ENERGY

20 years operation of the Nordic electricity market

ADB Regional Energy Trade Workshop

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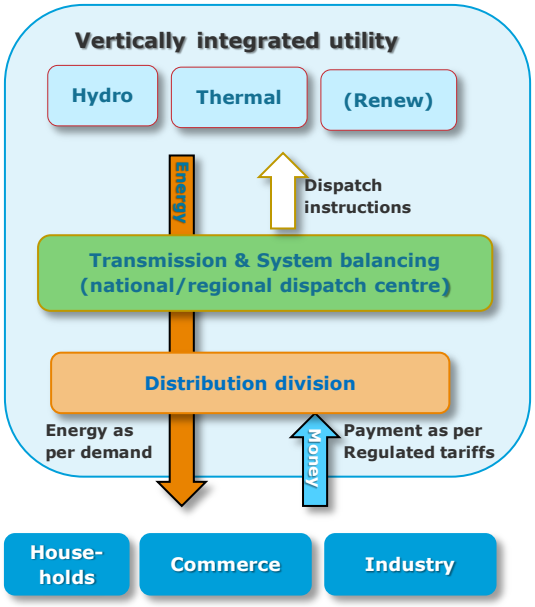
Dr. Per Christer Lund

Electricity market world wide

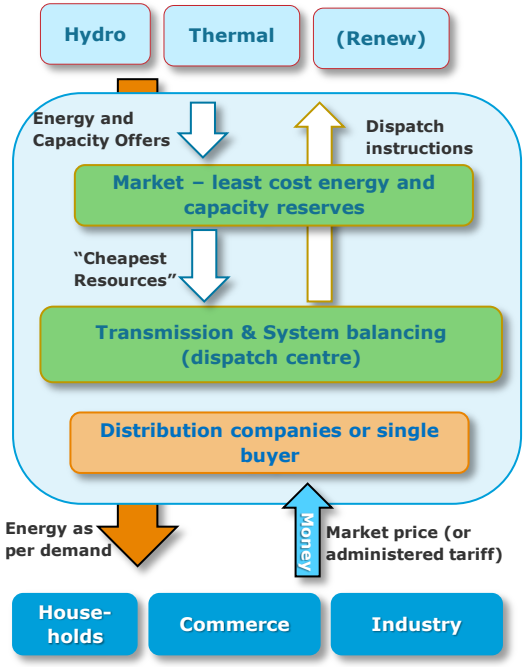
DNV·GL

Electricity market models – the Power Pool concept

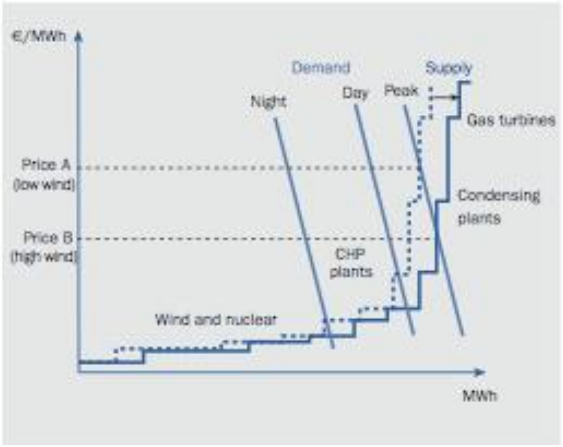
- Fully regulated electricity system



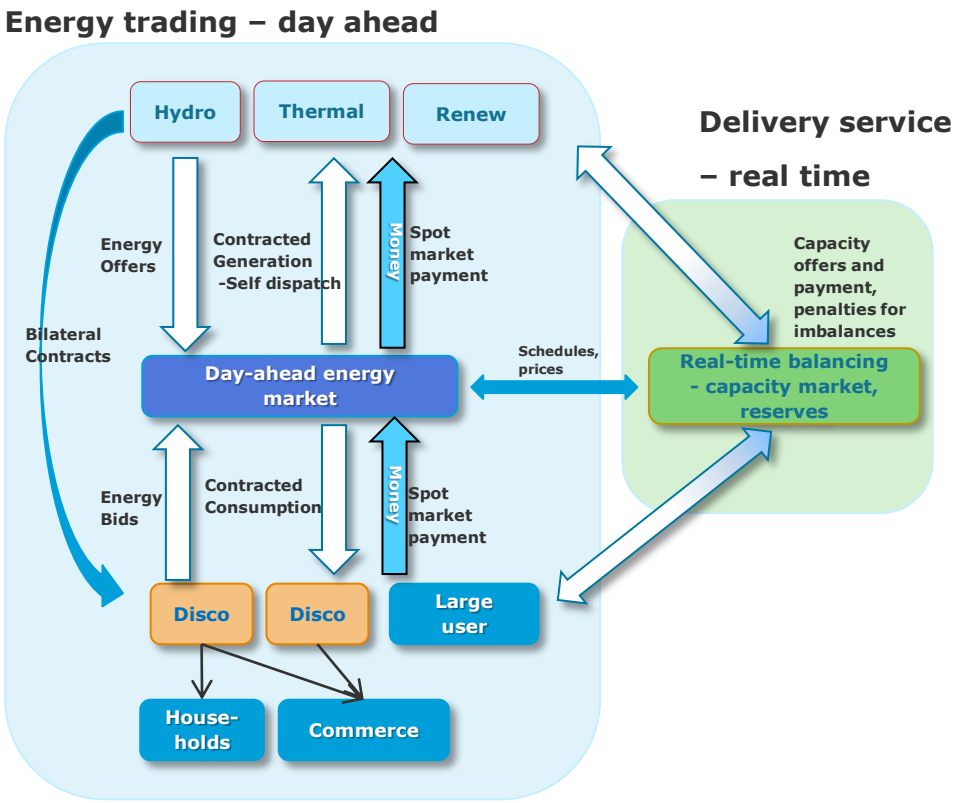
- Introduction of supply (generators) market



- ✓ Centralized dispatch – co-optimization of energy and capacity
- ✓ The market clearing price (MCP) covers both the cost of energy ("the commodity") and ancillary services ("delivery cost").
  - ✓ "Single Price" model
- ✓ Load is typically "price taker" – limited demand side participation
- ✓ Trading is typically limited to financial Contract for Differences to offset price risks



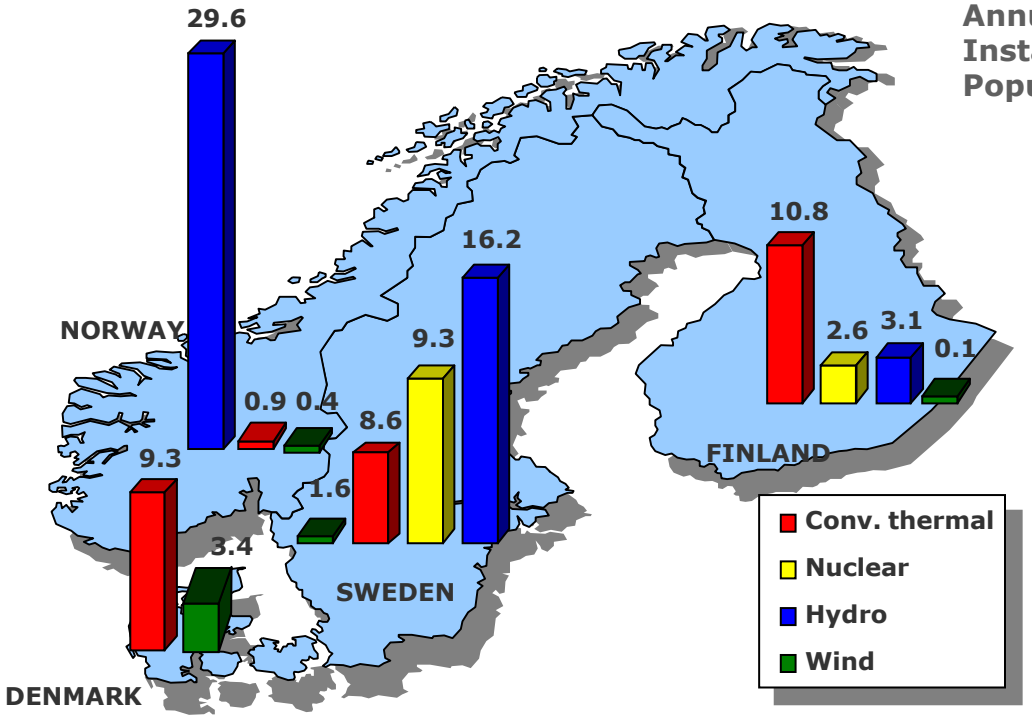
The Bilateral Market concept



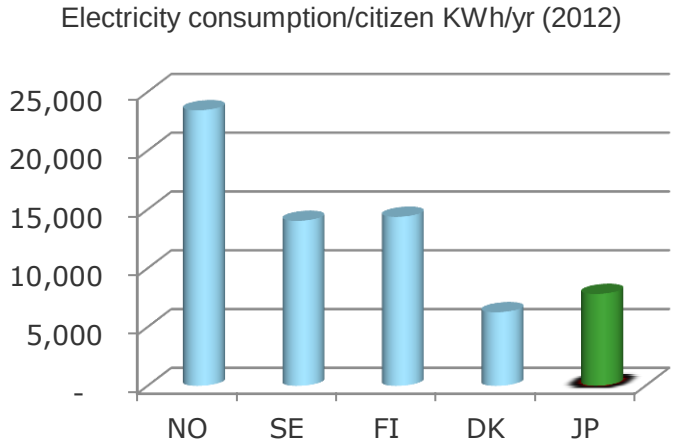
- ✓ No centralized dispatch
- ✓ Each market participant schedules its own assets based on his own internal supply and demand balance ("power portfolio")
- ✓ Each market participant is "balance responsible"; and must trade itself into balance using the bilateral market AND the Power Exchange(s):
  - ✓ Long-term contracts
  - ✓ Day-ahead market
  - ✓ Intra-day market
- ✓ The Power Exchange day-ahead market clearing price is typically the reference price for the commodity
- ✓ Contracts are physical and settled at the trade moment (day-ahead f. ex.)
- ✓ The balanced portfolios (schedules) are reported to the System Operator
- ✓ Imbalances between traded schedules and actual injection/withdrawal are handled by the System Operator
  - ✓ Physical rebalancing based on offers to Real-Time Balancing markets
  - ✓ Imbalance costs to the participant imposing the imbalance

The Nordic Electricity market

Installed capacity GW (2010)

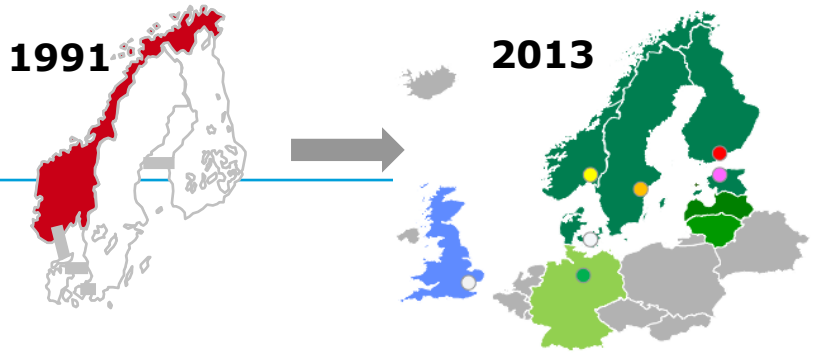


Annual consumption (2012)	**~ 365 TWh**
Installed generation capacity	**~ 96.000 MW**
Population (2013)	**~ 25.5 mil.**



Source: Swedenergy, NVE, EMV

NORDIC HISTORY



How to form a Regional market

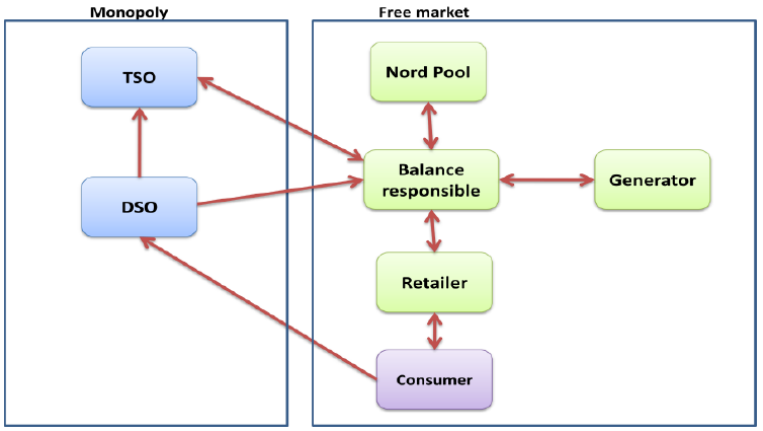
Main incentives to form:

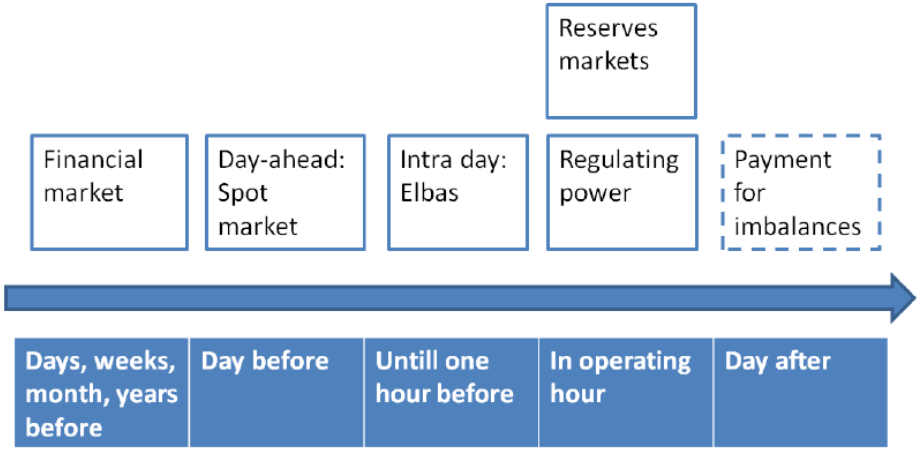
- One common free power market
- Approved market concentration
- Regional optimisation and use of power resources
- The national markets were opened for competition
- To a large extent similar legislation and regulatory framework
- Nordic TSOs cooperate through an "Inter-Nordic System Operation Agreement"
- Common transmission tariff structure
- Transmission border tariffs stepwise removed
- Import/export only through the Day-Ahead Market
- Bilateral contracts as inter-area trade
- Separate national procedures for system services and balancing mechanism

1991:	Norwegian power market deregulated
1993:	Nord Pool Spot established as 'Statnett Marked'
1996:	Rebranded to Nord Pool when Sweden joins
1998:	Finland joins Nord Pool
1999:	Elbas becomes the first intraday market
2000:	The Nordic market fully integrated as Denmark joins
2001:	Independent Market Surveillance is established
2002:	**Nord Pool Spot established as a separate company**
2005:	The Kontek bidding area in Germany opens
2008:	Financial market sold to NASDAQ OMX Commodities
2009:	Market coupling of 11 European countries launched through EMCC (European Market Coupling Company)
2010:	N2EX launched by Nord Pool Spot and NASDAQ OMX
	Nord Pool Spot opens bidding area in Estonia
2012:	Nord Pool Spot opens bidding area in Lithuania
2013	Nord Pool Spot opens bidding area in Latvia thus including all the Baltic countries

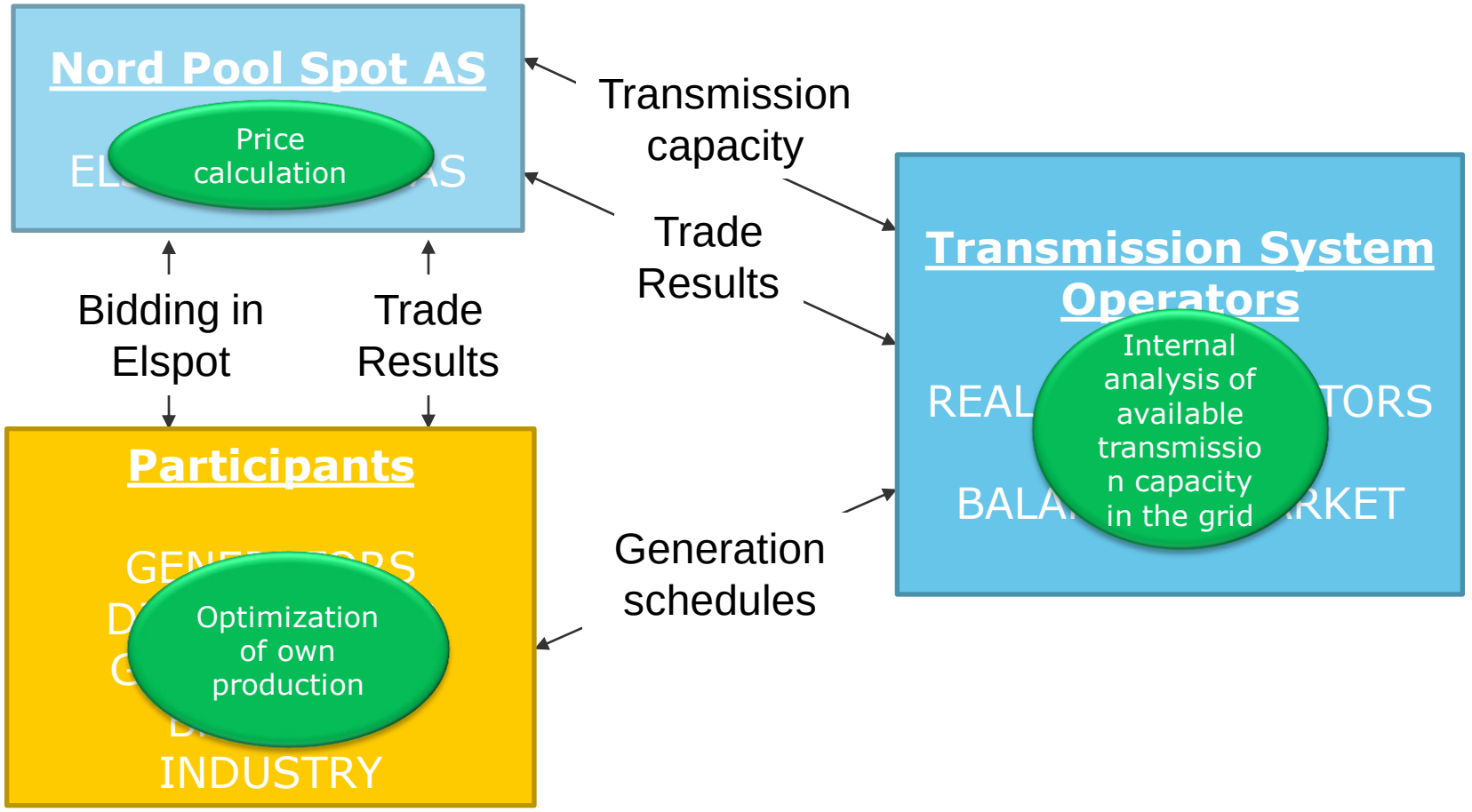
Nordic market – main principles

- ✓ Market participants
  - Producers, consumers, aggregators, traders
  - Do not need to have physical assets (generators or load), but must be:
- ✓ Balance responsible
  - Can be "pure" producer or consumer, or combination ("prosumer")
  - Must submit balanced schedules in the Day-Ahead market (Nordpool's spot market)
- ✓ Nordpool Spot
  - Day-ahead where the main balance of the Nordic electricity system is determined. Hourly auction based.
  - 70-80% of all energy is transacted in NPS – the remaining is "behind the fence" and bilateral contracts.
  - The entire market is in perfect balance day-ahead.
- ✓ Elbas
  - Intraday balancing market for "known" imbalances.
  - < 1% of the total energy transacted
- ✓ Real-time Market
  - Operated by the System Operators
  - < 5% of the total energy transacted
- ✓ Derivatives market for price hedging



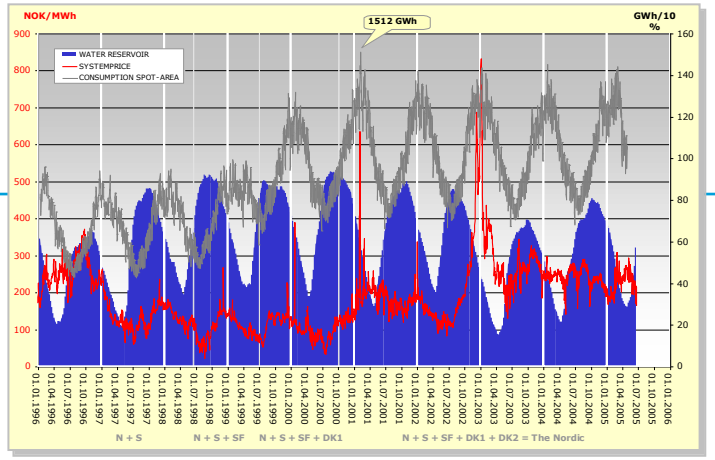


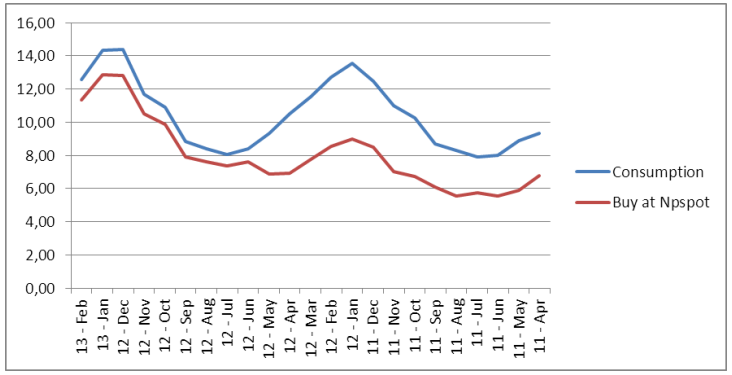
The triangle of roles in the power market

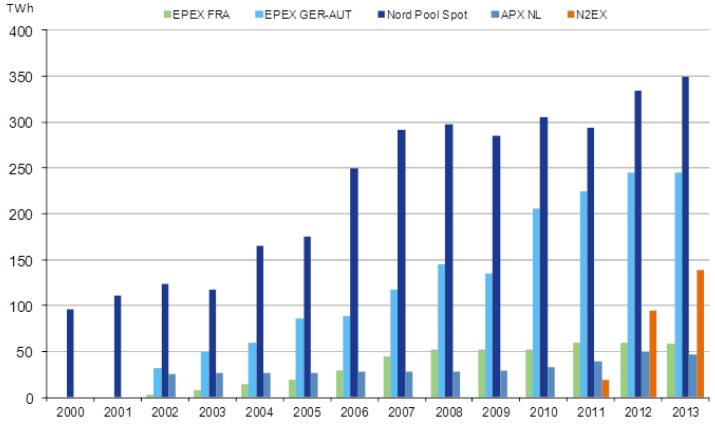


Features of Nordpool Spot

- Reference for other markets:
  - Reference price for bilateral trading
  - Reference price for Real-Time balancing market
- High liquidity:
  - 70-80% of the physical consumption in the Nordic market
- Features of the Market Clearing Price
  - Rational offers and bids
    - Marginal cost of generation (NB not mandatory!)
    - Intermittent renewable bids in at Zero (?)
    - Hydro bid at "opportunity cost" (hydro valuation models)
    - Substantial (and increasing) demand side bidding
  - Influenced by (and correlated with) external factors:
  - Weather conditions (temperature)
    - Hydro inflow and storage levels
    - Import and export
- Very high price volatility.
  - Price hedging handled by the Nasdaq OMX futures/forwards contract market







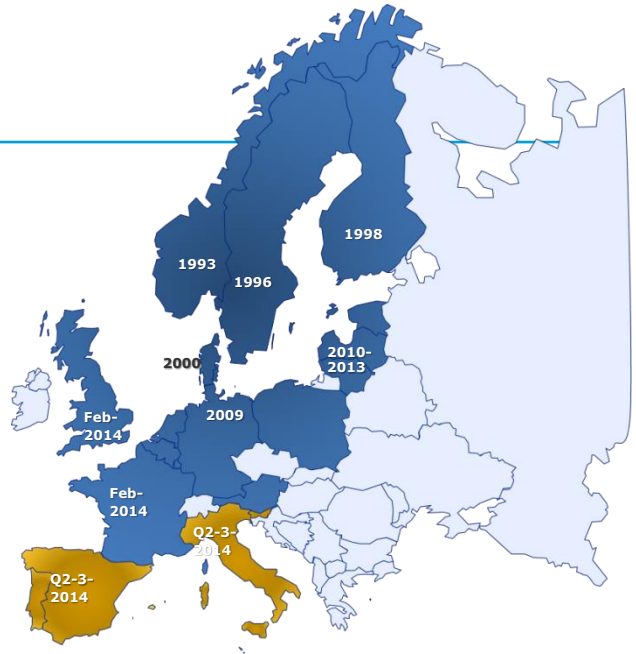
Connecting energy markets

- Expansion of the "Nordpool" model
  - EU markets (with a few exceptions) are based on the Nordic market model
  - Markets are connected by two principles:

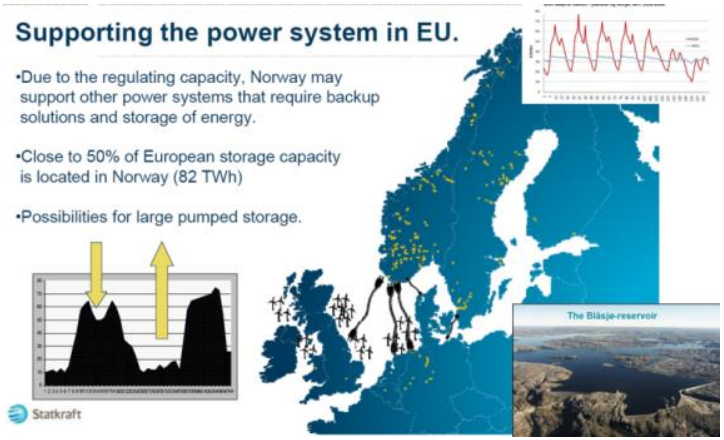
    Market coupling – explicit auction of interconnection capacity

    Market splitting – "one market" divided into price zones if transmission congestion – implicit auction of transmission capacity

- Better utilization of energy and capacity resources
  - Hydro power storage highly valuated as balance of intermittent RE
  - Better utilization of cross-regional transmission grid
  - Enhance international trading and competition
  - Incentive for investment in transmission capacity
  - Larger market reduce market power for large companies (oligopolies)

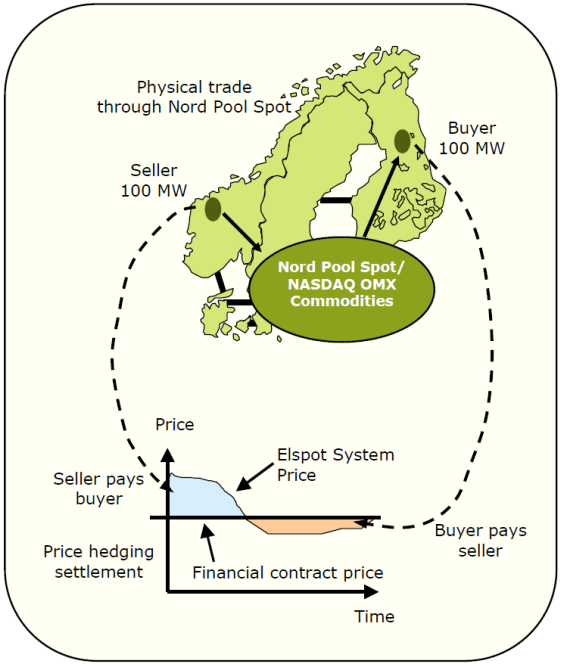


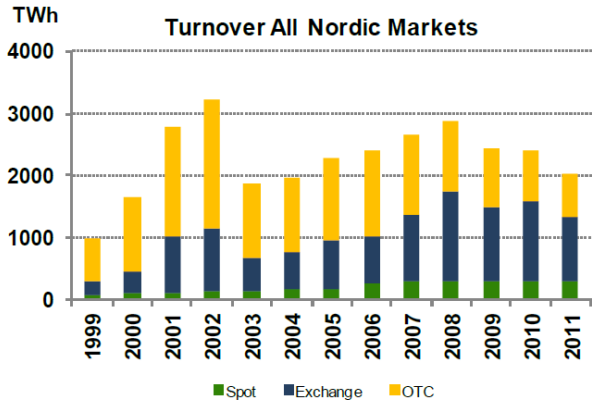
The integrated North-Western Europe (NEW) power market as of Feb. 4, 2014. 75% of Europe's electricity demand = 2,000 TWh/yr. Source: ENTSO-E

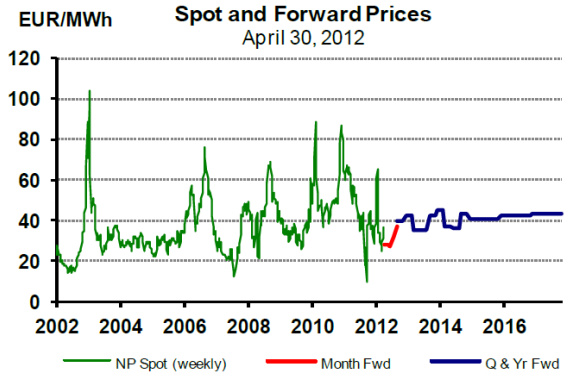


Risks in the wholesale market

- ✓ Larger consumers can hedge price risk at the derivatives market – Nasdaq OMX
- ✓ A variety of forward products with increasing fidelity.
- ✓ Very high liquidity.
- ✓ Nasdaq OMX also offers clearing service to reduce counterparty risks.







Summary

- Different design than the "US" model (popular in Asia, except Japan..)
  - Conceptual separation of the traded commodity (the power) from the service (capacity, balancing)
  - Decentralized generation planning and scheduling
  - Focus on flexibility, ease of access to markets, open for all categories participants, promotion of demand response
  - Contract based – high liquidity, but high price risk/volatility (offset by financial forwards market)
- 22 years history of successful operation
  - First multi-national power market
  - Model for all other European markets
- New challenges
  - Integration of European markets – cross border trading of energy, capacity and reserves
  - Handling of intermittent renewable energy – balancing and price (return) depression
  - Right investment signals – transmission, energy or capacity?
  - Demand response, smart systems, off-grid/decentralized energy sub-systems..

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Thank you.

Per Christer Lund, Principal Consultant, DNV GL
Per.christer.lund@dnvgl.com,
+65 9642 6983

Hans Randen, Director, NordPool Spot
hans.randen@npspot.com

www.dnvgl.com

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