
Power market integration

Geir-Arne Mo – Team Lead
Nordic Spot Trading
Bergen Energi AS

Geir-Arne Mo

Some background information:

- Working for Bergen Energi since 2015
- Team Lead Nordic Spot Trading
- I work 11 years for ICAP, Head of Nordic Markets in 6 years.
- Entrepreneur in four years for developing Wind Power forecasting system for the industry.

Agenda

Bergen Energi in a nutshell

The Spot Markets

- DAM
- Intraday
- Imbalance

Market coupling:

- What is it?
- What does it do?

AN ENERGY MANAGEMENT COMPANY

BERGEN ENERGI (IN A )

Independent Energy Management Solutions

Key figures

- An energy portfolio > 100 TWh
- > 1.000 clients in 14 countries

Independent

- Transparency
- Neutrality
- Flexibility

Provider of quality services

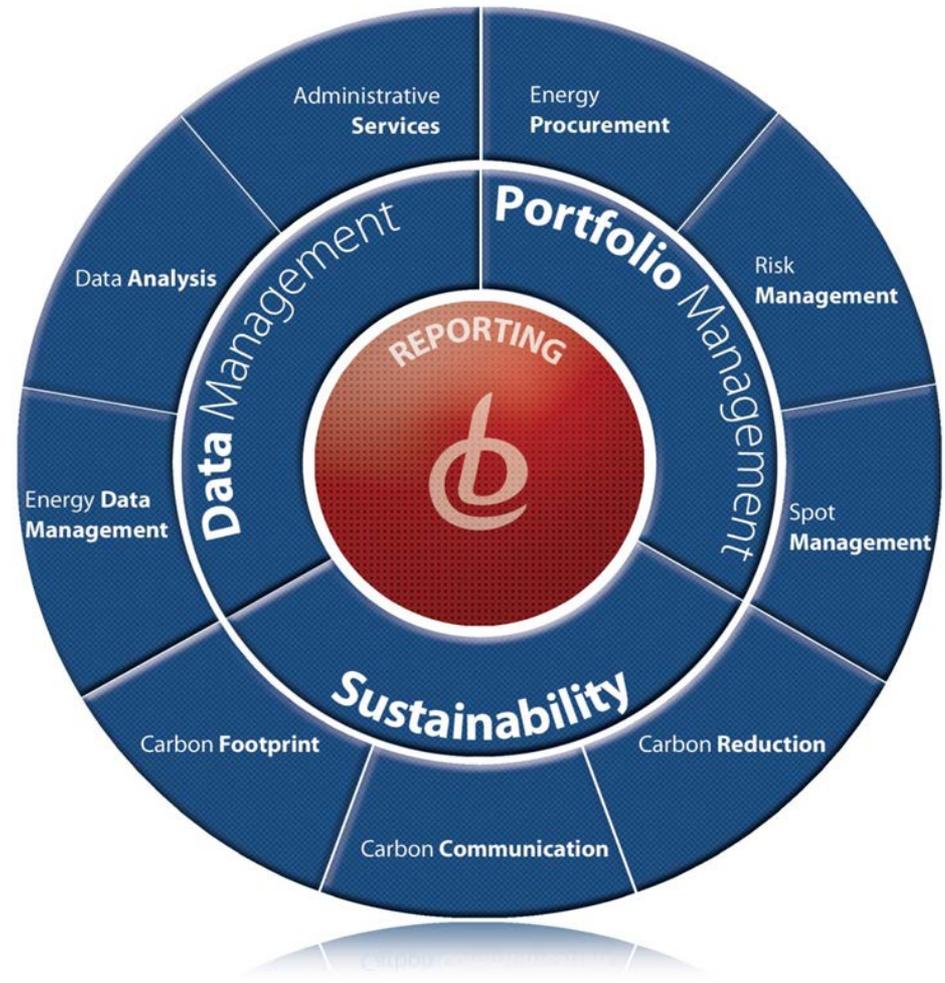
- MiFID license
- Quality insurance ISO9001&14001



A wide range of services

In order to monitor and reduce:

- Consumption
- Cost
- Carbon footprint





THE SPOT MARKET

European Spot Exchanges

EEXA A Energy Exchange Austria

EPEXSPOT
EUROPEAN POWER EXCHANGE

nordpool
spot

apx power spot exchange

emie

N2EX
NORD POOL SPOT
NASDAQ OMX COMMODITIES



The Spot Markets

- Balances supply and demand
- Generating reference price.
- Providing liquidity for producers, suppliers, TSOs and consumers
- Ensuring transparency and fairness
- Takes away counterparty risk



The Day Ahead market

- Main market at the exchange
- Physical power contracts traded daily for delivery in the next 24-hour
- Based on expected consumption/production
- Delivery and prices confirmed at closing time (13:00) daily
- The auction takes place, 7 days a week, year-round

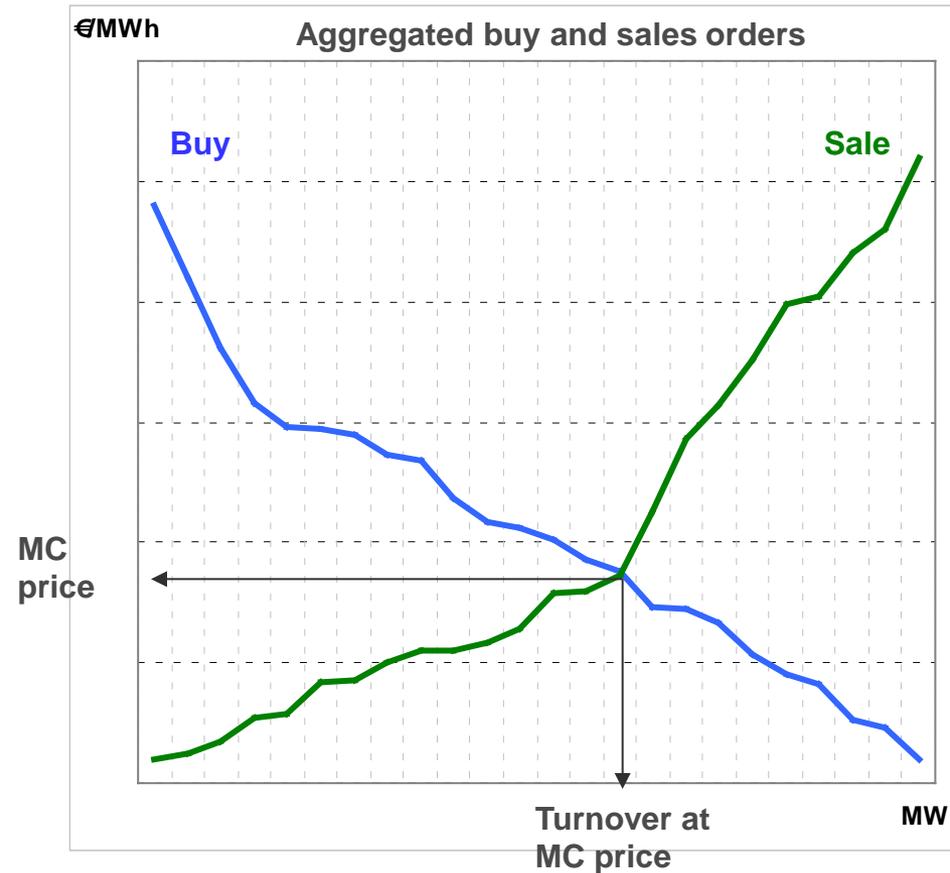
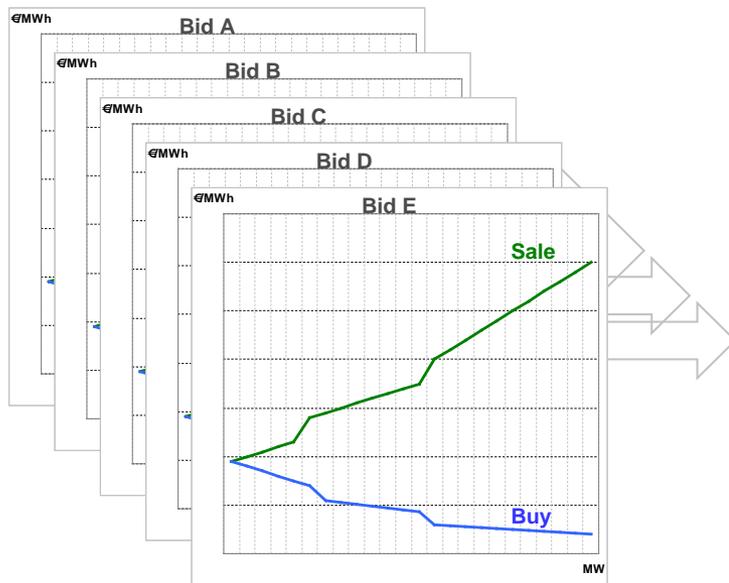
Objective:

Physical fulfillment of financial products

Physical delivery

Profiling and adjustments

Price matching in the DAM



Intraday Market

- Market open after closing time on DAM
 - Market for continuous trading of physical energy contracts
 - Trading up to 5 min before delivery
 - 24/7 market
-
- Objective intraday:
 - As the time span between the Day-Ahead and the delivery hour is long (36 hours), the consumption/production situation may change
 - Minimizing imbalance risk

Balancing Market

- A regulated market, organized by the TSO
- Balance volume:
 - Contract volume - actual volume
 - Balance volume > 0: Selling
 - Balance volume < 0: Buying
- Prices
 - Published directly after the delivery hour
 - Down Regulated
 - Balance price < Spot price
 - Up Regulated
 - Balance price > Spot price

ALL NO SE FI DK Hourly Daily Weekly Monthly Yearly 13-06-2014

EUR

EUR/MWh [Export to XLS](#)

SE1 Up - FI Down

	NO1		NO2		NO3		NO4		NO5	
	Up	Down								
13-06-2014										
00 - 01	22,18	16,40	22,18	16,40	25,92	25,92	25,92	25,92	22,18	16,40
01 - 02	22,18	16,25	22,18	16,25	28,30	24,41	28,30	24,41	22,18	16,25
02 - 03	22,18	16,14	22,18	16,14	28,30	21,03	28,30	21,03	22,18	16,14
03 - 04	16,10	16,10	16,10	16,10	17,16	17,16	17,16	17,16	16,10	16,10
04 - 05	16,01	16,01	16,01	16,01	16,26	16,26	16,26	16,26	16,01	16,01
05 - 06	16,01	14,34	16,01	14,34	22,90	14,34	22,90	14,34	16,01	14,34
06 - 07	16,50	16,50	16,50	16,50	28,54	28,54	28,54	28,54	16,50	16,50
07 - 08	22,18	17,15	22,18	17,15	33,18	33,18	33,18	33,18	22,18	17,15
08 - 09	22,18	17,53	22,18	17,53	36,85	35,00	36,85	33,31	22,18	17,18
09 - 10	22,18	17,56	22,18	17,56	35,48	35,48	33,31	33,31	22,18	17,29
10 - 11	17,55	17,55	17,55	17,55	33,95	33,95	33,28	33,28	17,30	17,30
11 - 12	21,56	17,37	21,56	17,37	32,13	32,13	32,13	32,13	21,56	17,20
12 - 13	21,56	17,21	21,56	17,21	30,90	30,90	30,90	30,90	21,56	17,19
13 - 14	21,56	17,11	21,56	17,11	29,81	29,81	29,81	29,81	21,56	17,11
14 - 15	21,56	16,96	21,56	16,96	29,62	29,62	29,62	29,62	21,56	16,96
15 - 16	19,71	16,50	19,71	16,50	29,04	29,04	29,04	29,04	19,71	16,50
16 - 17	16,41	16,41	16,41	16,41	28,61	28,61	28,61	28,61	16,41	16,41
17 - 18	16,35	16,35	16,35	16,35	29,06	21,00	29,06	21,00	16,35	16,35
18 - 19	16,30	16,30	16,30	16,30	30,64	20,95	30,64	20,95	16,30	16,30
19 - 20	16,24	16,24	16,24	16,24	31,96	25,20	31,96	25,20	16,24	16,24
20 - 21	16,16	16,16	16,16	16,16	30,62	23,00	30,62	23,00	16,16	16,16
21 - 22	16,11	16,11	16,11	16,11	30,33	23,00	30,33	23,00	16,11	16,11
22 - 23	16,24	16,24	16,24	16,24	30,69	30,69	30,69	30,69	16,24	16,24
23 - 00	19,71	16,27	19,71	16,27	29,45	29,45	29,45	29,45	19,71	16,27
Min	16,01	14,34	16,01	14,34	16,26	14,34	16,26	14,34	16,01	14,34

EPEX Spot

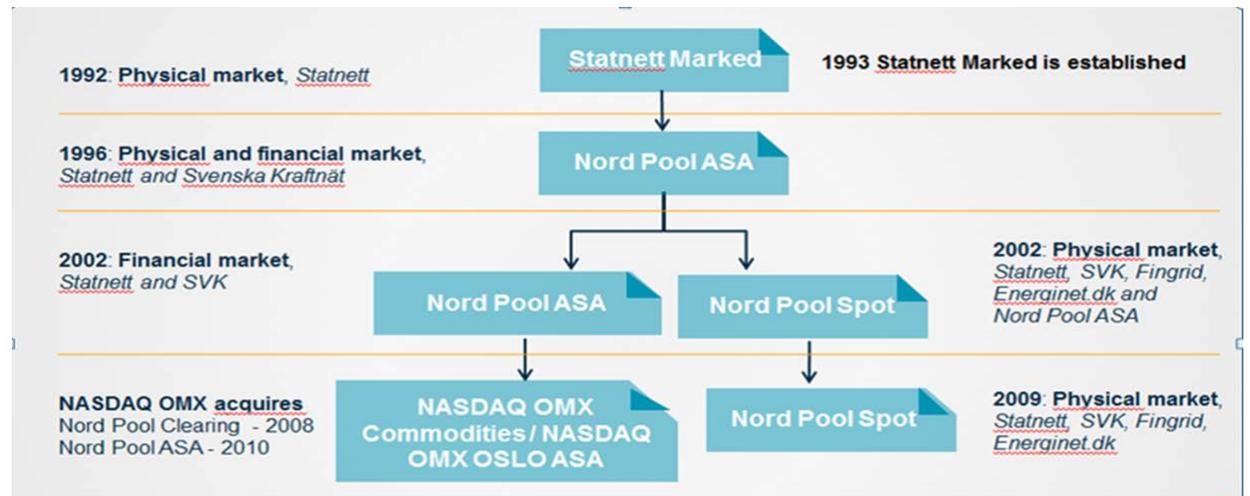
- Covers France, Germany, Austria and Switzerland,
- One third of European power consumption
- Created in 2008 through the merger of Powernext in France and EEX in Germany.
- 100% owner of APX Group, covering the Netherlands, Belgium and UK (since April 2015)
- 225 members
- 360 TWh yearly volume traded (2014)

EPEXSPOT



Nord Pool Spot

- Nord Pool Spot was the world's first market for trading power
- Today also the world's largest power market
- Nord Pool Spot operates in 9 countries:
- 370 companies from 20 countries
 - Producers, consumers, traders, suppliers
- 493 TWh traded at Nord Pool Spot, 84% market share (2014)

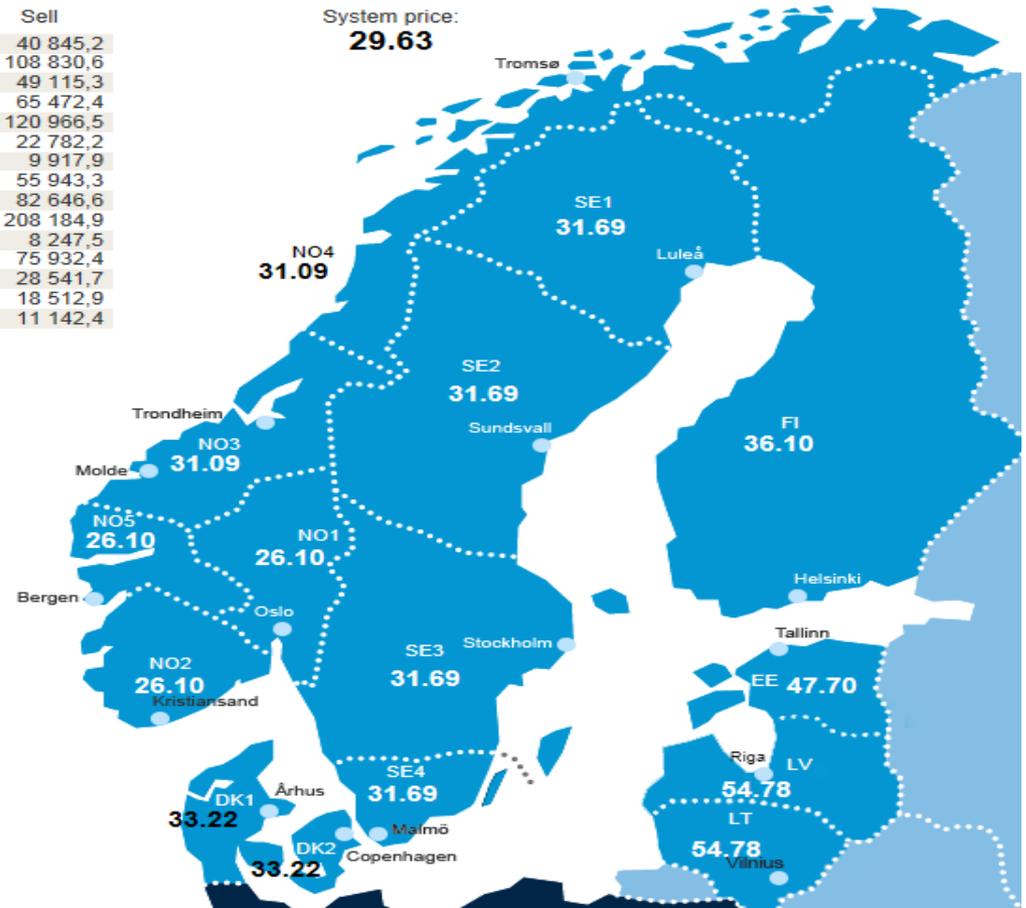


The Physical Markets in the Nord Pool Area

Elspot volumes

	Buy	Sell
NO1	62 628,8	40 845,2
NO2	98 825,9	108 830,6
NO3	52 421,7	49 115,3
NO4	38 071,1	65 472,4
NO5	42 455,7	120 966,5
DK1	56 184,8	22 782,2
DK2	37 691,4	9 917,9
SE1	24 618,6	55 943,3
SE2	33 575,4	82 646,6
SE3	198 210,1	208 184,9
SE4	65 899,9	8 247,5
FI	131 596,4	75 932,4
EE	16 559,1	28 541,7
LT	29 664,5	18 512,9
LV	18 678,4	11 142,4

System price:
29.63



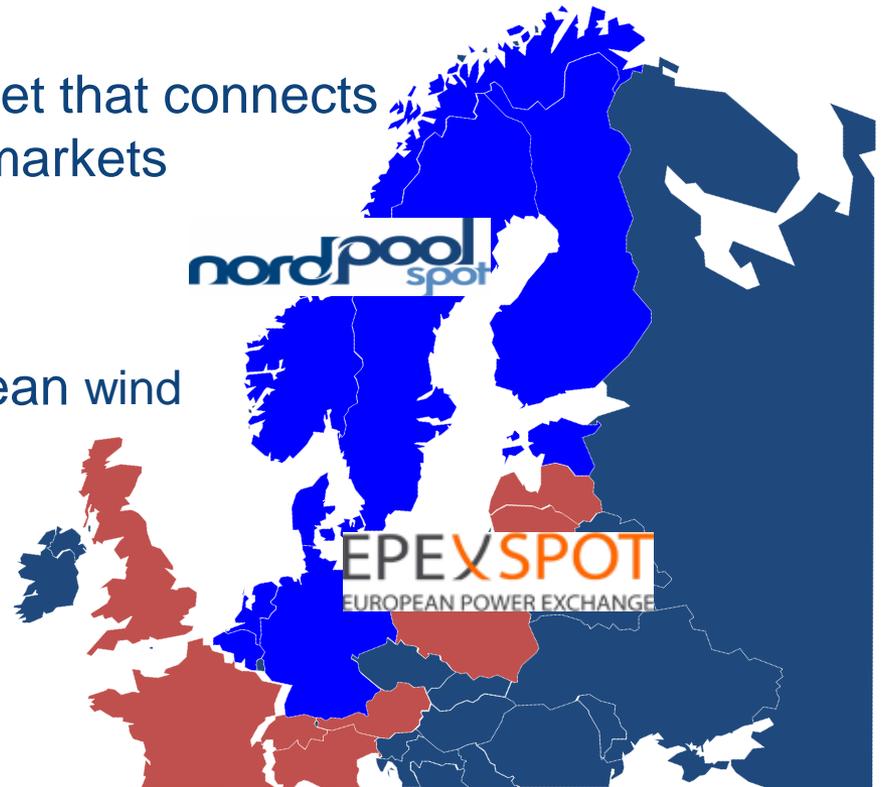
- The Elspot market
- The Elbas market

Intraday Cross Border market - Elbas

Access to all bidding areas in the Nordic, Germany, The Netherlands, Belgium and Estonia

Implicit cross-border intraday market that connects the Nordic and continental power markets

Can balance out hydro and European wind



Nord Pool Spot – Price areas

Due to congestion and bottlenecks between the bidding areas, Nord Pool Spot has several dynamic price areas

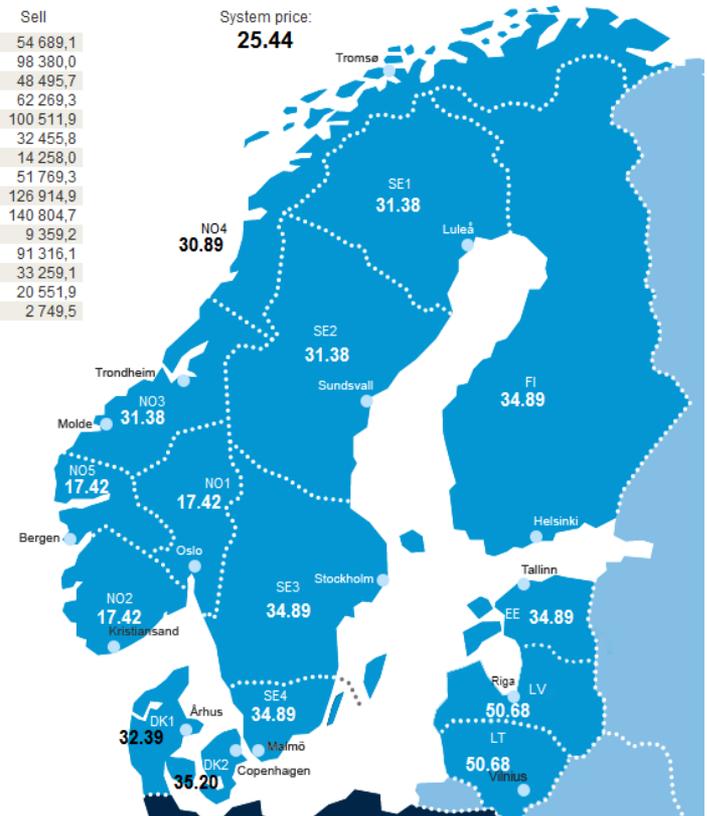
The System Price is the theoretical, common price we would have in the Nordic area if there were no bottleneck in the transmission grid

Also used as reference price for financial contracts

Eislot volumes

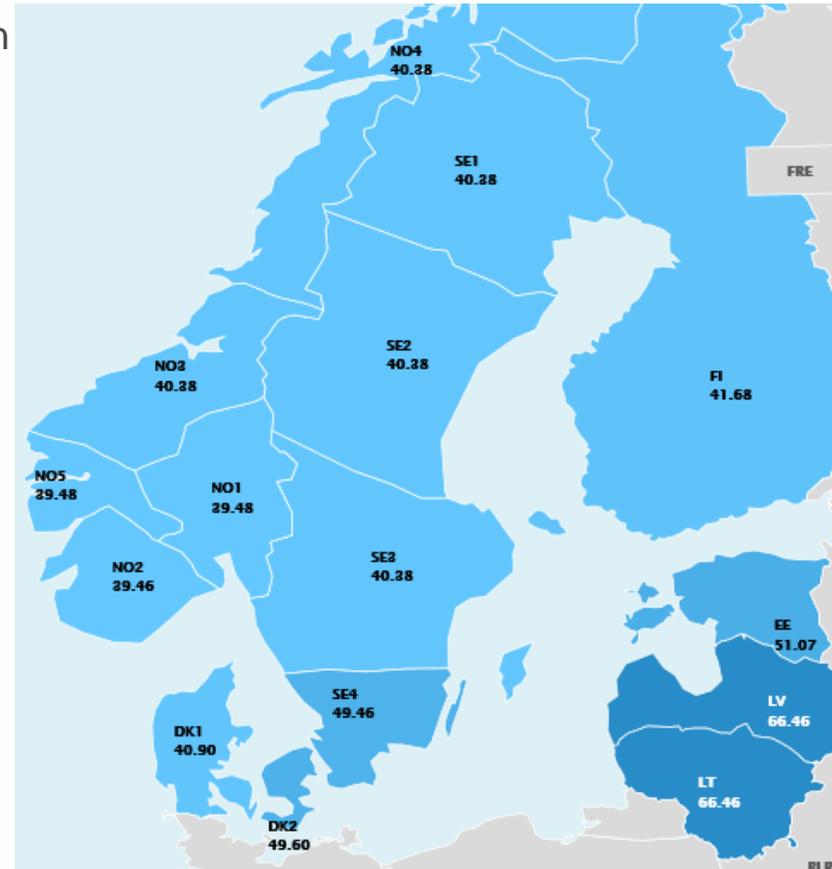
	Buy	Sell
NO1	62 603,4	54 689,1
NO2	104 172,9	98 380,0
NO3	53 952,6	48 495,7
NO4	40 390,3	62 269,3
NO5	42 059,7	100 511,9
DK1	44 936,6	32 455,8
DK2	32 132,7	14 258,0
SE1	24 578,6	51 769,3
SE2	33 228,1	126 914,9
SE3	194 093,2	140 804,7
SE4	68 983,0	9 359,2
FI	129 074,4	91 316,1
EE	16 307,6	33 259,1
LT	31 266,9	20 551,9
LV	10 004,5	2 749,5

System price:
25.44



Price areas Nordics

- Sweden
 - Large transmission capacity internally in Sweden
 - Plus transitt via Finland - Fenno-Scan 2
 - Highly correlated with Europe
 - Production in North –
 - Consumption in the south
- Norway
 - Poor transmission capacity internally
 - NO3 and NO4 strongly correlated with Sweden
 - Large share of production in NO2
- Finland
 - High price / deficit area
- Denmark
 - Renewables,
 - Linked to Germany



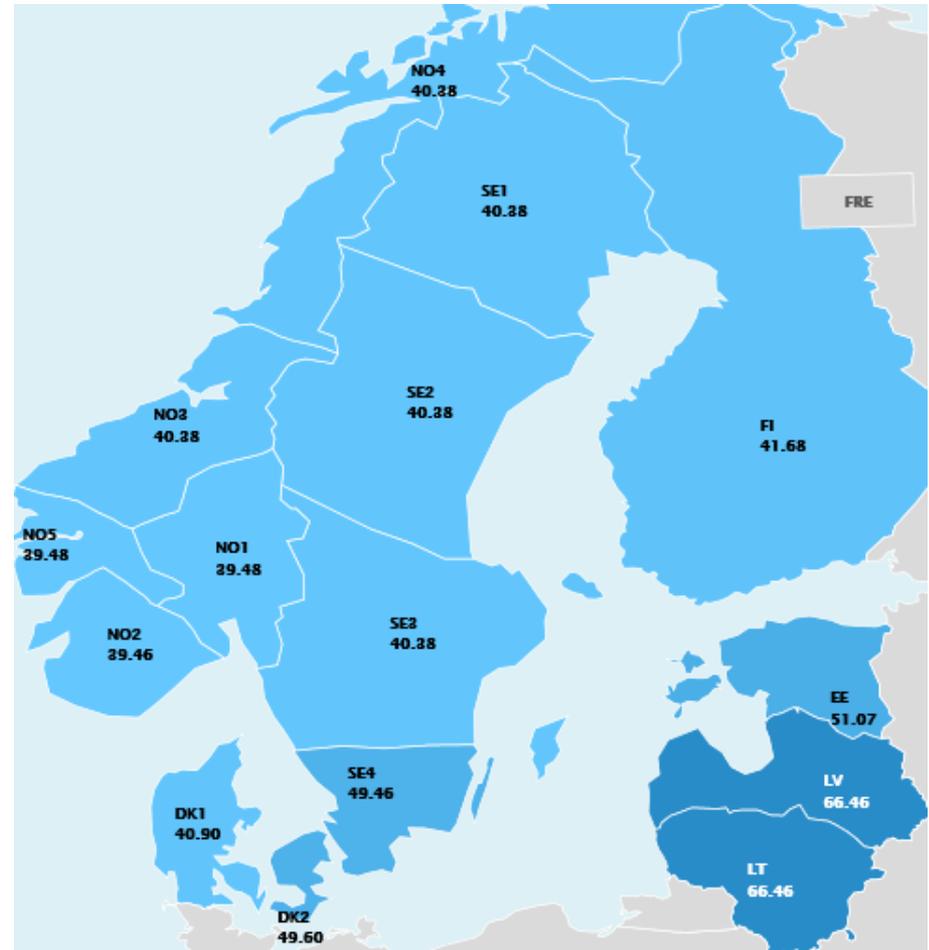
Nordic spot price correlations 2013-2015

Spot price correlation, NO Areas – SE, DK, FI

Area	SE1	SE2	SE3	SE4	DK1	DK2	FI
NO1	0,75	0,75	0,73	0,71	0,23	0,60	0,50
NO2	0,74	0,74	0,72	0,70	0,23	0,59	0,50
NO3	0,95	0,95	0,92	0,89	0,29	0,78	0,68
NO4	0,94	0,94	0,91	0,88	0,29	0,77	0,68
NO5	0,74	0,74	0,72	0,70	0,23	0,59	0,49

NO Areas

Area	NO1	NO2	NO3	NO4	NO5
NO1	1	,99	,79	,80	,99
NO2	,99	1	,78	,79	,98
NO3	,79	,78	1	,98	,78
NO4	,80	,79	,98	1	,79
NO5	,99	,98	,78	,79	1



How the Markets Work Together?

Financial market

Used for managing risks. Contracts can be made for up to six years. The Elspot system price is used as reference price.

Day-ahead market - Elspot

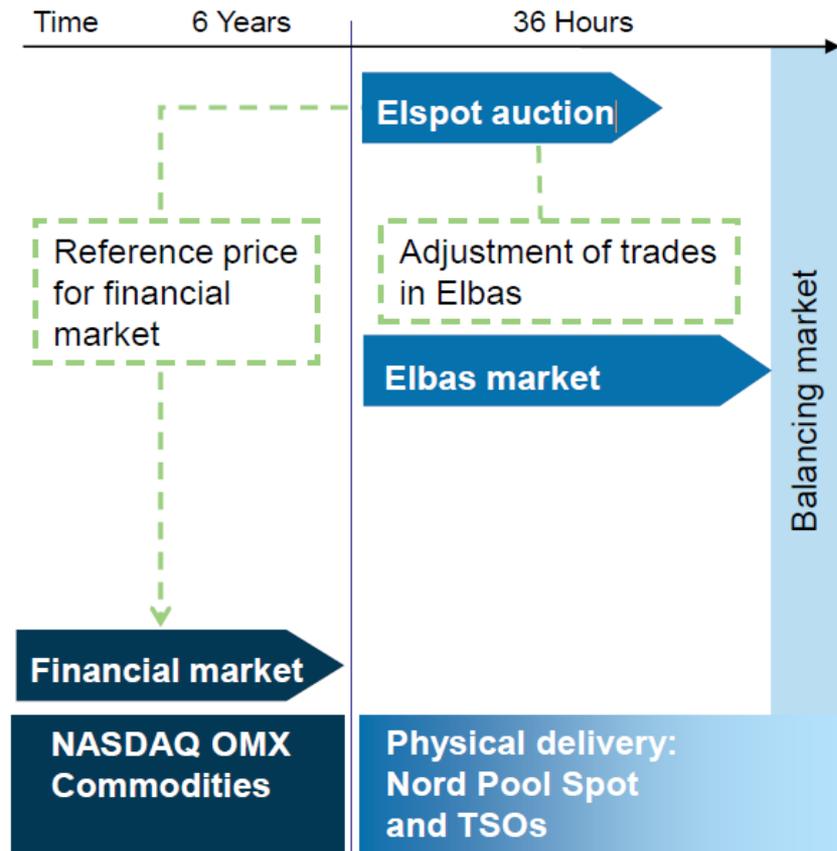
Day-ahead auction of power for delivery the next day. Nord Pool Spot calculates power prices based on supply and demand for every hour the following day.

Intraday market - Elbas

Continuous trading up to 30 minutes before delivery to adjust power production or consumption plans.

Balancing market

Operated by the respective transmission system operators. Final adjustments are made to ensure the correct frequency in the grid and security of supply.



Kilde: Nord Pool Spot



EUROPEAN MARKET INTEGRATION

Background

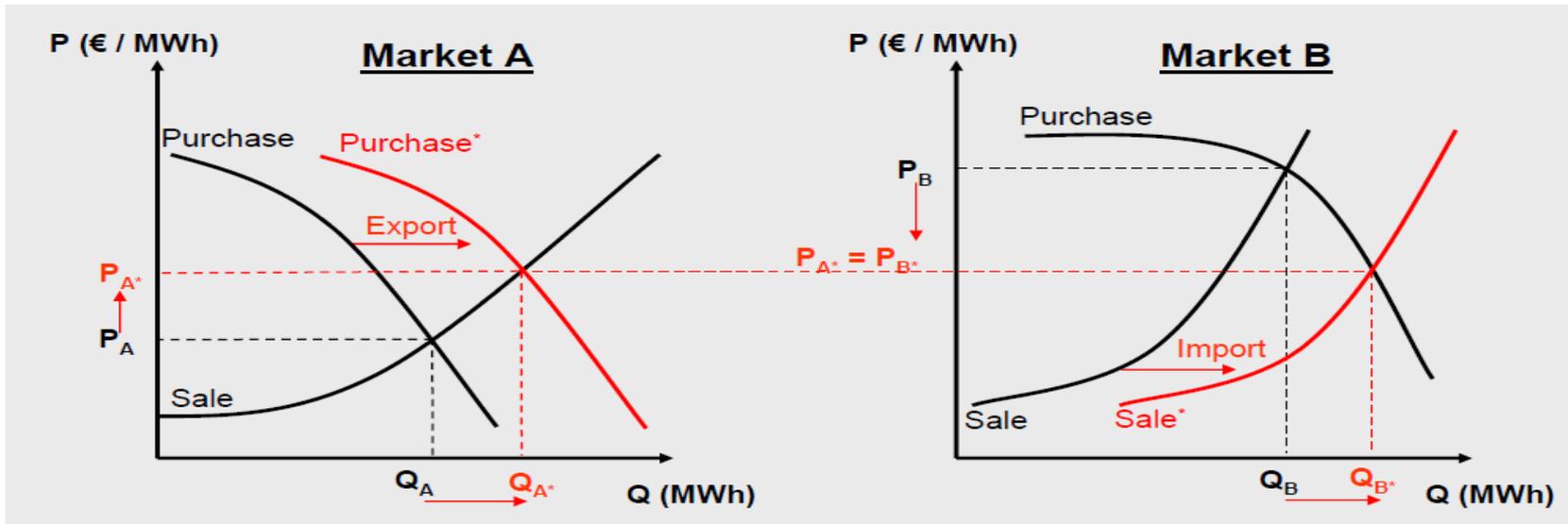
- The EU has decided on a common and harmonized European electricity market.
- The EU target model include
 - European solution for Day A head
 - European solution for Intraday
- The new European Regulation promotes **market based congestion management mechanisms**, to provide efficient use of interconnectors as well to give appropriate market signals giving the right incentives for transmission and generation investments

Market coupling in brief

- Market coupling is the use of so-called implicit auctioning, involving two or more power exchanges
- The capacity between bidding areas is made available to the spot price mechanism in addition to all the sales and offers
- The capacities between the markets are used in an optimal way to decrease price differences

Market coupling - Basic concept

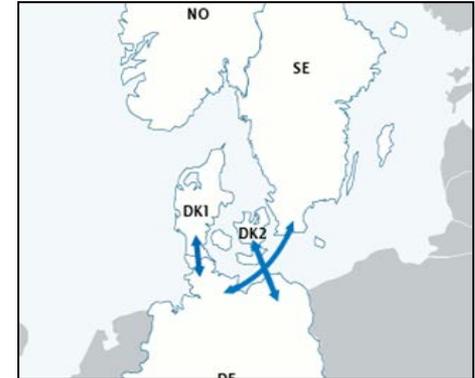
- Price in Market A is lower than in market B
- Market A exports to market B



Curves shifts until price market A = price market B

History

- 1996- 2000: Nordic marked (Nord Pool Spot)
- 2006 TLC (Benelux and France)
- 2009: European Market Coupling Company (DE and Nordic)



- 2010: Central West Europe (CWE)
- 2011: ITVC (EMCC+CWE)
(Two separate Market Couplings linked by a volume coupling)



NWE - North West Europe

- 4th February 2014
 - 13 Transmission System Operators
 - 4 Power Exchanges
 - 40 interconnectors
 - 30 bidding zones
 - Full coupling with GB

NWE - Interconnectors



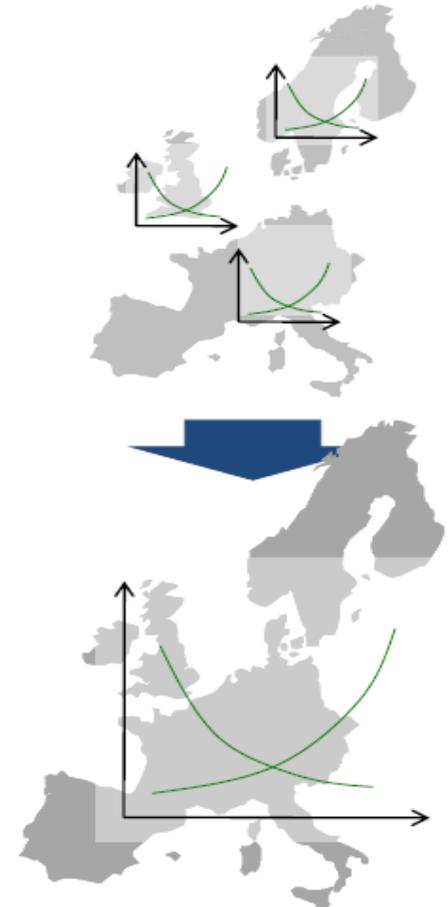
- The first step in the full Price Coupling of Regions (PCR)

PCR – Price Coupling of Regions

European virtual Power Exchange for 2300 TWh

7- Power exchanges

75% of Europe's consumption



If no bottlenecks; One European Spot price

How does it work

- **EUPHEMIA** is the name of the algorithm that daily calculates the Day-ahead **prices for 19 European countries**:
 - Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Great Britain, Italy, Latvia, Lithuania, Luxembourg, The Netherlands, Norway, Poland ,Portugal, Slovenia, Spain and Sweden.
- One algorithm for capacities and price

-
- Effects of market coupling

What does it actually do?

1. Market coupling is extremely important for the integration RES

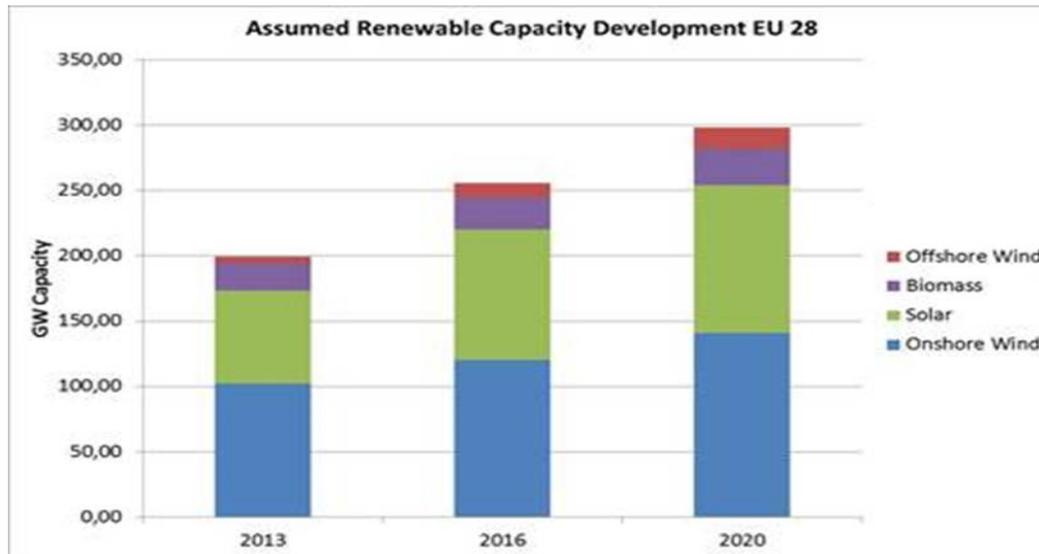
Market coupling expects to give:

2. increased economical welfare in Europe
3. increased liquidity
4. Less volatility

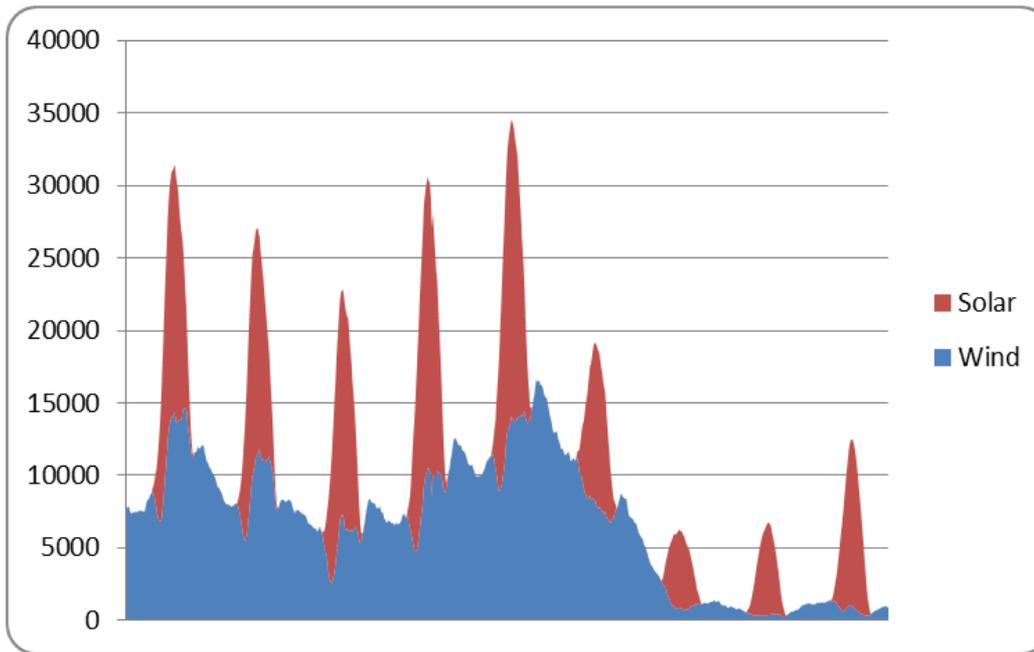
1. Intergration of renewables

Integration of renewables

- EU electricity markets are experiencing fundamental changes as a result of the 20-20-20 goal:
- According to National renewable action plans
 - 300 GW in 2020 from renewables
 - High increase in on- and off- shore wind



Variable output renewables



Germany 29.Sept – 7.Oct 2013

Source: Point Carbon

Solar production from 35000 MW to 0 in night hours
Wind production increases the capacity gap
Market coupling as an important tool to close the gap

Market coupling balances out

- Market coupling helps in the integrating RES
 - Gives back up capacities across borders
- Reduces SoS issues
 - Not dependent on a particular country, fuel or trade partner.
 - Also facilitate crisis support between countries.



2. Economical welfare

Increased economical welfare in Europe

Welfare = Producer surplus + Consumer surplus - congestion rent

Estimated annual value NWE of 150 mill €

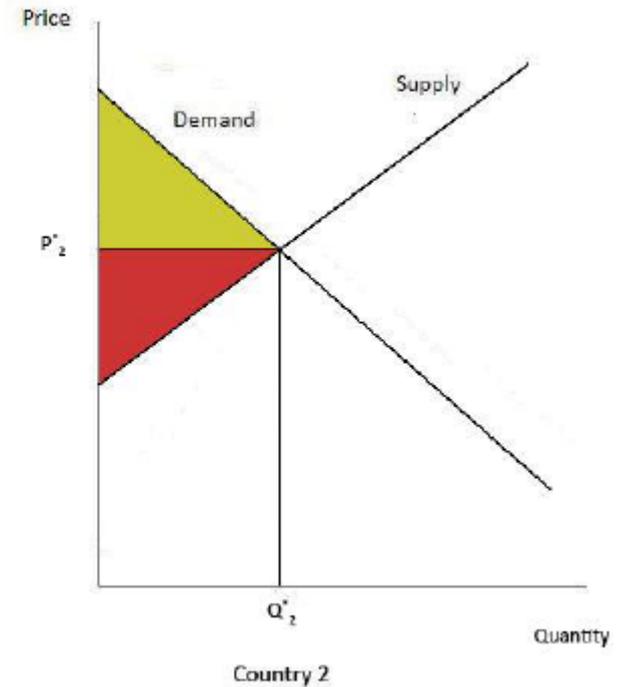
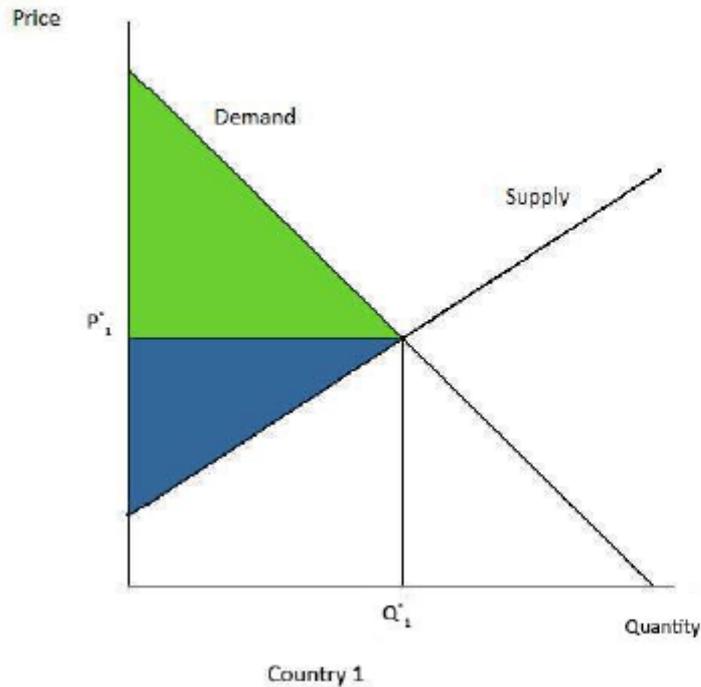
Gives the systems on both sides larger flexibility and better utilization of different energy sources.

Reduces the need for expensive back up capacities

- Thermal production in Europe supports hydrological deficits
- Hydro power delivers short term flexibility to Europe

Increased economical welfare

Without market coupling

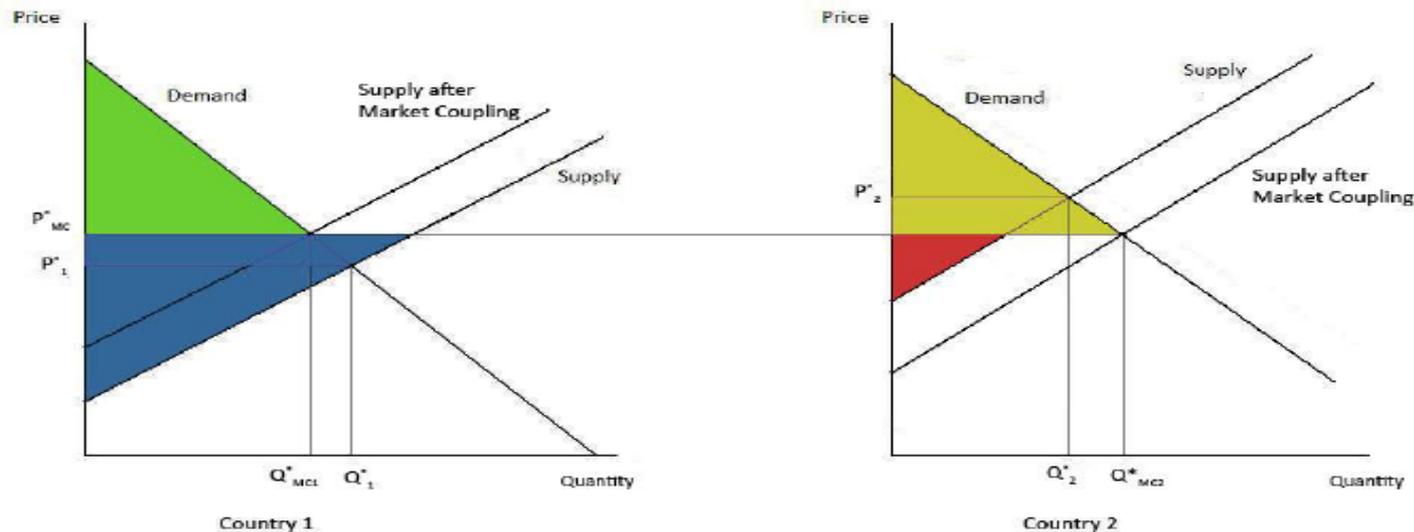


Increased economical welfare

With market coupling

The Producer Surplus in country 1 rises because suppliers are able to supply more units of electricity against higher prices.

The Consumer Surplus in country 2 rises. The demanders are able to buy more electricity against a lower price.



3.Liquidity

Increased liquidity

Market coupling mechanism offers more opportunities to find a counter party

Gives:

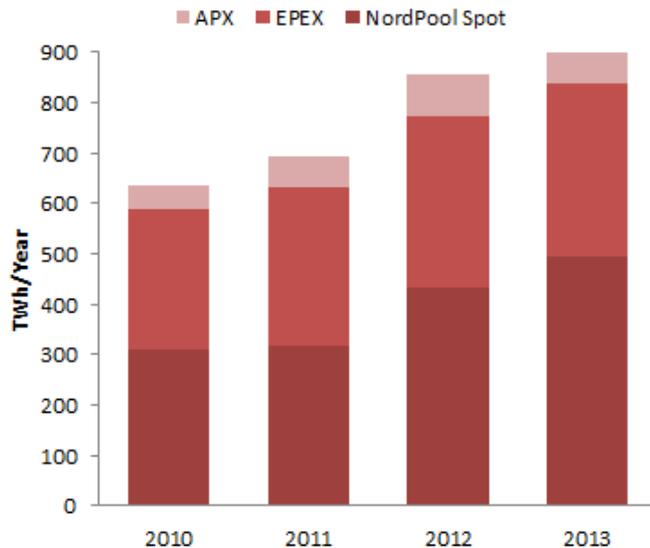
Less marked dominans

- Larger liquidity pool formes the price
- More difficult to dominate the price in smaller areas.

Better reference prices

- More robust and less volatile

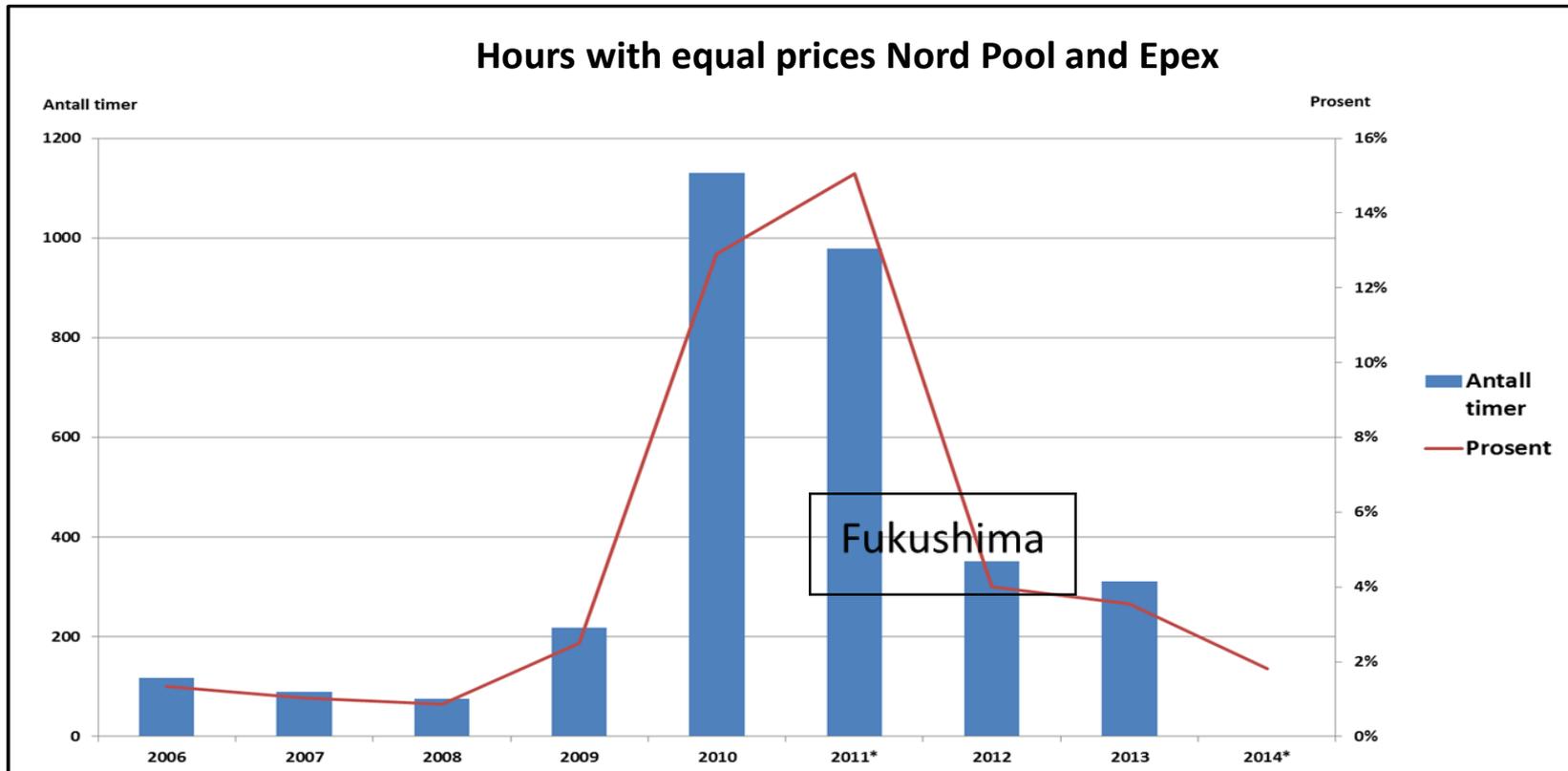
Increasing volumes at PXs



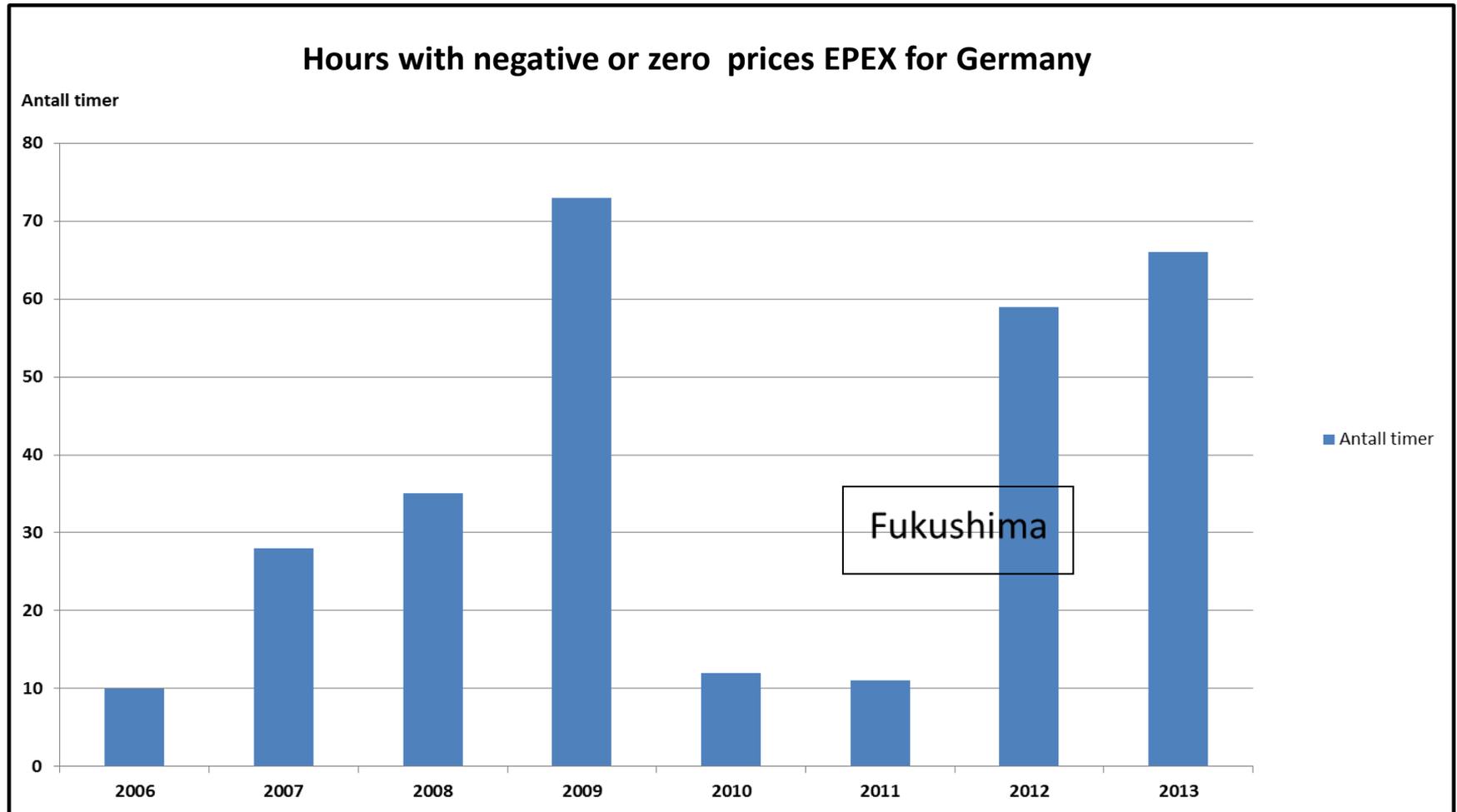
4. Price volatility

Less volatility

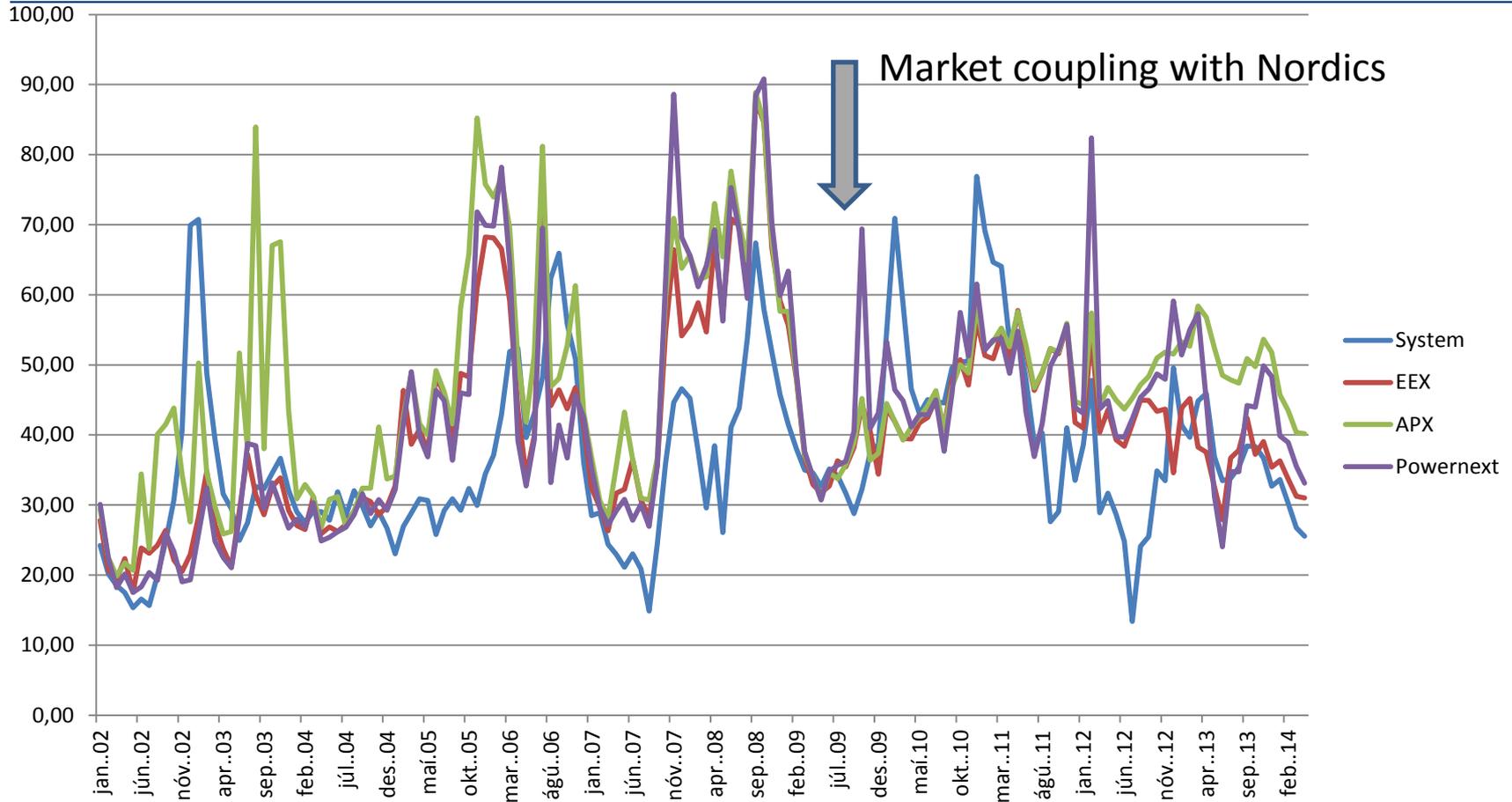
- Evens out the European differences



Less volatility



Less volatility?

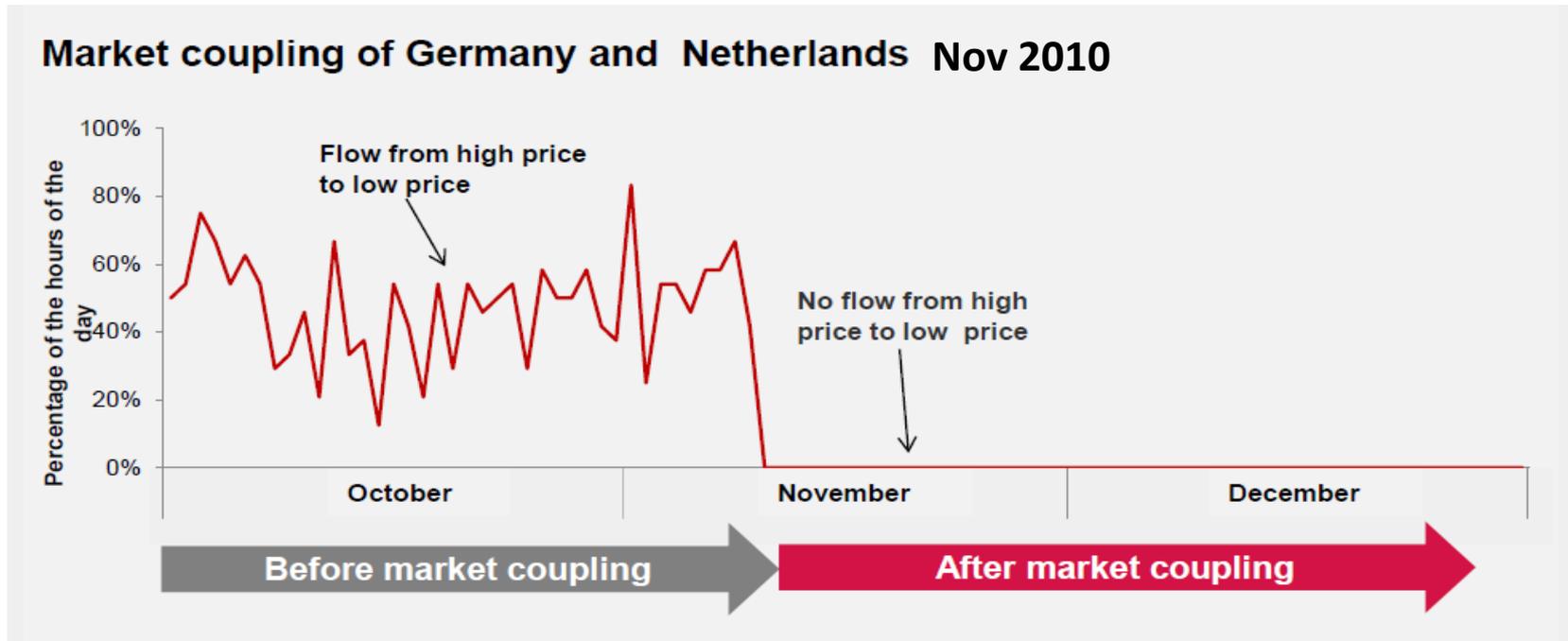


Volatility TCL

Daily average prices for TLC countries (in €/MWh)



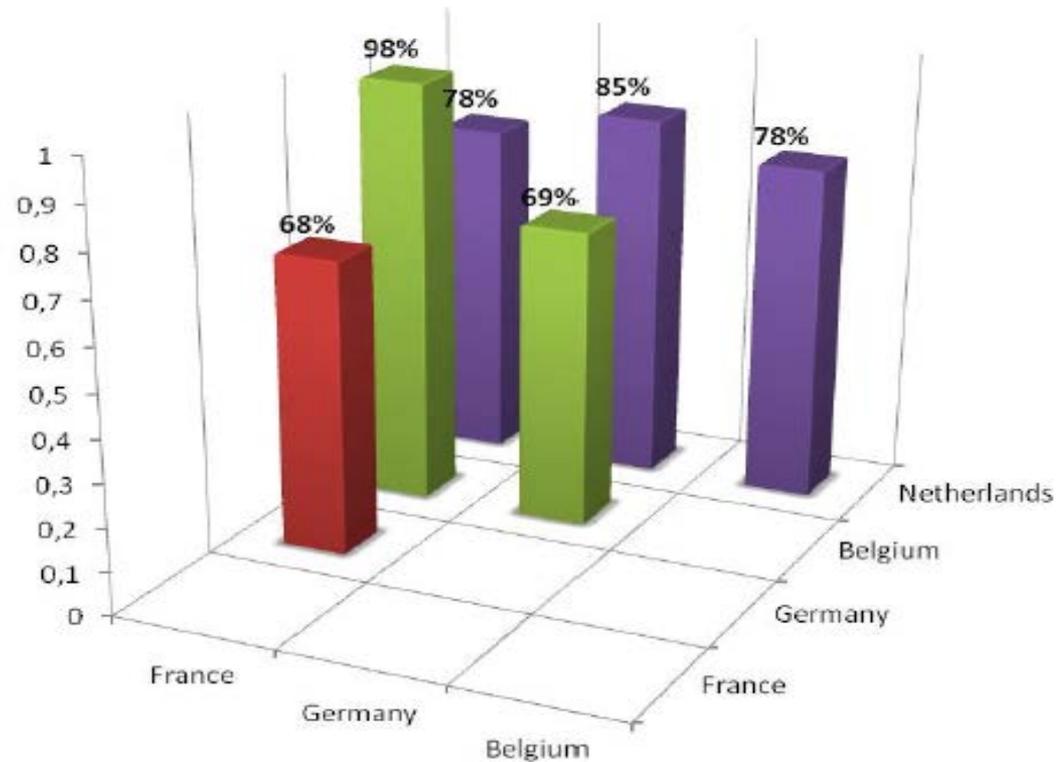
Volatility CWE



Number of identical prices increased from 12 % in 2010 to 87% 2011

Price convergence

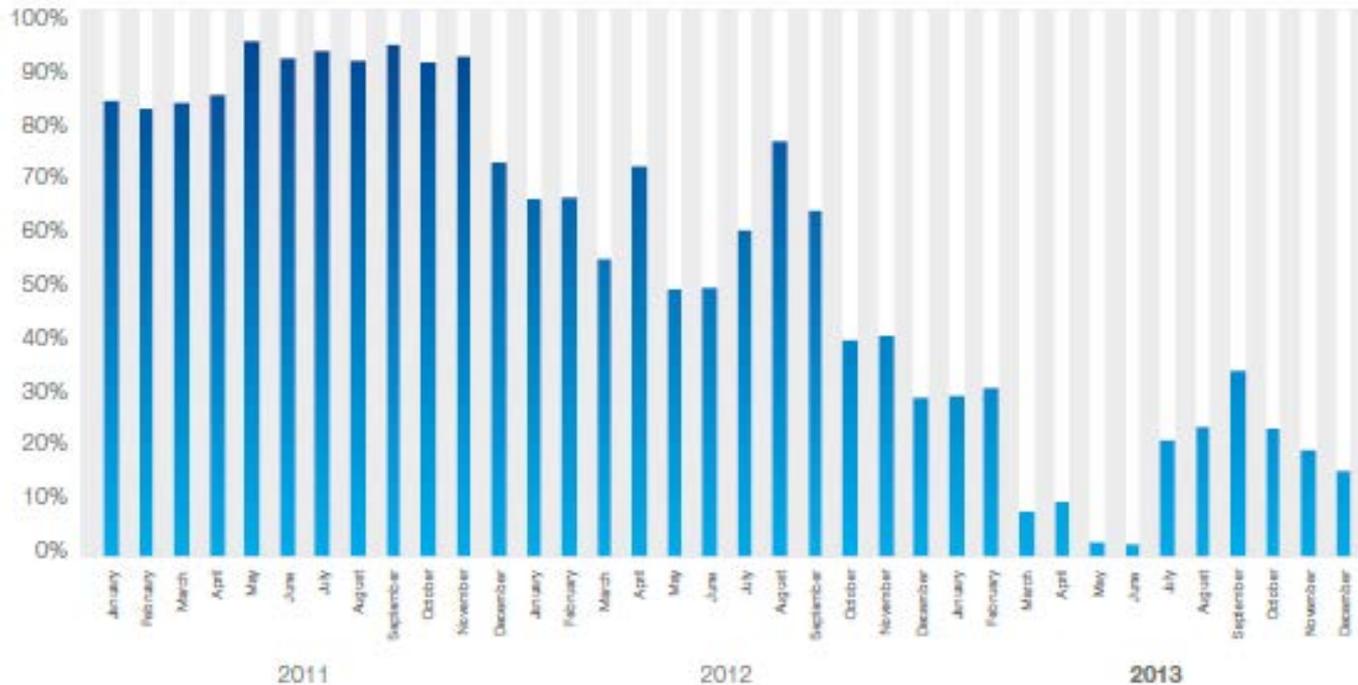
Average % of hours of price convergence Nov 2010 to April 2011



Price convergence

- However:
- From end of 2011, prices started to diverge in CWE

Price convergence between Germany and the Netherlands (in % of hours)

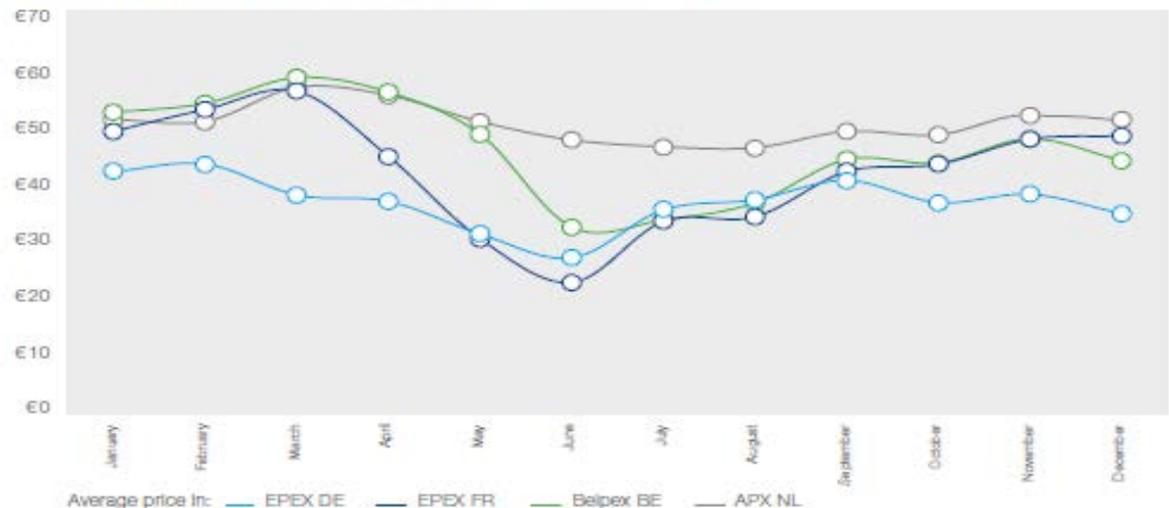


Price convergence

The development of RES has created a substantial gap between Germany and the rest of the CWE region

- German price moved down, while the Netherlands had an increase
- Decreasing German price during the summer period due to solar.

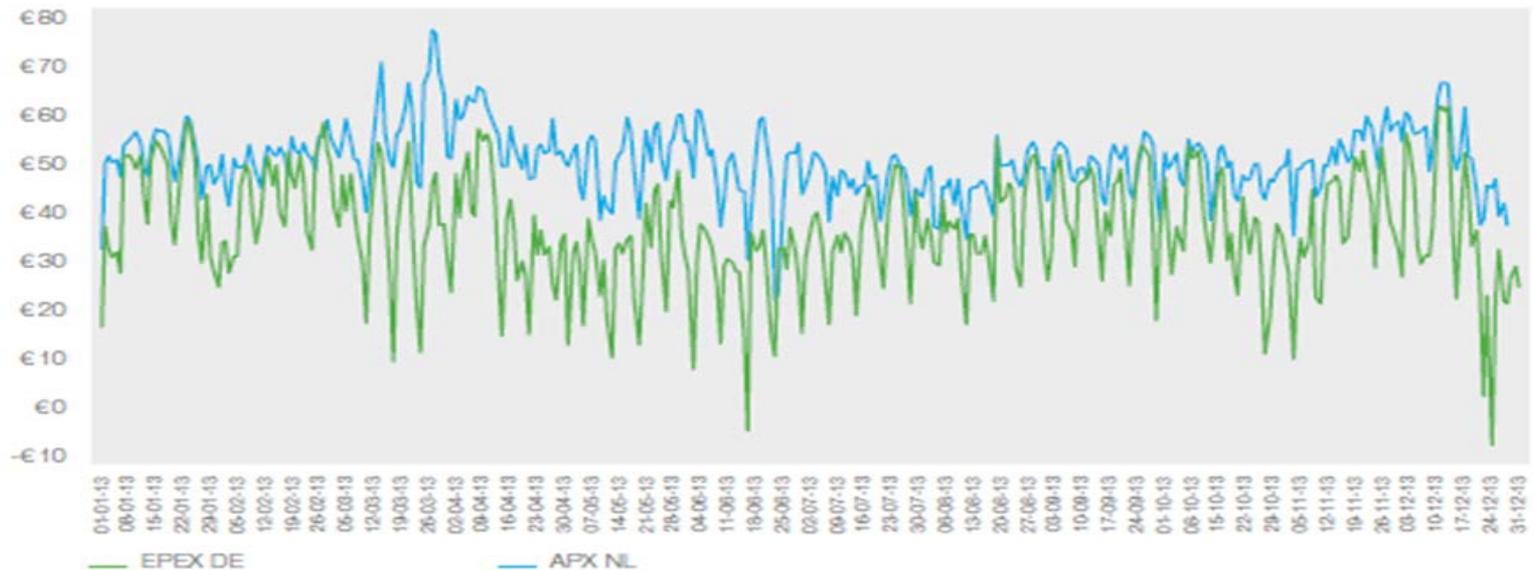
The year 2013 in more detail: CWE monthly average wholesale prices



Germany - Netherlands

Daily prices:
Germany shows stronger variation than The Netherlands

The Year 2013 in daily detail: daily average wholesale prices in Germany and in the Netherlands

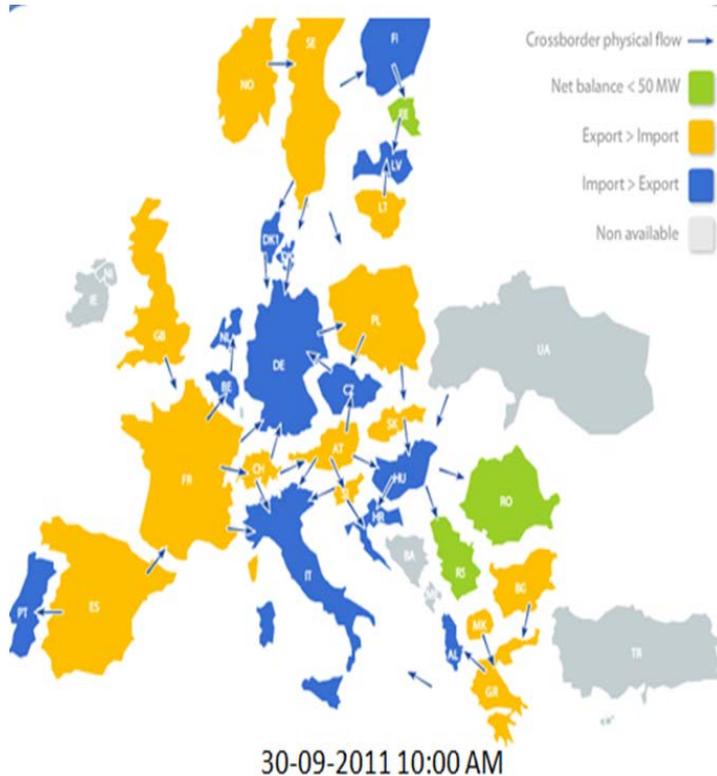


Norway- Netherlands

- Big difference between higher price in NL and a lower price in Norway, gives a large flow from Norway to the Netherlands
- But at times of high renewable input in Germany, the Dutch price is pushed down, causing NorNed flows to export to Norway.
- The net effect is a storage of German and renewables into Norwegian hydropower.



Market coupling and interconnectors



The effect of market coupling dependent on interconnectors

Big increase in capacities cross border needed to get a full convergence of spot prices

A lot is already planned.....

Planned interconnectors towards Nordics

Nordic and Continental interconnection capacity will double to over 10.000 MW by 2020

Transmission network operators' cross-border grid plans by 2020:

Two 1,400 MW NO-UK links as EU Projects of Common Interest: NSN link to England agreed to be built by 2020, NorthConnect to Scotland still requiring Norwegian permission

First direct 1,400 MW NO-DE link agreed to be built by 2018

EU financial support for a 700 MW DK-NL link, due to be built by 2019

Jutland – DE capacity planned to grow by 860 MW by 2019, with further 500 MW increase by 2022

Svenska Kraftnät agreed 3/2014 with 50Hertz to study a new Hansa PowerBridge DC link between Sweden and Germany

New internal Nordic grid investments provide for increased available capacity for transmission to the Continent and Baltics

320 MW of transmission capacity available on the 1,300 MW RU-FI link since December 2014

EU's Connecting Europe Facility co-financing 3rd EE-LV transmission line, due to be ready by 2020

EU's European Energy Programme for Recovery co-financing 700 MW NordBalt (ready 12/2015)

LitPol link (500+500 MW) to connect the Baltic market to Poland by end -2015/20.



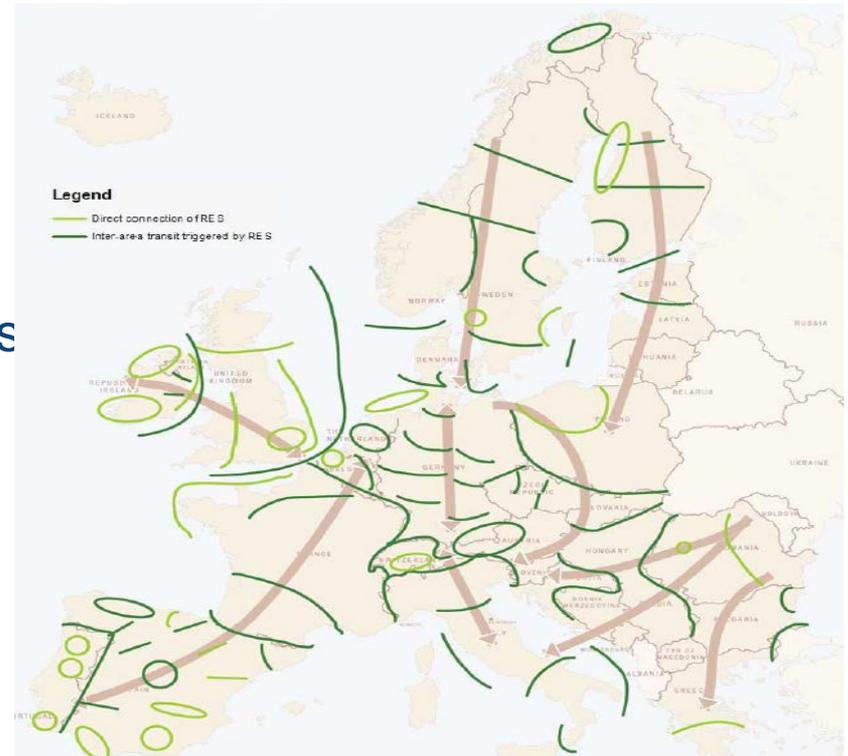
— Existing connections

— Future connections

— Future cross-border connections

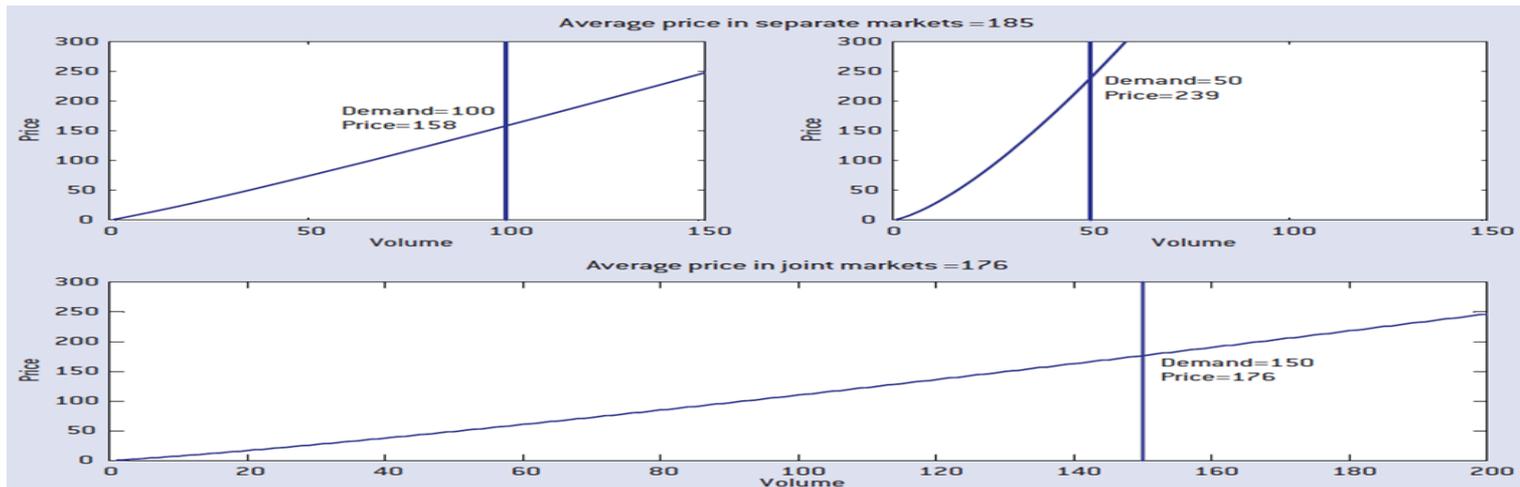
Internal grid investment

- The European Network of Transmission System Operators for Electricity (ENTSOE) has pointed out 100 potential bottlenecks in the European Grid
- 80% of these are directly linked to the integration of renewables
- 104 billion € Planned grid investments towards 2020
 - A lot in UK and Germany
 - Statnett 1 billion € yearly (10 year)



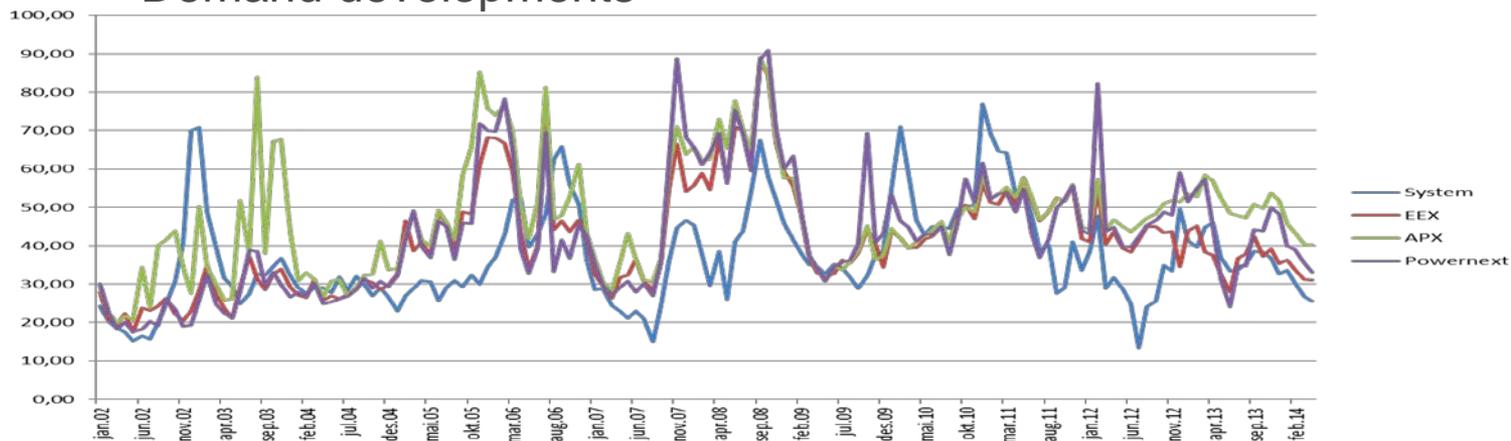
Does market coupling give us lower prices?

- In theory; Yes
 - The most expensive MWh in the expensive country can be replaced by one additional MWh in the cheaper country.
 - And the average prices are typically lower when the markets are coupled than if they are decoupled



Does market coupling give us lower prices?

- But in real life
- Price might converge to a higher price when a low-price area is forced to accept higher prices
- For example; if the last plant that needs to run to meet the joint German-French demand is a German coal plants; these expensive units would set the joint price.
- And there is a lot of other influencing factors on the spot price
 - Weather
 - Demand developments



Conclusion market integration

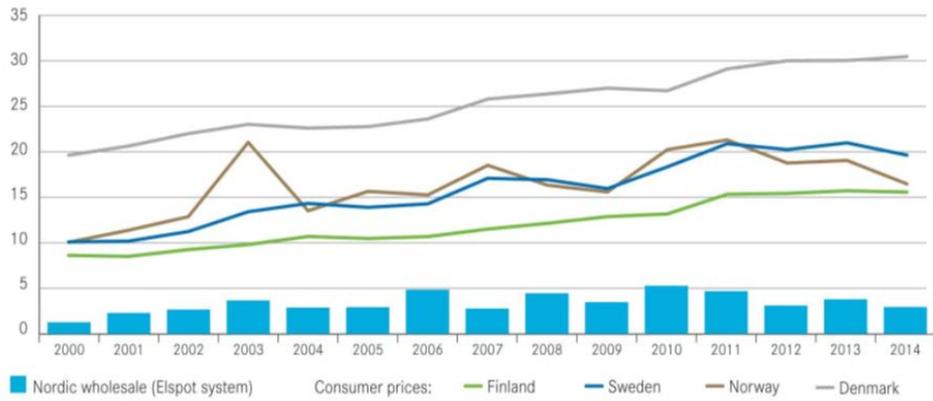
- Market coupling represents a major step for European market integration.
- Is important for the integration of renewable production
 - Back up capacity /SoS
- Has led to less volatility - At least before «Energiewende»
- Has given increased liquidity across Europe
- Gives higher economical welfare through better utilization of interconnectors and production sources.
- Does not necessarily give us lower prices.
- More interconnectors needed to get a higher convergence in Europe

A paradox?

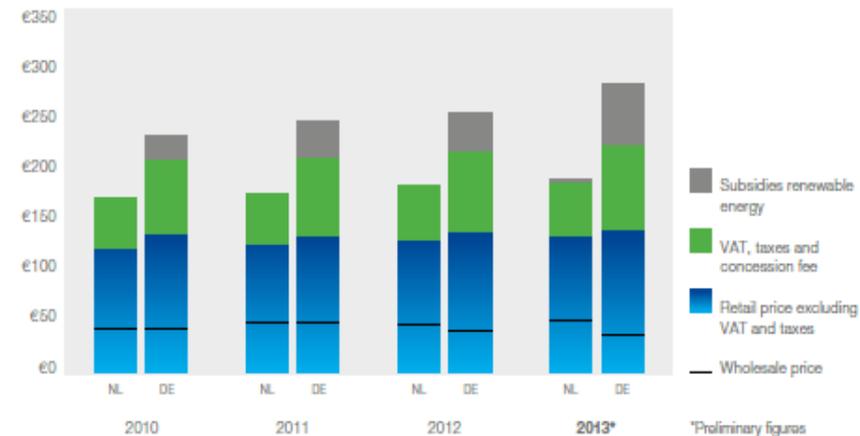
EUs targets is to have an integrated European energy market

- With possible converging wholesale prices between countries
- through efficient allocation of interconnector capacities

But: wholesale prices are an increasingly lower part of end-user prices



Average household consumer prices (in €/MWh)
Based on consumption 2.600 - 5.000 kWh/year



Thank you for your attention

Any questions?

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