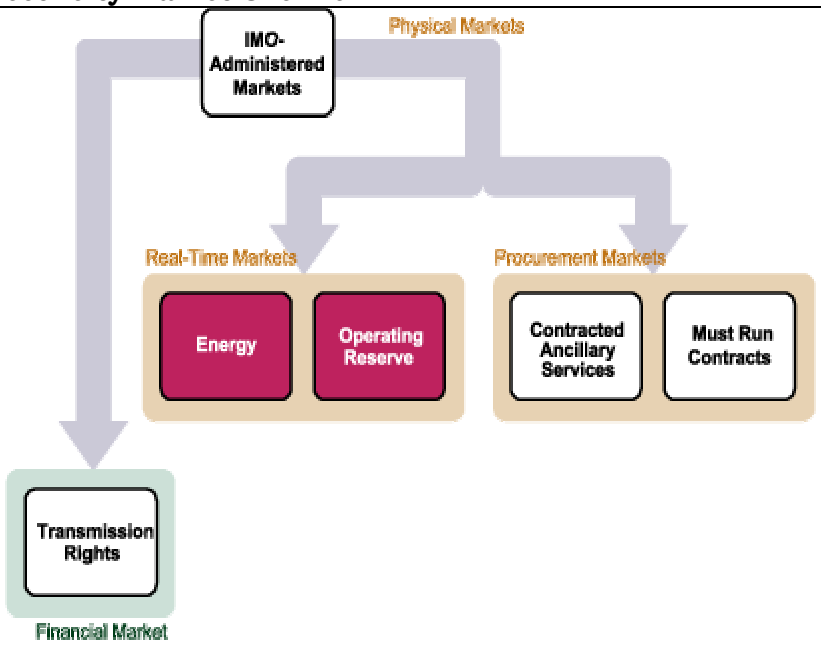
[21] Source: Nord Pool Market Presentation – Nordic Power Markets {April 2002} www.nordpool.no.

9 The Ontario Electricity Market

The market structure in the Ontario electricity market is similar to a bilateral contracts market with a net pool. Participants can choose to sell through the administered spot market/net pool or they may elect to enter into bilateral contracts with other participants. All market participants (generators, suppliers and traders) except distributors are permitted to play more than one role. However, distributors can form another company to participate in the market on their behalf.[22]

The market-clearing price of the administered spot market is set by competitive offers as long as no single company is able to exert market power. The size of the company Ontario Power Generation, as compared to the total market, led the Independent Market Ontario (IMO) of Ontario to believe that it would have substantial market power to set the price in Ontario at the time of market opening. To counteract this, the Ontario 'Market Power Mitigation Agreement' set a limit on Ontario Power Generation's revenues on a portion of its sales of electricity in Ontario.[23]

Ontario Electricity Market Overview



Source: Operating in the Market - An Overview of the IMO-Administered Markets[24]

[22] Operating In the Market: An Overview of the IMO-Administered Markets
http://www.theimo.com/imoweb/pubs/training/OperatingInMarketGuide.pdf

[23] Under this agreement, Ontario Power Generation's revenues are limited to an average of 3.8 CAN¢/kWh on 90% of its forecast domestic revenues. Any excess revenues are rebated to all electricity customers in Ontario. Therefore, this limit applies after the real time market-clearing price is set. The average of 3.8CAN¢/kWh is administered, based on the average cost of a pre-determined amount of electricity consumed in Ontario (about 75% of forecast Ontario consumption in 2001). This agreement applies for 4 years after the establishment of the market or until Ontario Power Generation brings its share of the total Ontario supply capacity to 35%. The revenue limit is to be phased out as this happens.

[24] http://www.theimo.com/imoweb/mktOverview/overview.asp

9.1 Spot Market

Market clearing prices are determined based upon bids and offers for energy and for operating reserve. Bids and/or offers are submitted every 5 minutes. These offers and/or bids are stacked against demand. The highest priced (marginal) offer or bid required to meet the demand determines the market-clearing price.

9.2 Dispatch

Dispatch instructions are issued by the IMO for every five-minute interval. These apply to every dispatchable facility. In this market a dispatchable facility is a physical facility (either a generator or consumer) that can accept instructions to increase or decrease its electricity supply/demand. Dispatchable generation submits offers into the real time markets to sell; dispatchable customers submit bids to purchase. Both may offer into the operating reserve market.

The bids and offers are utilised to:

- calculate market prices for energy and operating reserve; and
- determine each dispatchable facilities' actual dispatch.

The Transmission Rights Market supports the import and export of electricity between Ontario and other markets in Manitoba, Quebec, Michigan, Minnesota and New York. Participants can buy financial positions ahead of time to hedge their prices for electricity bought or sold across the interconnectors. These contracts do not give any scheduling priority.

Ancillary services are acquired through a procurement market via an IMO-administered competitive tendering process.

9.3 Settlement

The IMO collects daily metering data and calculates charges from market participants on an hourly basis. Five-minute data is used for dispatchable generators. A preliminary statement is issued 10 business days after the market day. Monthly invoices are issued to participants based on these daily statements.

10 The Pennsylvania New Jersey Maryland (PJM) Market

PJM operates the world's largest competitive wholesale electricity market and North America's largest power grid. PJM's installed capacity is approximately 67,000 MW and peak summer demand in 2001 was 62,445 MW[25].

The market structure is one of bilateral contracts and a net pool. Since 1997, PJM has operated a spot market within the North-eastern United States. Market participants may purchase electricity through the spot market, directly from generators or they may enter into bilateral contracts. PJM offers separate forward and real time energy markets.

10.1 Day-Ahead and Spot Markets

The forwards market is a voluntary day-ahead market that operates as a gross dispatch market while allowing for self-dispatch by generators. The real time market also operates as a gross dispatch market but settles only the imbalances between the day-ahead and the real time dispatch. Day-ahead quantities (in the forwards market) are settled at the day-ahead market price while real time imbalances (differences between the day-ahead dispatch and the real time dispatch quantities) are settled at the real time market price.

10.2 Pricing

The PJM market uses Locational Marginal Pricing (LMP). Prices for each location are determined based on the marginal energy price for the area, taking into account system constraints and losses. Generation units are ranked in merit order by price, the highest merit order price becomes the market clearing price if there is no congestion.[26] "If the lowest price energy can reach all locations, (i.e. no congestion) prices are the same over the entire system. When there is transmission congestion, energy cannot flow freely to certain locations. More expensive energy is ordered to meet that demand and the LMP is higher in those locations." [27]

The day-ahead prices are determined once a day for each hour of the following day for each location. It accepts day-ahead bids for sale and purchase until noon of the day ahead. The schedules are published by 4pm along with the Locational Marginal Prices (LMPs). Generators whose day-ahead bids were not accepted are able to re-bid from 4-6pm for next-day scheduling.

The real time prices for each location are calculated every 5 minutes, *ex post* based on actual metered generation and load.

10.3 Dispatch

PJM is the clearinghouse, scheduler and dispatcher for the mid-Atlantic states. Dispatch is based on generator bids from the day-ahead market and subsequent re-bids. These are used to determine the optimal merit order dispatch that is feasible to

[25] Includes PJM and PJM West.
[26] http://www.pjm.com/training/downloads/pjm_101_p1_revised.pdf and http://www.pjm.com/training/downloads/pjm_102.pdf
[27] PJM manual – The Power of Connecting. www.pjm.com.

the transmission constraints and system security constraints. The system is re-dispatched on this basis every five minutes.

Reserves

All units that are centrally dispatched provide bids into the day-ahead market for operating and load following reserve. The ISO determines the reserve requirements and schedules generation/interruptible load to meet these requirements on a least cost basis, based on the bids received. Facilities are scheduled for reserve and energy so that the market cost of the combined products is optimised.

Financial Transmission Rights (FTRs)

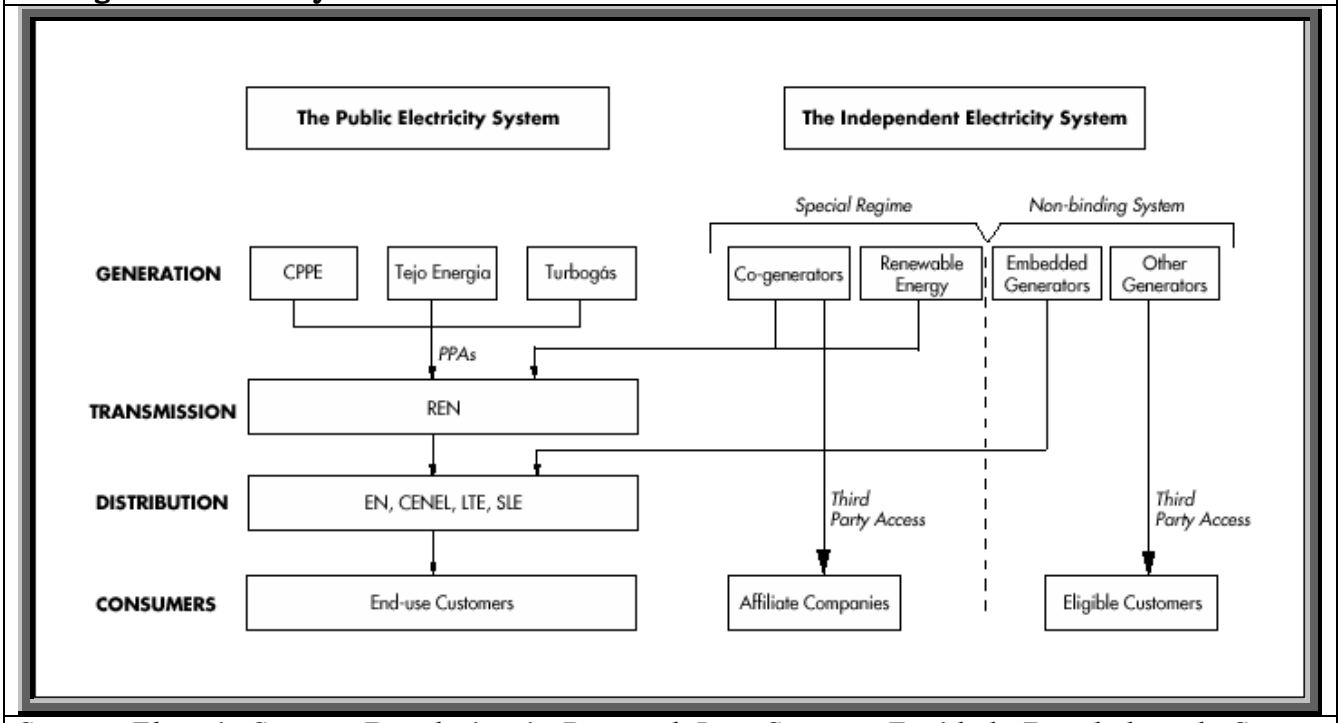
Financial Transmission Rights (FTRs) are financial instruments that entitle the holder to a stream of revenues (or charges) based on the day-ahead locational marginal price differences across the transmission path. The purpose of a FTR is to provide all Market Participants with the ability to have price certainty when delivering energy across the PJM system. FTRs provide a hedging mechanism for locational price differences. These can be traded separately from transmission service and are auctioned monthly.

11 The Portuguese Electricity Market

The Portuguese electricity market consists of the public system, Sistema Electrico de Servico Publico (SEP) and the independent system Sistema Electrico Independente (SEI). The SEP (which is partly state owned) is composed of the national transmission network (RNT), the grid operator (REN), and licensed producers and distributors.[28]

The SEP is obliged to supply all 'captive' customers (non-eligible customers) and business units within SEP are party to long-term contracts. Generators within SEP are obliged to sell their output to the commercial agent for SEP. The grid operator carries out this function.

Portuguese Electricity Market



Source: Electric System Regulation in Portugal Joao Santana Entidade Reguladora do Sector Electrico Portugal World Energy Council 18th Congress, Buenos Aires, Ocboter 2001.[29]

The Portuguese energy market was initially opened up to competition in 1993, when independent power producers were legally authorised to enter the market. Under the present structure, the part state owned "public system" has obligatory contracts with suppliers at a regulated price. The public provider has a duty to ensure security of supply. The introduction of competition to eligible customers, in the form of the "independent system", has given such customers a choice of supplier.[30]

[28] Some useful sources:
http://www.eia.doe.gov/emeu/cabs/portugal.html#elec,
http://europa.eu.int/comm/energy/en/elec_single_market/implementation/implpt00.pdf.
[29] http://www.worldenergy.org/wec-geis/publications/default/tech_papers/18th_Congress/downloads/ds/ds16/ds16_9.pdf
[30] Eligible customers are customers with an annual consumption exceeding 9 GWh.

The independent regulator, Entidada Regulation do Sector Electrico (ERSE) is responsible for regulation of the activities of SEP and of the commercial relations between SEP and SENV. The regulator is responsible for management and account unbundling of the separate activities within the holding company EDP. In particular, the TSO (REN) has to function as a distinct entity in relation to the generation, distribution/supply and non–electricity activities.

SEI consists of the so-called "non-binding system", which describes generators and distributors that are not part of the public system, and eligible customers. In this system, electricity is traded via bilateral contracts. Access to the public grid is via a regulated two-part tariff to cover use of system and of the interconnector.

11.1 Balancing Market

The market operator manages the balancing market. Here, electricity not governed by public or independent system contracts is traded out and prices are determined by supply and demand. Bids are received from both the SEP trading agent and from independent generators. Excess capacity from independent generators can be bought by SEP on behalf of the public system (non-eligible customers) when there is a requirement for this capacity and independent producers cannot address this shortfall directly.

11.2 Dispatch

REN is responsible for centralized dispatching on a merit order basis. All producers above 10 MVA that are linked to the public grid are dispatchable, including those in the independent system. REN is also responsible for settlement.

12 The Spanish Electricity Market

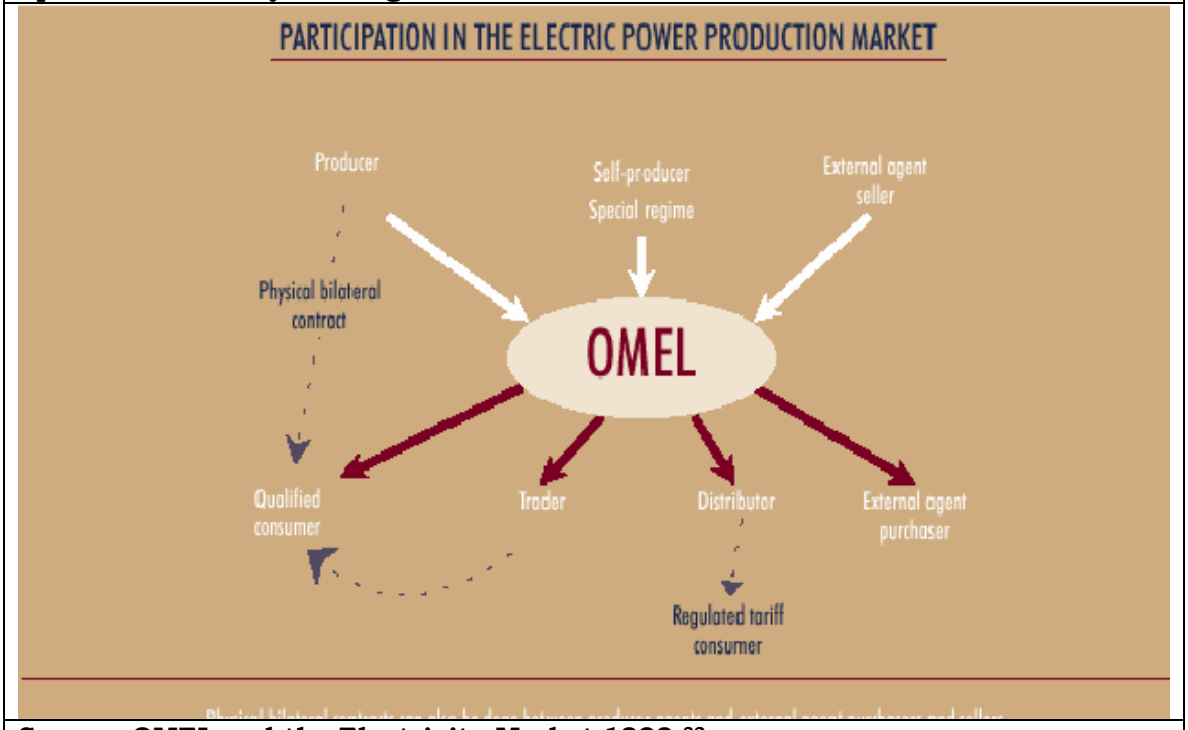
Under the present structure access to the transmission and distribution networks, in the Spanish electricity market, is based on regulated third party access whereas supply is a liberalised activity. An independent market operator, Compania Operadora del Mercado Espanol de Electricidad (OMEL), and an independent system operator, REE, have been established. OEML oversees the operation of the spot and futures markets, determines order of dispatch in conjunction with the system operator and is responsible for settlement. As system operator REE has responsibility for the management of the transmission system and for the development and enforcement of the transmission network.[31]

The trading structure has the characteristics of a bilateral contracts market with a net/voluntary pool. Trading within this general regime is carried out in three markets: the daily, intra-day and ancillary services markets.

12.1 Market Format

All generators generating in excess of 50MW are required to bid into the pool, excepting quantities contracted for bilaterally. The pool price is a marginal price determined by the market operator on a merit order basis.

Spanish Electricity Trading Format



Source: OMEL and the Electricity Market 1999.[32]

Purchase bids are submitted by eligible customers, distributors and suppliers wishing to purchase electricity. Those generators producing less than 50MW, auto-producers

[31] Useful sources include Instituto acional de Estadística (www.ine.es), Compania Operadora del Mercado Espanol de Electricidad (www.omel.es) and La Comisión Nacional de Energia (www.cne.es).

[32] www.omel.es

using co-generation or other forms of electricity generation with non-electricity operations and renewable energy producers are entitled to trade via bilateral contracts outside of the pool. These physical bilateral contracts must be declared to the market operator.[33]

All available generation units are active in the daily market as sellers. All output is traded through this market, except that which is bilaterally contracted for sale.

Eligible customers can either:

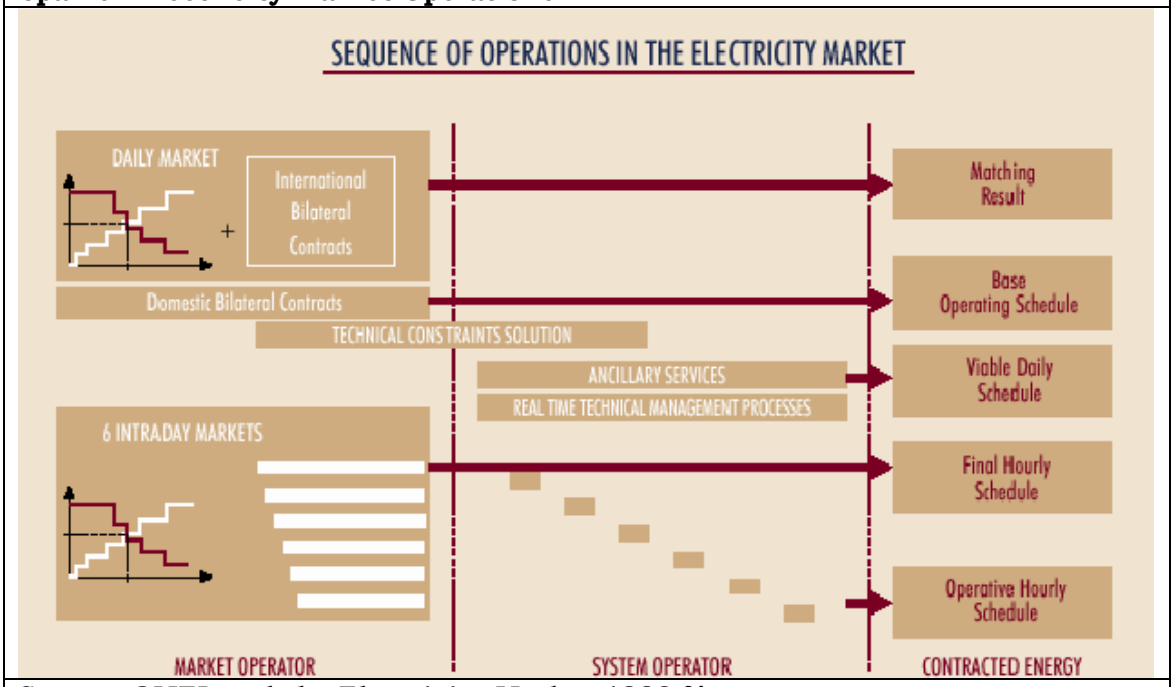
- Buy electricity directly from the pool; or
- Enter into bilateral contracts with any generator/supplier.

12.2 Dispatch

The transactions derived from the daily market, together with the physical bilateral contracts and the international contracts entered into by REE, give rise to the base daily operating schedule.

Once this schedule has been established the system operator, REE, assesses the technical viability of it and, when necessary, works with the market operator to modify the production unit schedule in order to ensure adequacy and security of supply.

Spanish Electricity Market Operations



Source: OMEL and the Electricity Market 1999.[34]

By means of an auction based on the marginal price, the secondary regulation range required to raise or lower production of the various units on the system is determined.

[33] In addition, those trading in this fashion are guaranteed payment for their surplus production by the system under secondary legislation. The remuneration received for this surplus must be between 80% and 90% of the electricity-selling wholesale price. Renewables receive supplemental payments in order to provide incentives to encourage this type of generation.

[34] www.omel.es

At that point the different intra-day market sessions (currently six) take place. It is a form of imbalance market where participants can make bids and offers to vary output or consumption.

The result of each intra-day session is the final hourly schedule. The auction system for congestion management, which has independent auctions in both directions of flows and permits participants to bid the minimum price and resell capacity.

13 Additional Useful Links

Please note that the websites referenced in the text or listed below often contain additional links to other related websites that may be of interest.

Council of European Energy Regulators – links to EU Regulatory Agencies
http://www.ceer-eu.org/

Energy Regulators Regional Association – including the EU Accession Countries
http://www.erranet.org/

List and links to Regulatory Agencies Worldwide
http://www.cne.es/f_direcciones_paises.asp?idtema=1

Utility Connection
http://www.utilityconnection.com

Korea
http://www.kpx.or.kr/english/intro/intro3_1.htm

US Federal Energy Regulatory Commission (FERC) (Standard Market Design Initiatives)
http://www.ferc.fed.us

Links page on the FERC website
http://www.ferc.fed.us/informational/links/links.htm

US Associations and Regulators

Electricity Consumers Resource Council (ELCON)
http://www.elcon.org/

Electric Power Research Institute (EPRI)
http://www.epri.com/

Gas Research Institute (GRI)
http://www.gri.org/home.html

National Association of Regulatory Utility Commissioners (NARUC) in the US.
http://www.naruc.org/

National Energy Marketers Association
http://www.energymarketers.com/

National Regulatory Research Institute (NRRI)
http://www.nrri.ohio-state.edu/

North American Electric Reliability Council (NERC)
http://www.nerc.com/

Electric Industry Links

Automated Power Exchange, Inc.
http://www.energy-exchange.com/

Bonneville Power Administration
http://www.transmission.bpa.gov/

California Polar Power Brokers
http://www.calpol.com/

Northern California Power Agency
http://www.ncpa.com/

Open Access Same Time Information Systems (OASIS), once referred to as Transmission System Information Networks (TSIN)
www.tsin.com

OASIS Nodes in the WSCC (tsin)
http://www.tsin.com/nodes/wscc.html

Western Electricity Coordinating Council (WECC)
http://www.wecc.biz/main.html

Electric Reliability Council of Texas (ERCOT)
http://www.ercot.com/

Midwest ISO
http://www.midwestiso.org/

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

PJM Interconnection
http://www.pjm.com/

New York ISO
http://www.nyiso.com/index.html

Power Marketing Association Online
http://www.powermarketers.com/

VIASYN, Inc
http://www.viasyn.com/

The Californian ISO
http://www.caiso.com/

The link page on the CAL ISO website
http://www.caiso.com/aboutus/links/

New Zealand Transmission System Operator
http://www.transpower.co.nz

The links page on the Transpower website
http://www.transpower.co.nz/grids/a_grid.asp?id=187&area=13