Markets for Electricity in Europe
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Topics Covered

• Markets for electricity
• Electricity pricing
• The Pool in England and Wales
• The Nordic electricity markets
• The Spanish electricity market
• Britain’s New Electricity Trading Arrangements
• Conclusion
Markets for Electricity (i)

- Members of EU liberalising their electricity industries
  - The EU Electricity and Gas Directives 96/92/EC and 98/30/EC were adopted in 1996 and 1998, with member countries having until February 1999 and August 2000 to incorporate their provisions into domestic legislation.

- Electricity is a difficult commodity to deliver:
  - All power stations in an AC network must be synchronised
  - Electricity is generated at the instant it is consumed
  - Some capacity must always be held in reserve able to increase output instantaneously

Markets for Electricity (ii)

- The main objectives for a set of electricity trading arrangements should be:
  - Grid remains electrically stable in operation
  - All power supplied is paid for
  - The efficient operation of the system is encouraged using the cheapest power stations available to meet demand
  - Agents have the choice of making most transactions at stable prices, agreed in advance
Electricity Pricing (i)

- Traditional peak–load–pricing for a public utility
- But:
  - Demand is random (depends on weather)
  - In electricity markets most sales take place at prices fixed in advance
  - The level of available capacity also a random variable (depends on the unpredictable no of plant outages)

![Diagram](image)

Electricity Pricing (ii)

- Two mechanisms for setting prices
  - Prices set by demand and supply: Marginal plants will earn the premium over the variable c that consumers are willing to pay for power at peak times
  - Prices are administered: Marginal plants will earn the amount that reflects the value of the power cuts that an extra unit of capacity can prevent
  - If capacity is high, revenues low, investment will be unattractive, old–high cost stations close
  - If capacity is short, revenues high, old–high cost stations defer their retirement
  - Although short–term market prices are set from day to day, hedging contracts allow generators and retailers to lock themselves in prices for a year or more
The Level of Variable Costs

- **Thermal system:**
  - Fuel costs the greatest component of VCs
  - Base stations: Low fuel costs at the expense of high fixed costs
  - Peak stations: Higher fuel costs acceptable in return for lower fixed costs

- **Hydro system:**
  - System is energy-limited rather than capacity-limited
  - The marginal cost of energy is the shadow value of water
  - Price will be almost constant over short time periods but rise in low rainfall and fall when water is abundant

- **Mixed hydro-thermal system:**
  - Both types of plant may be marginal
  - Shadow value of water will equal the VC of the thermal stations that would increase their generation in response to a reduction in the available water supply

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Pool in England and Wales (i)

- First power system in Europe to introduce market-based reforms—separate generation from transmission, distribution and retailing
- Fears that changes would make the system hard to control; wholesale market had much in common with operating systems used before privatisation
- In the Pool dispatch is centrally scheduled by the SO, based on bids made by generators and the SO’s estimates of demand. These are also used to determine prices, although generators and electricity suppliers can hedge Pool price fluctuations with financial contracts.
Pool in England and Wales

(ii)

- Generators compete to supply electricity in a particular day by submitting bids for each genset by 10am the previous day. A bid consists of 5 elements:
  - a start–up price (which is a price in £ for simply starting–up the unit),
  - a no–load price (£ per hour, for keeping the unit warm regardless of the amount of electricity produced)
  - three incremental prices for power actually generated (£ per MWh)

- A computer algorithm, SUPERGOAL, sorts the generators’ bids into a “merit order” to produce an unconstrained schedule to meet the forecast demand and reserve requirements at minimum cost.

Pool in England and Wales

(iii)

- The replacement of coal fired stations by combined–cycle gas turbines tied to privatisation and the formation of the pool
- The pool was more prone to price spikes
- The pool never succeeded in introducing more cost–reflective charges

- By the late 1990s widely recognised that the pool was incapable of reforming itself leaving the market in a vulnerable position
Nordic Electricity Market (i)

- **Features of NordPool**
  - NordPool provides short-term physical markets and medium-term financial futures markets for trading electricity.
  - Currently comprises 43 generators, 43 distributors, 16 brokers/traders, 14 industrial producers/consumers and 3 market makers.
  - Nordpool consists of a two main markets:
    - the physical day-ahead spot market and
    - the financial market for weekly contracts.
- **Day ahead spot market**
  - Bidding:
    - Each morning, players submit bids to buy or sell for each hour of the following day. The day runs midnight to midnight.
    - Participants in Norway with generators or loads in different geographical locations will submit separate bids for the different locations. These locations are defined weekly by Statnett.
  - Sweden is treated as a single region.

Nordic Electricity Market (ii)

- **Bid format**
  - Participants submit a price/quantity curve for each hour. This shows the quantities in MW that the participants is prepared to supply (a positive MW) or purchase (a negative MW) from the spot market at different prices.
- **Price Formation**
  - Nordpool balances supply and demand by stacking up the supply and demand curves of the market participants.
  - A price in NOK is calculated for each hour of the day ahead by 1300 hours at the latest of the prior day and the exchange notifies each player of the prices and quantities of their trades.
  - If there any disputes to be resolved, these should be notified by 1430 – and prices and quantities recalculated if necessary.
- **Financial market for weekly contracts**
  - Contract Types:
    - There are two types of contract that can be traded on the financial market:
      - base load power covering 24 hours of each day for a full week;
      - peak-load power covering 0700–2200 hours Mondays to Fridays.
  - Duration and timing of contracts:
    - These contracts can be trade as single weeks up to between 4 and 7 weeks in advance, as blocks of four weeks from between 5 and 8 weeks and up to 52 weeks in advance, and as seasons of several blocks 1–3 years in advance.
Spanish Electricity Market (i)

- “Day-ahead market” started operations in Jan. 98
- Working of the market
  - Before 11:00 a.m., qualified buyers and sellers of electricity present their offers for the following day.
  - Each day is divided into 24 periods
  - Sellers in the pool present offers consisting of up to 25 different prices and the corresponding energy quantities for each of the 24 periods and for each generating unit they own; the prices must be increasing.
  - If no restriction is included in the offer this is called a “simple offer”.

Spanish Electricity Market (ii)

- A seller may also present a “complex offer” which may include indivisibility conditions, a minimum revenue condition, production capacity variation or load gradient conditions and scheduled stop conditions.
- The pool administrator combines these offers matching demand and supply for each of the 24 periods and determines the equilibrium price for each period (the system marginal price) and the amount traded. This matching is called the base daily operating schedule.
- After the base daily operating schedule is settled, the pool administrator evaluates the technical feasibility of the assignment and make the provisional hourly schedule
- Purchase bids state a quantity and a price of a power block
- The pool administrator constructs with these offers an aggregate demand.
Britain’s NETA (i)

- Replaced the Pool’s centralised market with as much freedom to contract as possible
- No central market until 1 hr before real time and most electricity is traded via bilateral contracts or in futures markets
- Bilateral contracts signed in advance give traders the option of price stability
- In the last 1hr the SO runs a balancing mechanism by accepting bids and offers to raise or reduce generation and consumption
  - Companies buying power pay the system buy price (SBP) – the average price NGC paid to buy power in the balancing mechanism
  - Companies selling power get the system sell price (SSP) – the average price NGC received for selling power in the balancing mechanism

Britain’s NETA (ii)

- NETA’s performance (so far):
  - Volatile balancing market prices were a design objective to encourage early contracting but generators who cannot predict output in advance (eg wind generators) make losses because of this volatility
  - Falling prices for power but arguments whether this is a direct result of NETA
  - Government and the regulator have argued that moving from uniform pricing to bilateral trading reduce the scope for market power but studies show (Newberry, 1999) this may also discourage entry making prices less competitive overall
  - A consequence of the substantial over-capacity of generation at the present time is that there is no incentive for further investment in traditional generation plant, and this is thus biasing future generation towards a gas based generation industry
Conclusion

- The lights have stayed on
- No one size fits all design that should be adopted universally
- No market design works well unless market power is curbed
- If trade across European borders can reduce market power
  the market design should foster this
- Companies want to be able to hedge their trades in advance
  so bilateral contracts or contracts for differences are a vital
  component of market design
- Forcing trades through an unhedged spot market can mean:
  - Volatile wholesale prices are passed on to the consumer
  - Utilities run the risk of a Californian-type disaster

Useful References

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