



# **POWER MARKET AND TRADING**

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EU Commodity Markets and Trading: An introductory workshop

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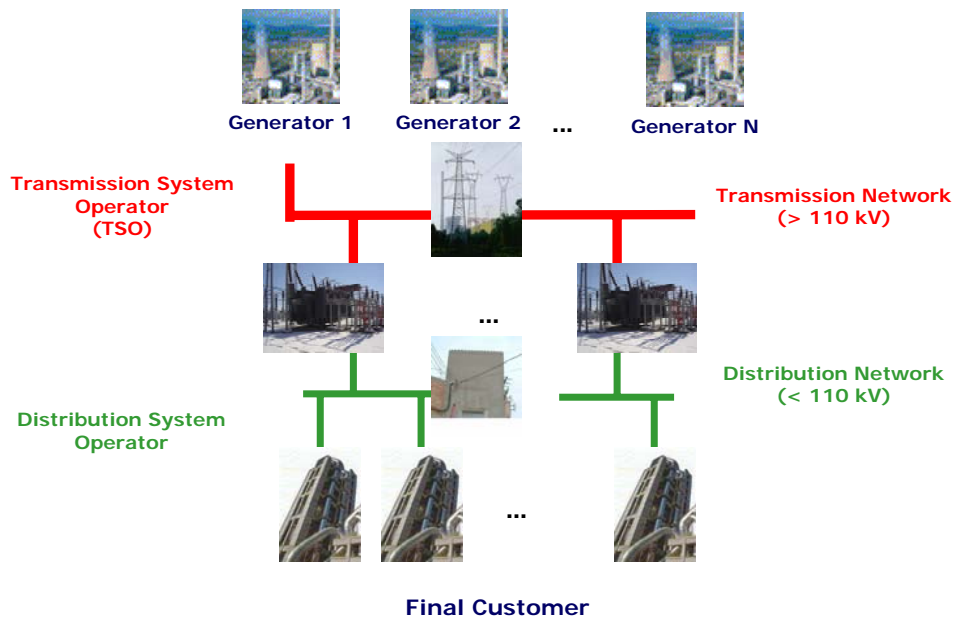
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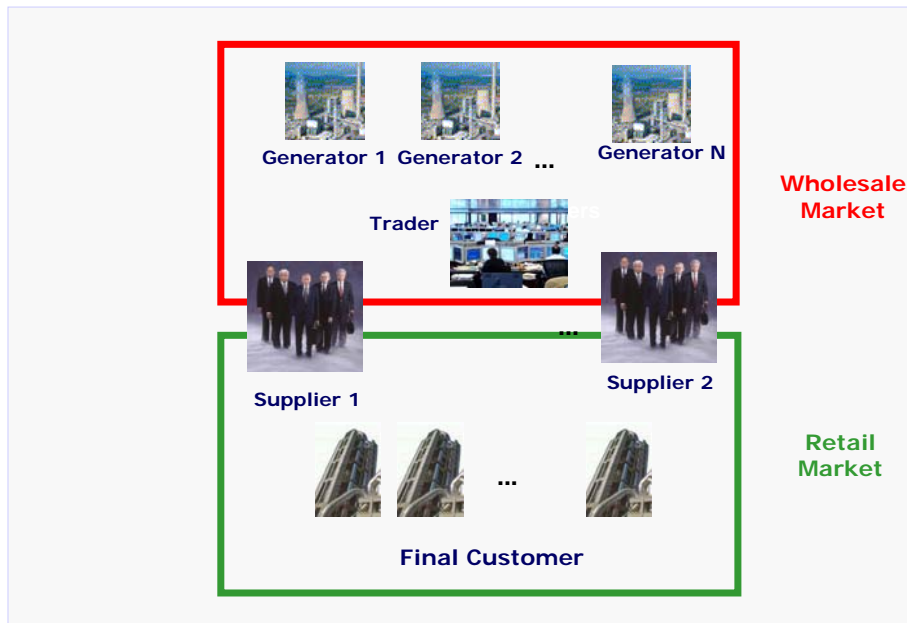


The transmission network moves large amounts of power around large areas at very high voltages (400 kV, 220 kV, 132 kV, etc.). It is managed by a Transmission System Operator (TSO), responsible for:

- Security:
  - Keeping supply and demand in balance at all times and under all circumstances
  - Ensuring that no element of the network is overloaded
  - Reacting when a power plant or a line fails
- Operation of the network:
  - Use the adequate configuration to ensure that losses are minimized while security is ensured (i.e., the network can withstand foreseeable incidents).
- Open access:
  - Ensuring that all network users (generators, traders, suppliers, customers) can have non discriminatory access and use the network to move their power
  - Allocation of scarce capacity in interconnections
- Sometimes: maintenance, expansion, etc.

The distribution network moves power down to the end consumers, at lower voltages (220 V, 20 kV, 66 kV, etc.). It is managed by a Distribution System Operator (DSO), whose functions are conceptually similar to those of the TSO (although different in practice).

Both the TSO and the DSO can be simultaneously owners of the networks that they manage, or independent entities. In any case, the European electricity Directive establishes unbundling obligations for them: they have to be adequately separated from generation and supply activities.

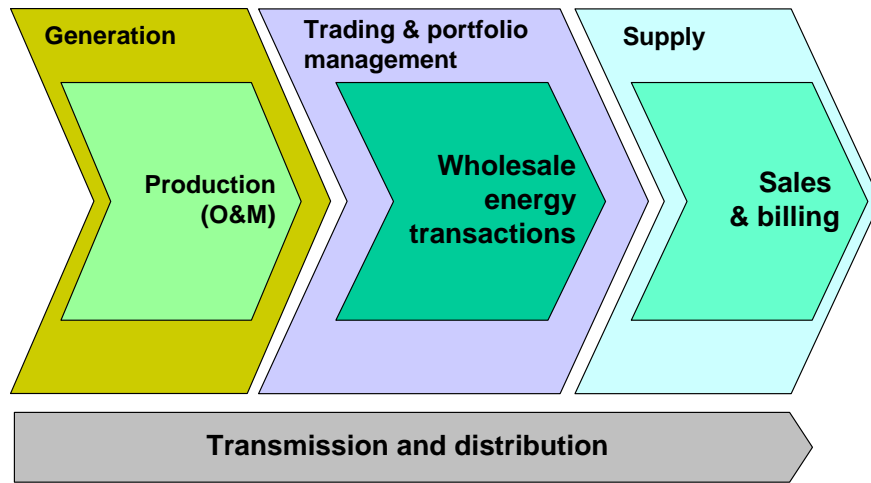


The networks are required to provide a level playing field for two markets:

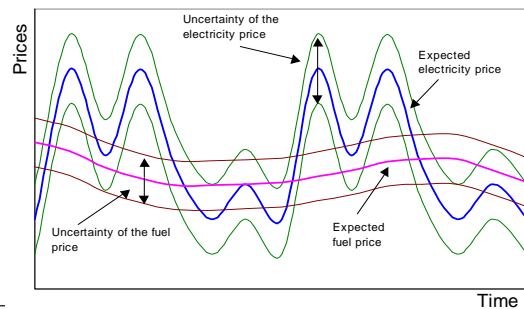
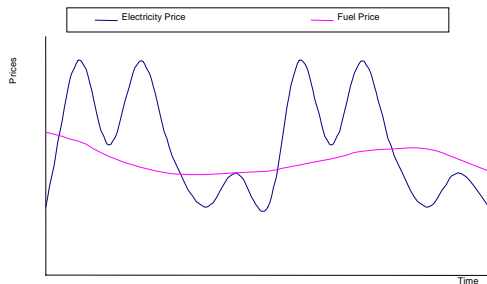
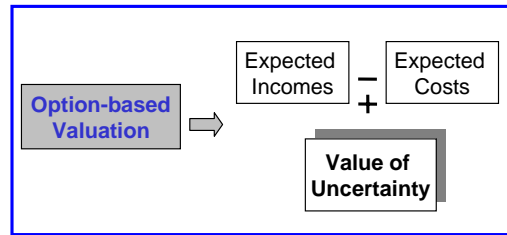
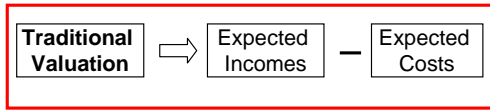
- The wholesale market, where large amounts of energy are traded, who has most of the characteristics of other commodity markets. Generators, traders and suppliers can buy and sell on the spot and forward, bilaterally or through organised markets, trade both physical and financial products, etc.
- The retail market, where energy is sold to end customers.

The separation among the different roles in these markets is not always clear:

- The same company can be at the same time a generator, a trader and a retailer.
- As in other commodity markets, there are market participants that are not involved in production, consumption or retail sales, but are specialized on speculative trading, sale of risk management services to their customers, etc. These can be banks, hedge funds, etc. Although these market participants are sometimes called “financial players”, they frequently trade contracts involving physical delivery.
- “Traditional” energy companies are usually nowadays active in wholesale electricity markets, dealing with products such as options, forwards, etc, both bilaterally and through organised markets. They can also provide, for instance, portfolio management services that include a component of risk management for their clients.



- Generators value and manage the assets as options
- Suppliers manage their customer portfolio through different markets
- Trading and portfolio management become critical
  - Optimisation of the assets and contracts
  - Generation-supply balance
  - Cross border trading
  - Hedging of fuel price risk
  - Hedging of electricity price risk
- System operator as responsible of security, using tools such as balancing markets
- Arbitrage to take advantage of market inefficiencies
- Speculation as in any other market

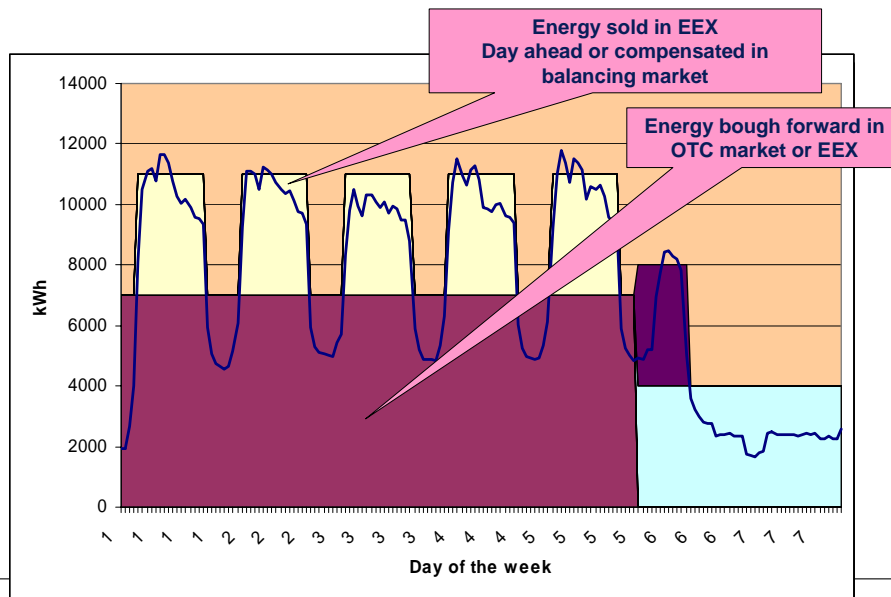


**Generators act as if they were traders, they have a strip of spread options, because they have a power plant and decide if it runs or not, depending on the prices.**

Generators value and manage the assets as options, produce **when electricity prices exceed gas prices and O&M prices.**

Spread Call Option: Right to buy a fixed amount of electricity, exercised when the difference between the two underlying variables exceeds the strike price.

## Supply Delivery to a client in Germany



Traditionally, customers have purchased all their power needs from a single supplier that provides all the utility services on a fixed-price tariff :

- Suppliers take all the risks and use complex tariffs.
- Customers have the advantage of simplicity but with costs in transparency, flexibility and price.
- This was possible in an environment of vertically integrated regulated utilities.



In a market environment, suppliers must:

- Forecast the demand of the customer.
- Value the supply at market prices.
- Once the offer is accepted by the customer, hedge the position in the forward markets, by buying blocks of peak and baseload that approximate the load profile of the client.
- Schedule those blocks for delivery to the TSO of the network where the customer is located.
- Manage the position on a daily basis: expected differences between the client consumption and the blocks that have been bought in the forward market must be sold or bought in the spot market or compensated in the balancing mechanism (typically more expensive).



## Supply New role of the supplier...

Suppliers offer a wide range of products to help their clients manage their energy risks:

- Contract at fixed prices
- Contracts indexed to electricity prices, with cap and floor
- Contracts indexed to commodity prices
- Extendible:
  - Client signs for one year delivery at a given price (lower than market price at that moment)
  - Supplier has the option to extend the contract for one more year

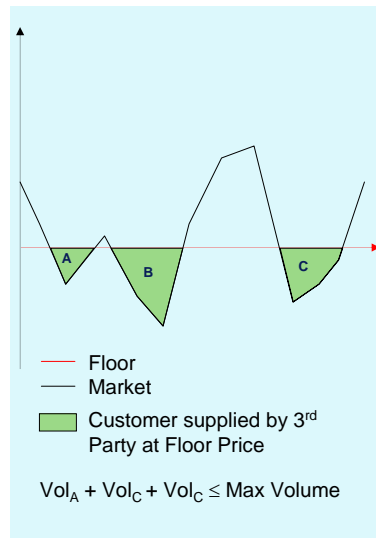
**The type of products that actually the final customer demands implies that the supplier must manage its portfolio, in a continuous and different way, using all of the products and markets available.**

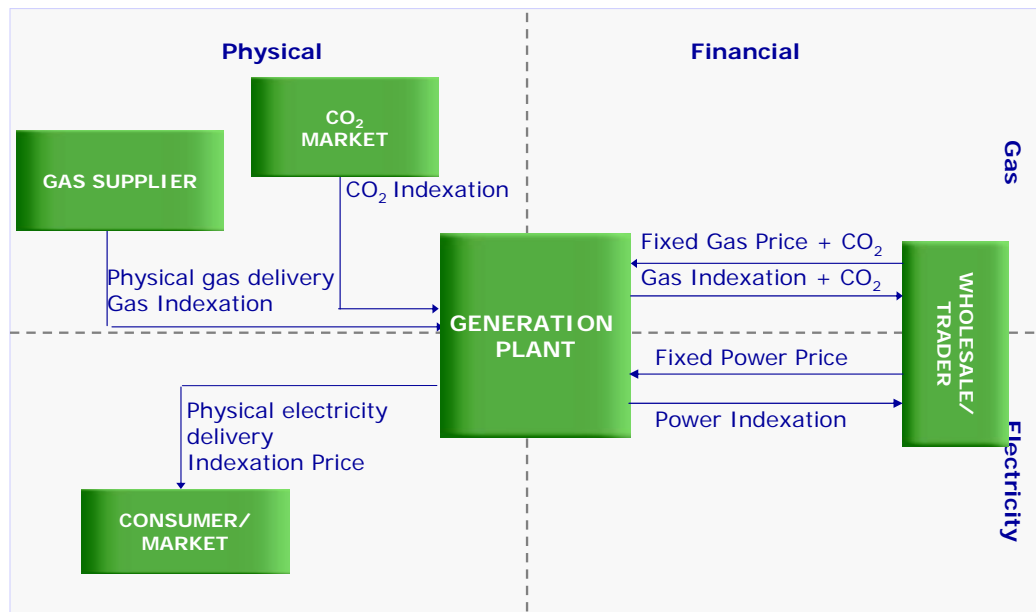
#### When

- ✓ Customer's supply contract with incumbent supplier has considerable **volume flexibility, at price P (Floor)**
- ✓ Customer gains a **premium** for this flexibility with no extra-cost

#### Characteristics

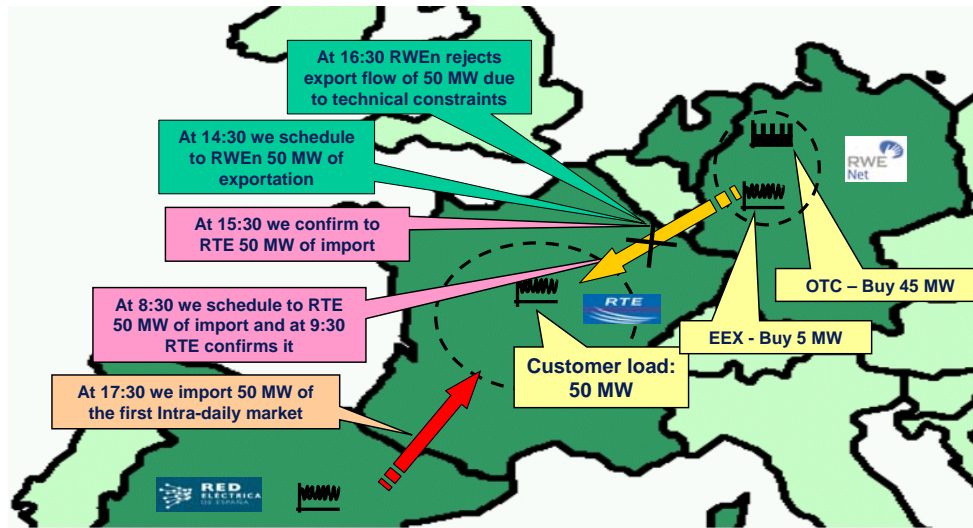
- ✓ Customer will **be supplied by a different third party** when Market Price is lower than Floor up to a maximal volume
- ✓ Customer continues to pay same price P





Tolling agreements are basically “spread options”. The strike-price is the spread between the variable cost (fuel cost) and the electricity price paid by the Toller to the plant owner. The premium of the option represent the fixed cost of the Power Plant

- The power generator “rents” a part of the generation capacity and **receives a capacity price.**
- **The toller receives the right to operate the plant.**
- The toller is responsible for the fuel input (gas) and electricity (output) offtake.
- **Such structures can be financial and physical.** In the case of financial structures, swaps would be arranged to fix the differential between gas (input) and electricity (output).
- Compared with the utility simply dispatching the power itself when wholesale power prices are advantageous, the option provides guaranteed, regular revenue.



A case inspired in reality: our first supplies to customers in France where sourced in Germany because of lack of liquidity in French market.

In one import-export operation to serve a customer, several markets have been involved due to problems with the network. But the consumer does not notice: he has been served without problems.

Finally we will have to sell 50 MW in Germany, or incur in an imbalance.

From an electricity system in a monopoly regime ...

- A central dispatching schedules all the generation, planning in several time horizons
  - months ahead, week ahead, day ahead
  - scheduling of reserves, used to compensate imbalances between generation and load
  - intra-day re-scheduling to recover the level of reserves

... to a system in competition

- Generators, traders and suppliers enter into bilateral contracts and sell/buy to/from power exchanges
  - the superposition of all contractual commitments will give the schedule of each market participant
- But the actual production/consumption can frequently depart from the schedule
  - The balancing mechanism is used by the system operator to compensate deviations

### **Market-based mechanisms are feasible in balancing systems**

But beware ...

- “Consumers” of balancing services are frequently unaware of the imbalances

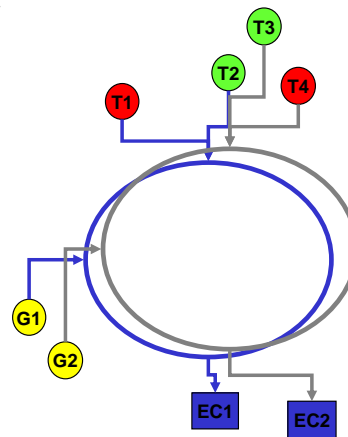
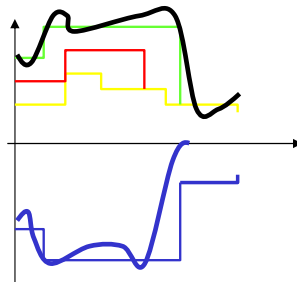
Actually, it is the whole system that is consuming balancing services

- In some cases, the imbalance of a market participant can be compensated by a symmetrical imbalance of somebody else

## Balancing Market

### Balancing responsible parties

- Each balancing responsible party is like a “virtual network” that must keep its schedules balanced
- But all the balancing parties shared the same physical network
- In reality, the actual production/load will be different from the schedules



The System Operator manages a Balancing Mechanism where generators submit bids to increase or decrease their output.

In order to be sure that there will be enough bids, some TSO can contract with generators who commit themselves to send bids.

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**Section 1**                      **Market Participants**

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**Section 2**                      **Markets and Products**

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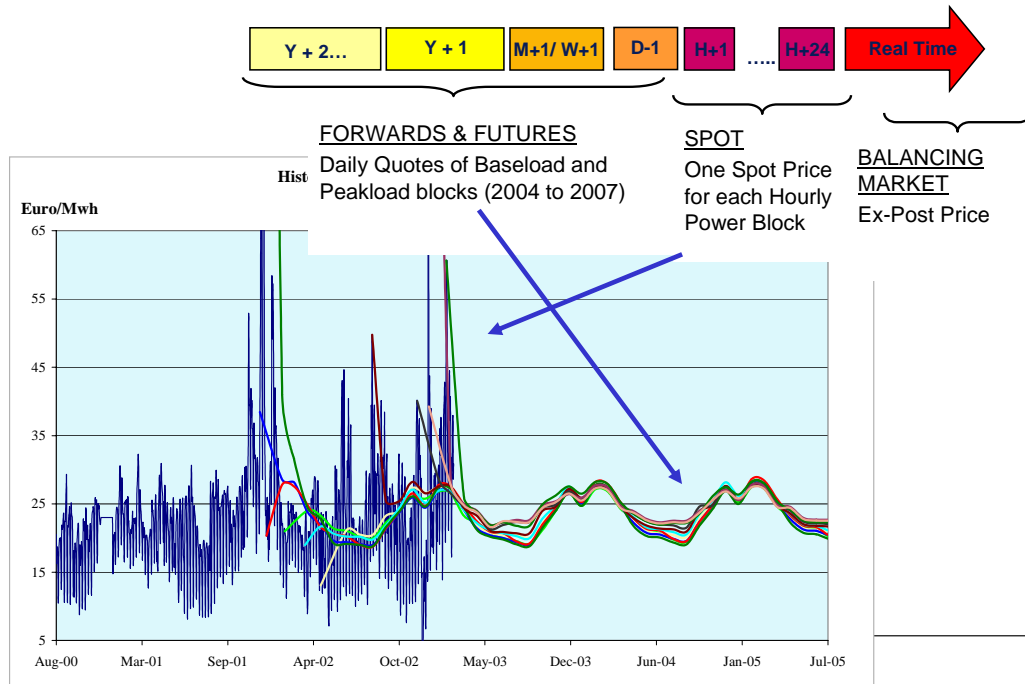
**Section 3**                      **European Experiences**

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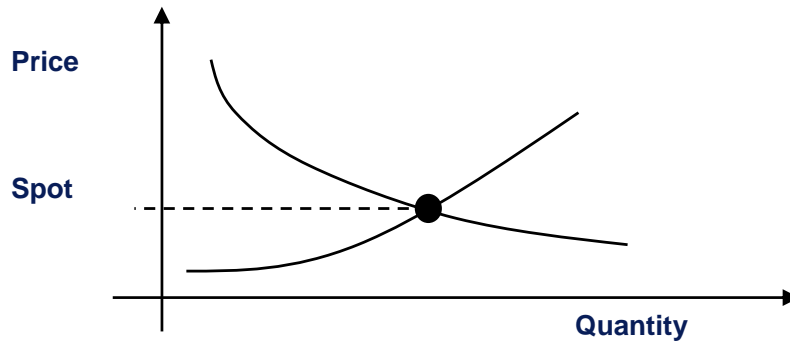
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# The temporal sequence of the markets



Usually, spot price formed in Power exchange, where one auction takes place each day to determine the price for each hourly block during the next day.



**Exchanges:** there is an entity that centralised all of the orders.

- Some countries have power pools, markets linked to production units
  - Normally, it is a mandatory or pseudo-mandatory market (ancient UK, Spain)
  - Day-ahead market where hourly offers are submitted
  - Agents: Generators, retailers, TSOs and eligible clients
  - Sometimes bids have components that reflect the actual cost structure of generation units: start-up, ramps, minimum up time, etc
- Power exchanges are similar to other financial or commodity exchanges
  - Day-ahead market where hourly products and blocks are traded
  - Agents: "Pool" agents + traders
- Common characteristics
  - Organized markets
  - Marginal price: Price settled by last offer needed to cover the total demand
- Pools tend to disappear as the market becomes mature

**OTC markets:** as in any other commodity or financial product

- Brokers, trading platforms, OTC clearing facilities

## Delivery can be physical or financial

### Physical

Entail physical and cash delivery on expiry

The “hub” is the High Voltage Grid

Participants require a license/contract granted to agents to transport/schedule the energy

TSOs must approve the schedules of all participants, to prevent constraints

A mechanism is put in place by the TSOs for settlement and management of the real time imbalances

### Financial

Entail only cash delivery on expiry

Differences between an specified index and the contractual price are settled

The buyer pays the contractual price and the seller pays the index

Physical purchased/sold through Spot or physical contract

Exchange (or Pool) prices are normally selected as index

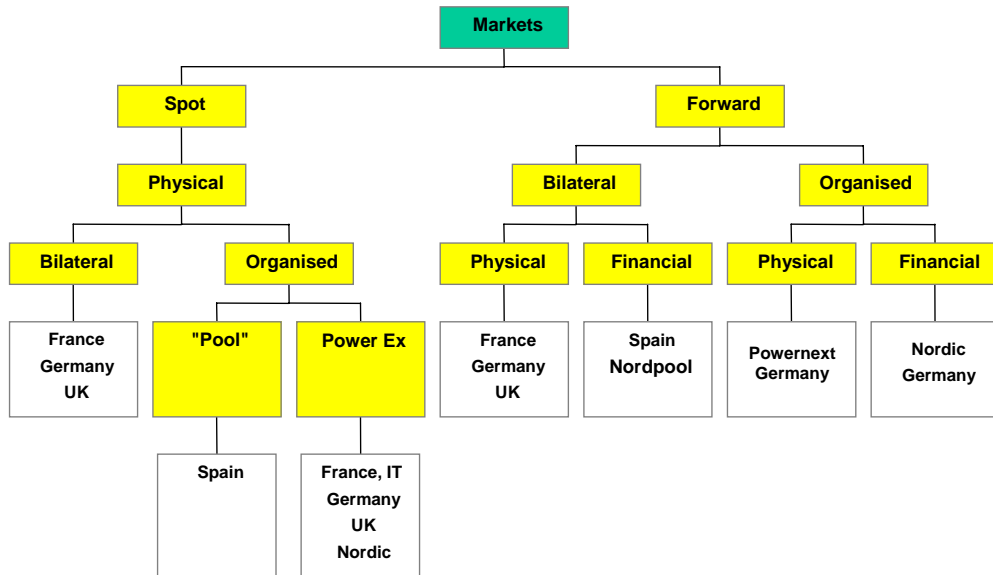
Market liquidity is important to provide a reliable index

### **The type of settlement does not predetermine the aim of the contract**

- A generator can hedge its production with a financial contract. The dispatch of the plant is not modified by the contract and this contract only fixes the incomes of the plant.
- A trader can speculate with physical contracts. They only need capacity to deliver power into the grid or have signed an additional back up physical contract with a “physical” agent.

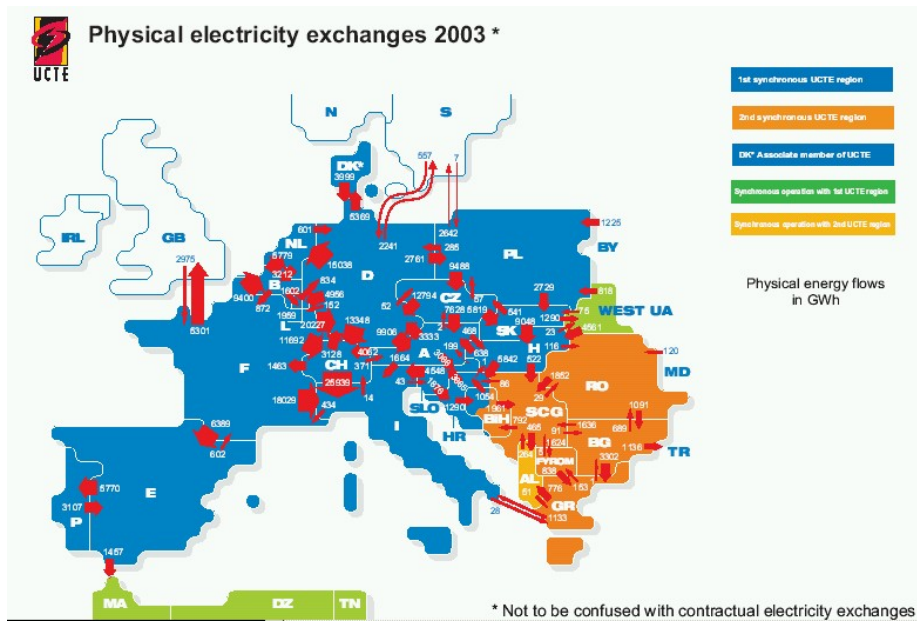
#### Standard contracts

- EFET for physical delivery
- ISDA for financial delivery





Physical electricity exchanges 2003 \*



- Explicit auction
  - Allocation of capacity on yearly, quarterly, monthly, daily basis
  - Auction price usually set at bid price of last allocated bid
  - Market participants separately trade capacity and energy
  - Problem: firmness of the acquired capacity
- Implicit auction/market coupling/market splitting
  - Allocation by spot exchange
  - If Price B > Price A, cheapest bids from country A into exchange B are allocated up to complete use of A-B interconnection capacity
  - Capacity used to level out price differences between regions
- First come, first served
  - Allocation of capacity through historical ranking of contracts
  - Usage rate of contract influences ranking
- Pro-Rata Allocation
  - Participants request capacity up to maximum available capacity
  - Allocation on a pro-rata basis if necessary

A new market for capacity rights can develop, closely linked to the power market.  
 Primary capacity offer by TSO.

The products negotiated are similar to those traded in other commodity markets,

- Futures and forwards
- Swaps
- Options: CALL if the buyer has the right to BUY  
PUT if the buyer has the right to SELL

...and any combination of all of them, leading to more complex structures: extendable, interruptible price, indexation, tolling agreement (spread option), etc.

## Bringing liquidity to the market Virtual Power Plants

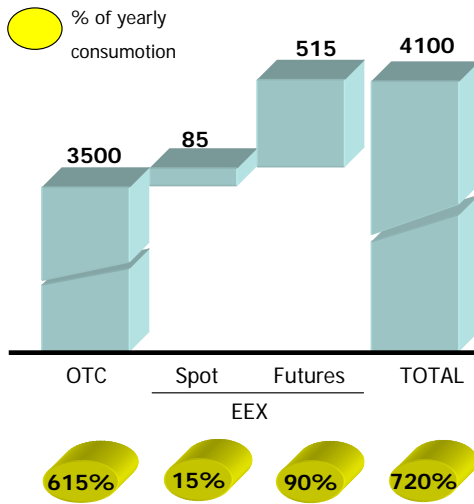
- An option that represents the cost structure of a power plant
  - The strike price is the variable cost
  - The premium is the fixed cost
- Auctioning Virtual Power Plants is frequently considered by regulators as a tool to provide liquidity in a market in cases of market concentration or vertical integration, or as a remedy in merger cases
- First large implementation: EdF, as a remedy in the purchase of a stake in EnBW by EdF
  - Starting in November 2001
  - The holder has the right to buy electricity at a fixed price (€/MWh) and has to pay a premium which is the result of the auction.
- The auctions are organized every three months and the available capacity has been around 6000 MW, equivalent to 42 TWh/year
- “Simultaneous ascending clock” format, under which each bidder asks for an amount of capacity at a given capacity price. The price is then increased in steps in successive rounds until the total amount of bids is just less than the capacity for sale.



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## Volumes traded in 2005, TWh



Source: EEX, Endesa

- EEX (European Energy Exchange) and LPX (Leipzig Power Exchange) started in summer 2000 and merged two years later
- More than 130 participants
- Generators, consumers, banks, distributors, retailers, hedge funds, oil/gas companies, etc
- EEX negotiates electricity futures and options. Volumes have increased since March 2002
- The underlying is the Phelix index (hourly average price).
- In March 2005 it has launched CO<sub>2</sub> emission rights
- Negotiated products are financial with the option of physical delivery.



## European experiences France

### Spot

- **Day ahead OTC market**
- **Powernext** started in Nov 2001 and had 20 participants in December 2005
  - Volume negotiated approximately 4% of the total French Consumption in 2005
  - Its shareholders are energy companies, financial institutions and Euronext
- **Intraday OTC market** (not very liquid)
- RTE operates a **balancing market** since April 2003

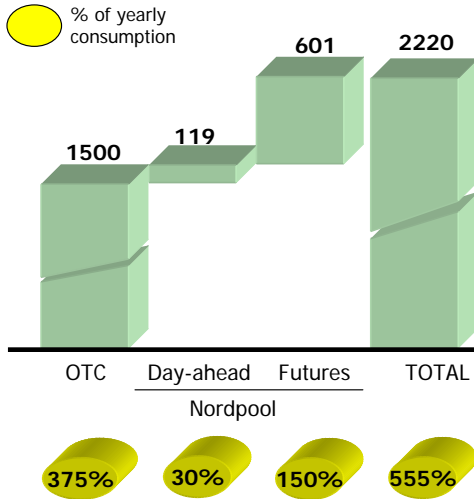
### Forward

- **OTC market:** Begins in may 2001
  - Volumes traded during 2005 were around 500 TWh, similar to annual demand
  - Powernext offer its clearing services for OTC transactions.

### Futures

- Powernext launched a Futures Market in June 2004, in 2005 negotiated 62 TWh.
- Futures are **settled by nomination of the physical** positions to the TSO (RTE).
- **RTE ensures that the electricity injections and withdrawals** corresponding to commitments contracted on Powernext Futures actually take place.
- Powernext SA nominates on behalf of the corresponding balance responsible entity. Trading members are exempted from any nomination to RTE in order to avoid double counting.
- Powernext is under the regulation of **Autorité des Marchés Financiers (AMF) and the Commission de Régulation de l'Energie (CRE)**

## Volumes traded in 2005, TWh



Source: NordPool, Endesa

- Nordpool started as day-ahead market in 1996, created by the Norwegian and Swedish TSOs
  - In 1997 a financial futures market was added. Finland was incorporated in 1998 and Denmark in 2000.
  - 300 members
  - Elspot, day-ahead market and Elbas, intraday market
- Futures: Nordpool negotiates futures, options and contracts for differences
  - Financial settlement against daily system price.
  - In March 2004 begins the negotiation of Green Certificates
- Spot and forward bilateral contracts
  - Nordpool Clearing offers clearing services

Several areas with different prices in case of network congestion. Contracts for differences have financial settlement against daily area price spreads.

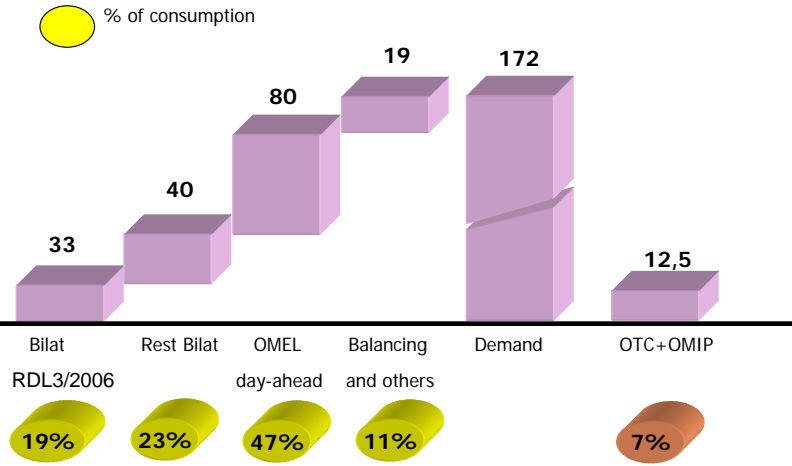
### Spot Market

- The English pool was the first organized power market in Europe in 1990.
  - Mandatory for all generators
  - Problems: demand did not participate  
very complex bids
- Revision of the model of model 6 years later,
  - NETA (New Electricity Trade Arrangements) for Engand and Wwales
  - **BETTA** British Electricity Trade and Transmission Arrangements), Scotland also included
- **New model was based on bilateral agreements (OTC)**
- **UK Power Exchange** is the main power exchange (Initially 3 organized markets)
  - volume traded around 20 GWh/day
  - It was bought by APX
- **Balancing mechanism** managed by System Operator

### The Forward Market

- **OTC contracts**
- **Futures:** UKPX. Offers a wide range of financial contracts
- Reduced liquidity

**Volumes traded in 2006, TWh**  
(until 31.8.06)



Source: OMIP, Endesa

### Spot Market

- **OMEL** is the Spanish Market Operator
  - Responsible of a near-mandatory pool
  - Day-ahead spot market with hourly bids, and several intra-day markets.
  - Strongly affected by energy regulation
- **Bilateral contracts**
  - Small volumes, increased because of regulatory intervention
- **Balancing markets** managed by the System Operator (REE)

### The Forward Market

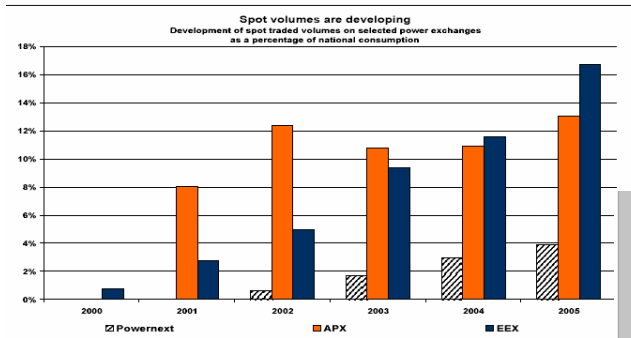
- **OTC market:** low progression.
  - In 2005 the volume traded has been 32 TWh, and 6 TWh in January-April 2006 period

### Futures

- MIBEL (Iberian Electricity Market) has just launched a futures market: **OMIP**
- Different terms, without cascading and only base-load contracts (at this first stage)
- The holder of the contract **decides the type of settlement, financial or physical**
- The underlying is OMEL daily average price.
- **OMICLEAR** acts as clearing house

**Auctions:** In July a system of mandatory auctions for Spanish distributors has been launched.

- A Ministerial Order establishes the volume and term that each distributor has to buy in each auction. The volume is equivalent to 5% of its demand.
- These contracts are defined as “future contracts with physical delivery”.
- The auctions have been managed by OMIP



Source: Powernext, APX, EEX

	Power exchanges	OTC brokered
OMEL - Spain	84.02%	negligible
SME - Italy	43.67%	n.a.
Nord Pool - Nordic region	42.82%	n.a.
EEX - Germany	13.24%	5.40%
APX - The Netherlands	11.88%	5.90%
Belgium	no power exchange	0.04%
Powernext - France	3.37%	1.50%
EXAA - Austria	2.96%	n.a.
UKPX - UK	2.17%	8.60%
Pol PX - Poland	1.28%	n.a.

Source: exchanges' and brokers' data

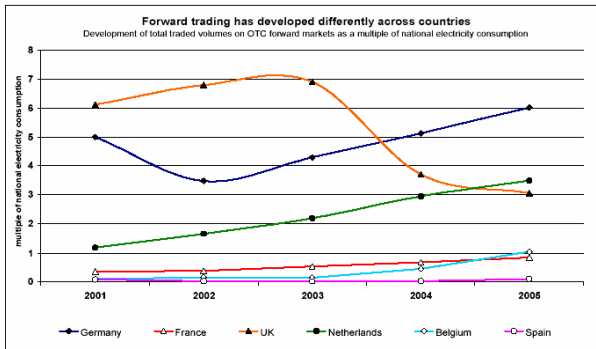
Note: This table does not contain an exhaustive list of all power exchanges in Europe. OTC numbers refer to volumes reported to us by major energy brokers.

Overview of price differences in EU member state countries, 01 January - 15 November 2005



Source: plants, Power exchanges.

# Comparing figures... Forward and futures markets



Source: Energy Sector Inquiry 2005/2006.

Number of active market participants on forward and futures markets			
	total number of participants trading	local generators	pure financial traders
Nord Pool	36	16	8
Germany	34	8	10
UK	23	12	7
France	20	2	4
The Netherlands	18	5	5
Belgium	5	1	0

Source: exchanges' and brokers' data

Note: The number of participants in the table represents companies that are reported to have traded yearly or seasonally benchmark contracts over the period January-May 2005 and represented at least 0.5% of the total volumes traded in those contracts.

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✓ **Power markets are very complex**

- complex physical flows
- Electricity cannot be stores: need for real-time equilibrium between offer and demand
- scarce interconnections among national markets
- many and very different types of participants

✓ **After liberalisation of the markets the traditional role of each participant has changed**

- generators operate their plants as options
- suppliers act as portfolio managers, offering more and more complex products (the most suitable for them),
- trading companies provide risk management services and assume risks expecting a benefit,
- Within integrated companies energy managers/traders/portfolio optimisers develop an integrated activity and help to design the strategy of the company (from generation to supply),
- ...and the System Operator is the “guarantor” of the system.

✓ **A lot of products and markets “appear”, from the traditional to the most sophisticated ones**

- Forwards, futures, options
- Capacity auctions, tolling, indexation products, extendable...
- Most of them can have a financial or physical settlement
- The nature of the contract, physical or financial, does not imply the aim of the operation, hedge or speculation.

✓ **There is a strong regulation around physical and financial electricity markets, that constrains**

- the type of products and markets,
- its functioning,
- and the behaviour of all participants (import limits, obligations)....
- ...even the price (price caps)