



1st International Capacity Building (ICB) "Learning from
Regulatory Experiences and Market Development in Europe"



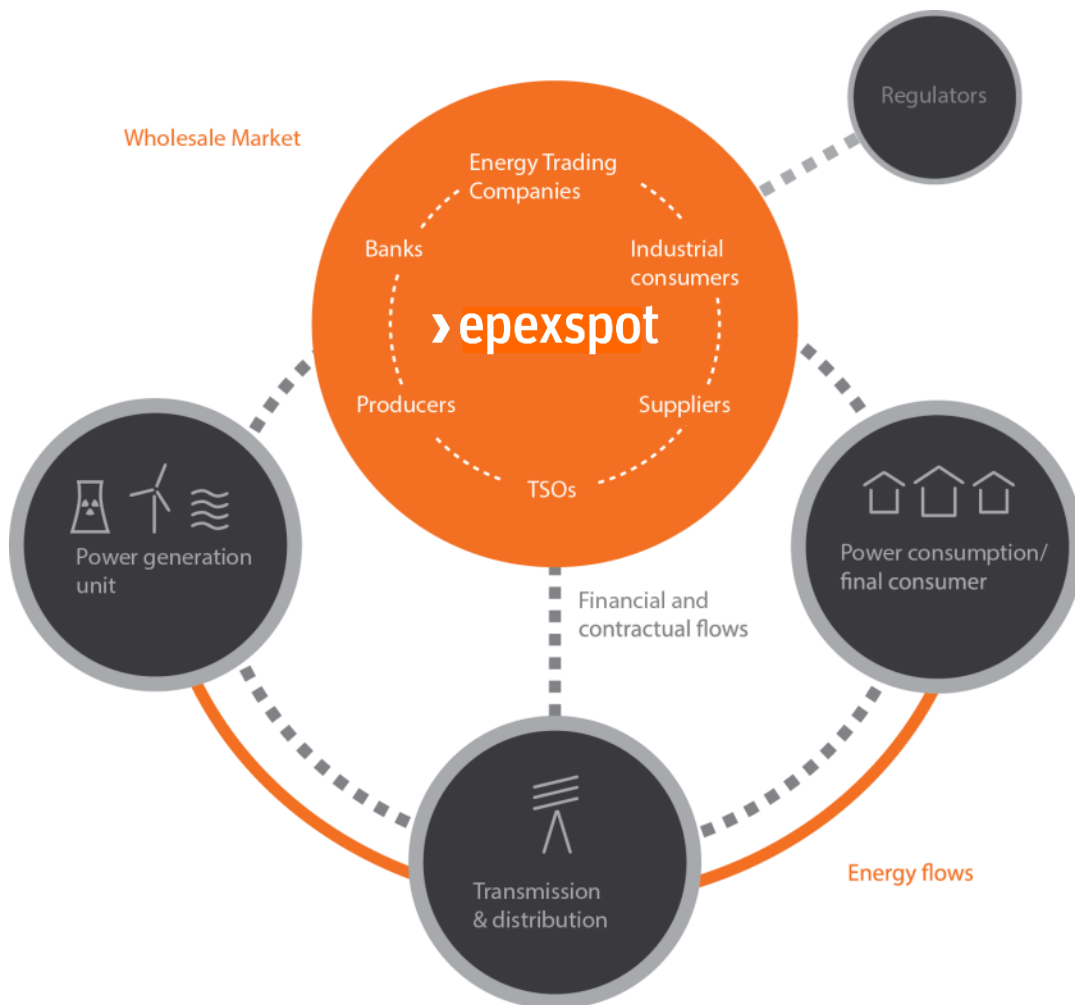
EPEX SPOT

Power for Today. Power for Tomorrow.

17 October 2018

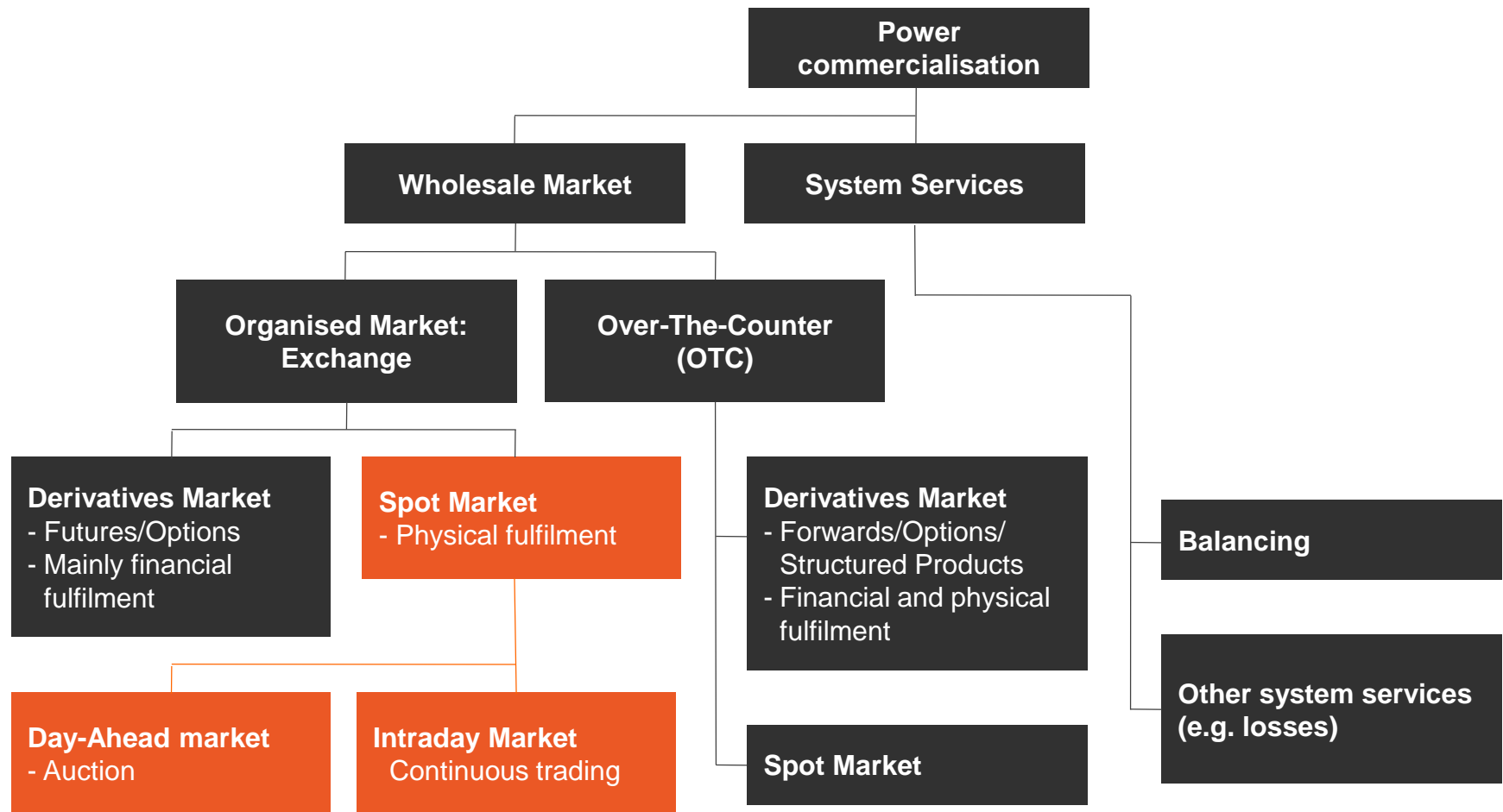
Howard Wright, Norbert Anhalt

The organised market: principles



- Access to an anonymous market
- Level playing field between members
- Financial guarantees through the Clearing House
- Calculation and publication of transparent and fair price references

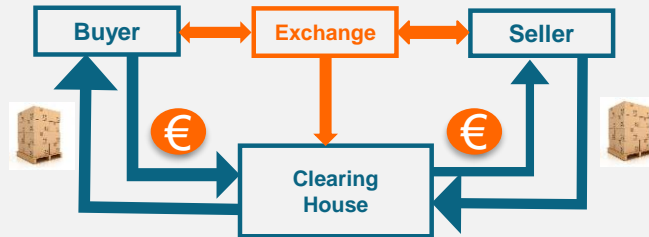
Ways of commercialising power



How to trade power?

How to trade
power?

Exchange



Electronic platform
Anonymous trading
Market rules
Market surveillance
Transparency
Safe payment and delivery

Power trades comply with market rules.
The Clearing House ensures market participants against counterparty risk.

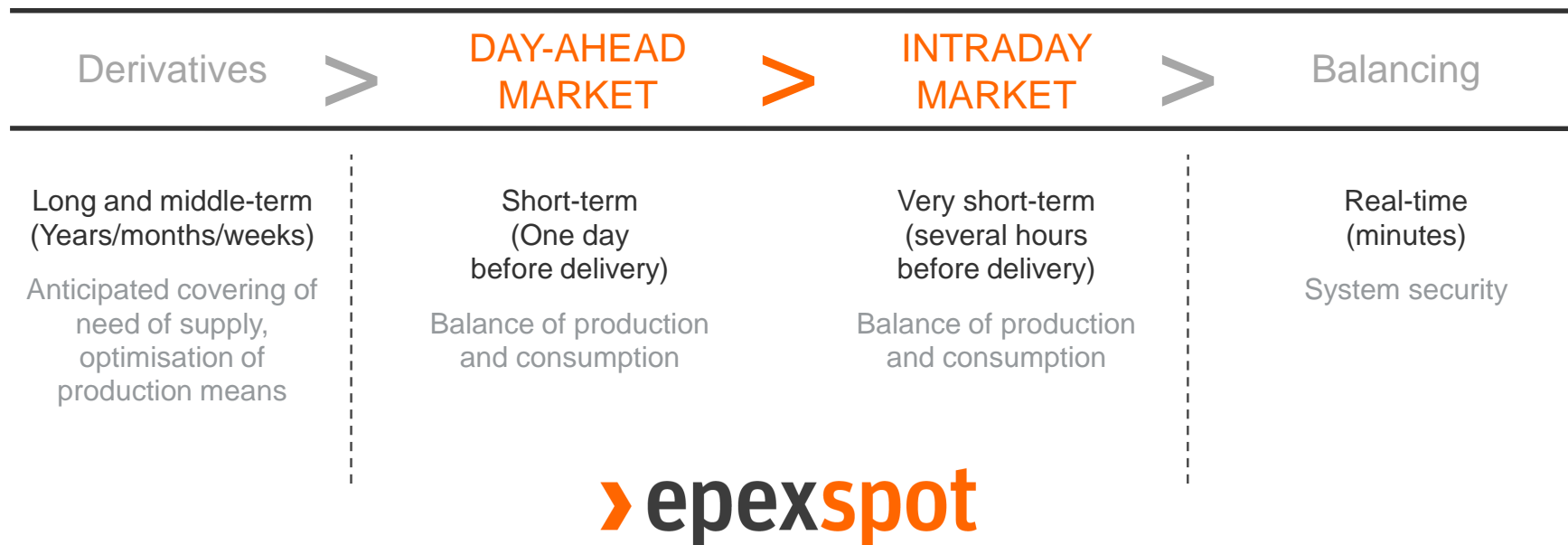
Over-the-counter trading



Via telephone or trading screens

Bilateral trades are not public.
Market participants need to have their own guarantees against counterparty risk.

The role of the Exchange in the timeline of the market



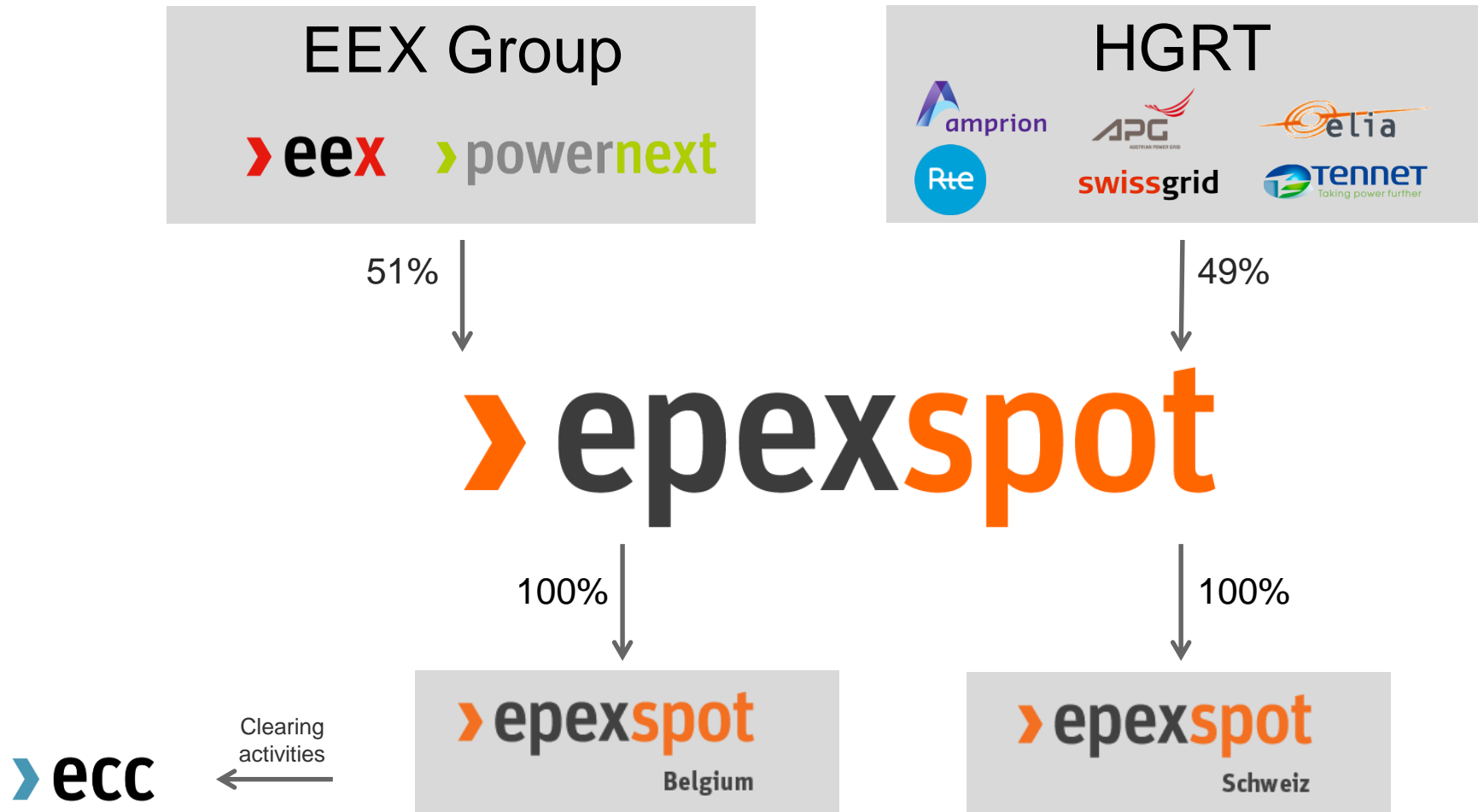
DAY-AHEAD AUCTION

- Optimisation of liquidity via an auction
- Market areas: Germany/Austria/Luxembourg, France, Great Britain, the Netherlands, Switzerland and Belgium

CONTINUOUS INTRADAY

- Flexibility through continuous trading
- Market areas: Germany/Luxembourg, France, Great Britain, the Netherlands, Switzerland, Belgium and Austria

Shareholder structure



» ecc

Part of
EEX Group



EEX Power Derivatives

18 October 2018

EEX Group at a glance

The European Energy Exchange (EEX) is the leading energy exchange in Europe.

It develops, operates and connects secure, liquid and transparent markets for energy and commodity products.

At EEX, contracts on Power, Coal and Emission Allowances as well as Freight and Agricultural Products are traded or registered for clearing.

EPEX SPOT, Powernext, Cleartrade Exchange (CLTX), Gaspoint Nordic, Power Exchange Central Europe (PXE) and Nodal Exchange are also part of EEX Group.

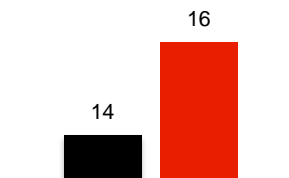
Clearing and settlement is conducted by the clearing house ECC and by Nodal Clear in the United States.

EEX is part of Group Deutsche Börse.

EEX Group – Growing Together

- Powernext, EPEX SPOT and Gaspoint Nordic are part of EEX Group since 2015, PXE joined in 2016, Nodal Exchange in 2017
- Increase of office locations, employees, trading participants and of course advantages for all EEX Group clients

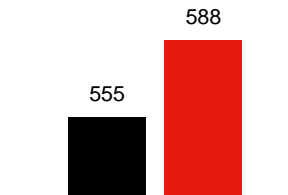
Locations



■ 2016 ■ 2017

+ 14%

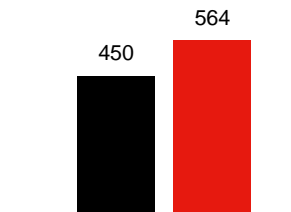
Participants



■ 2016 ■ 2017

+ 6%

Employees



■ 2016 ■ 2017

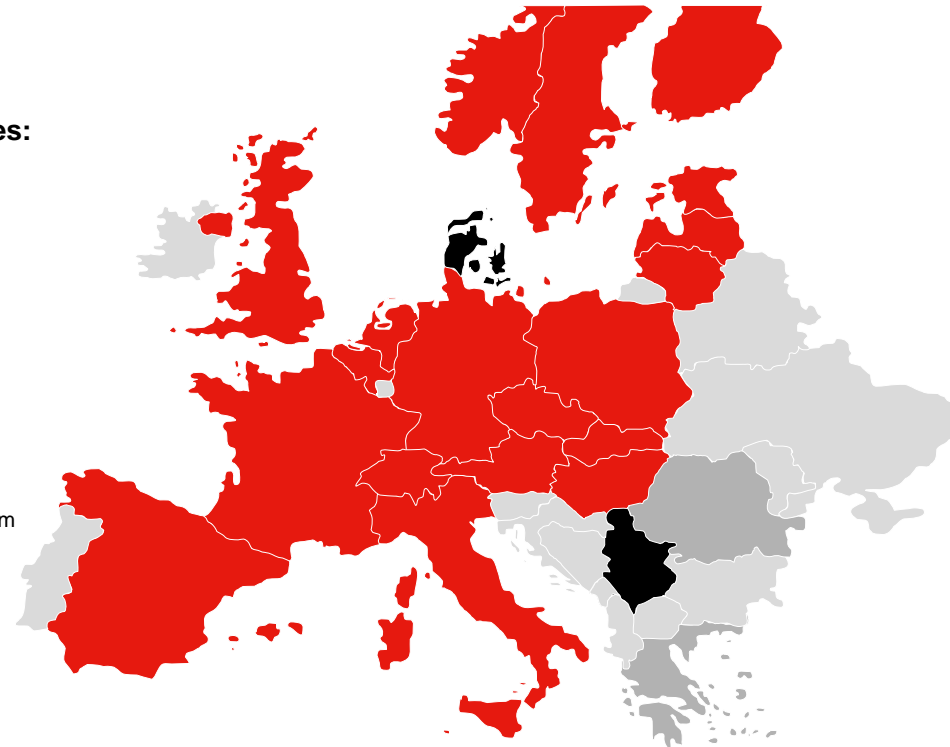
+ 25%

Trading participants of EEX

EEX connects **262** trading participants from **27** countries:

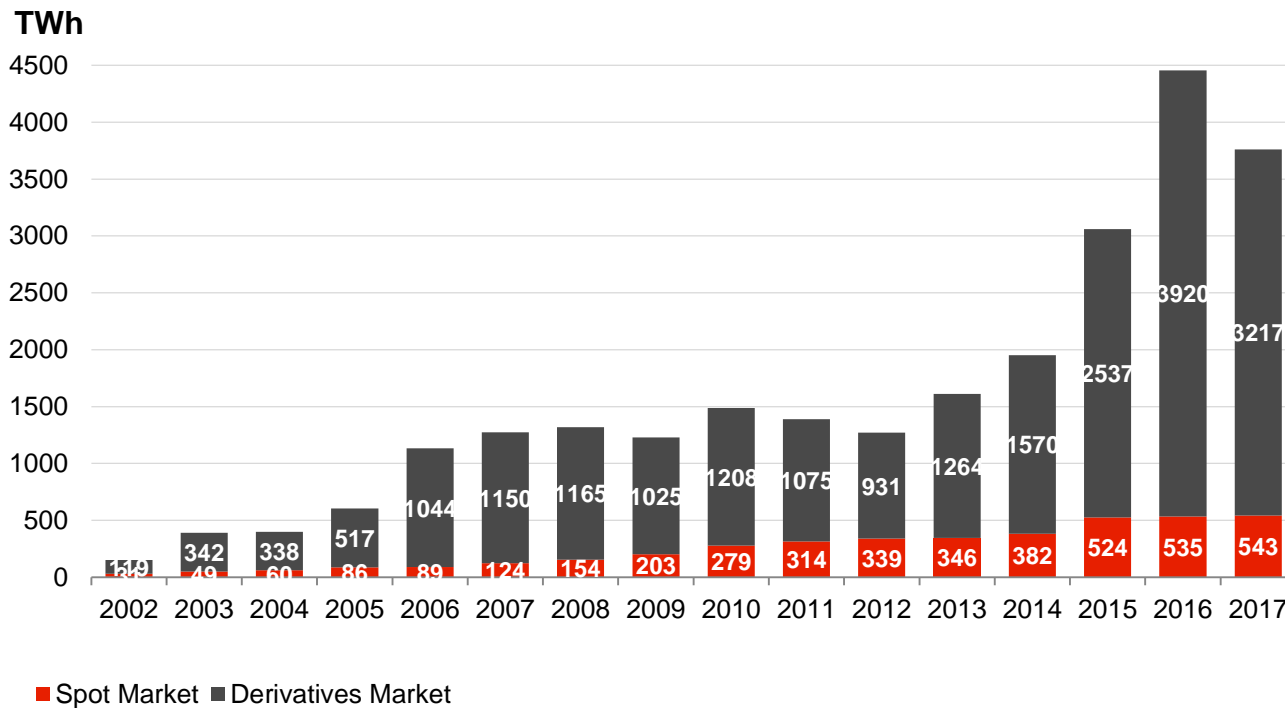
8 Austria	1 Luxembourg
1 Bulgaria	12 Netherlands
1 Croatia	6 Norway
17 Czech Republic	11 Poland
9 Denmark	1 Portugal
1 Finland	3 Romania
13 France	4 Slovakia
55 Germany	4 Slovenia
3 Greece	15 Spain
3 Hungary	3 Sweden
2 Ireland	18 Switzerland
33 Italy	34 United Kingdom
1 Liechtenstein	2 N.N.

1 non-European participants
Cayman Islands

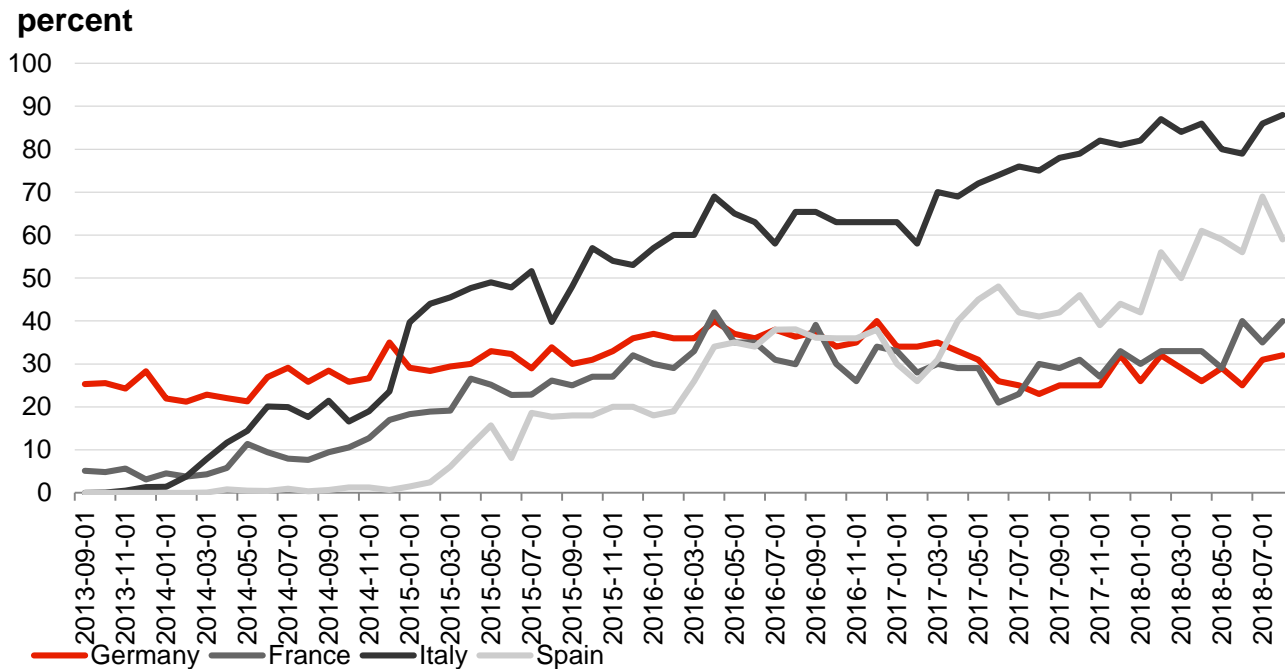


- Exchange traded EEX Power Futures
- EEX Trade Registration Services for Power Futures
- ECC Clearing for Partner Exchanges

Trading volume on the Power Spot and Derivatives Market



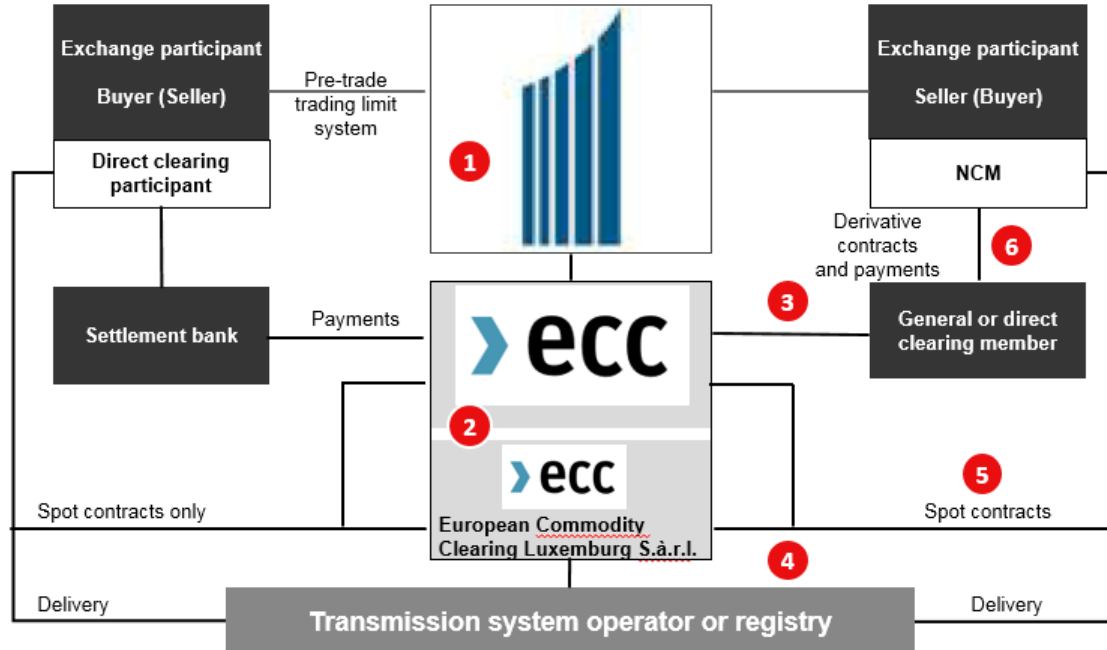
Market share of EEX's core Power Derivatives Markets



The calculation of EEX's market share is based on the figures published by the exchanges and the London Brokers' Association (LEBA) every month.

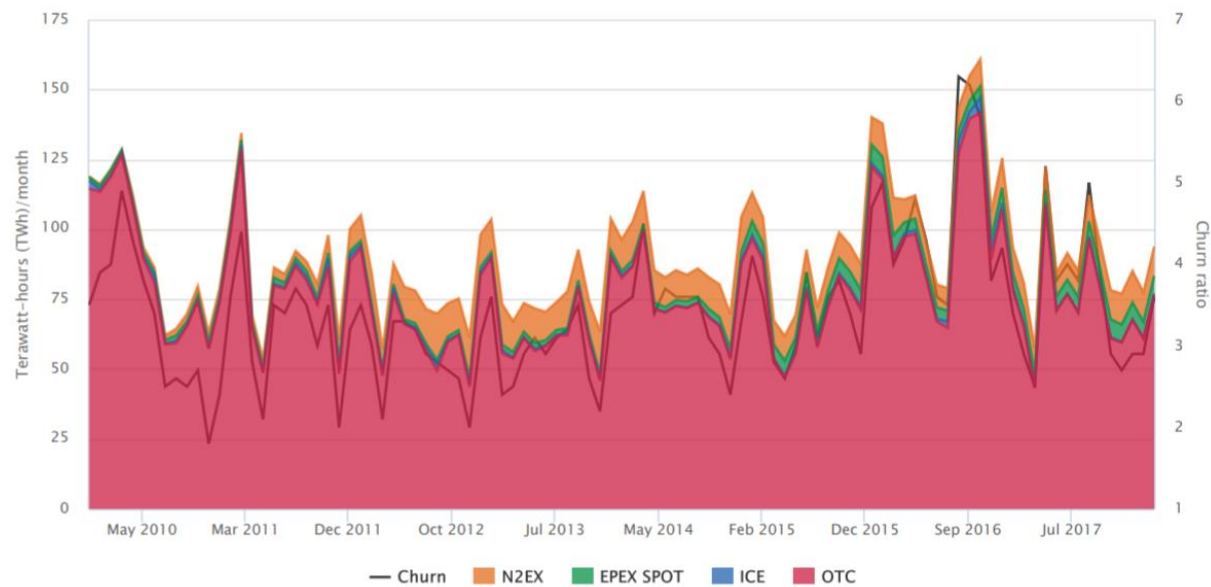
Market structure

The EEX group develops, operates and connects secure, liquid and transparent markets for energy and commodity products. Standardized contracts are traded or registered for clearing. Clearing and settlement of all trading transactions are provided by the clearing house European Commodity Clearing (ECC).

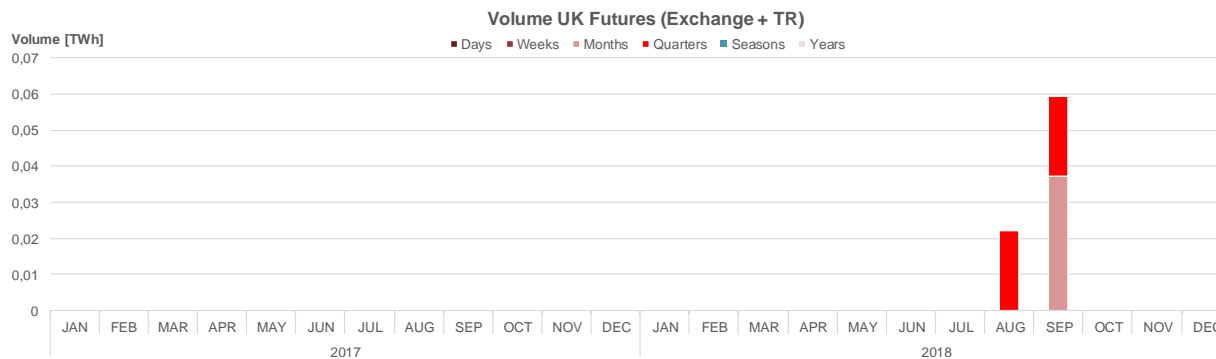


UK Power Market

Electricity trading volumes and churn ratio by month and platform (GB)



UK Power Market





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Liberalization of the European power market

1990: Creation of the UK Pool

1992: Creation of Nord Pool in Norway

1996: European Directive on energy market liberalization

2000: Creation of the two Power Exchanges in Germany. **UK's first independent power exchange, established**

2001: Creation of Powernext in France. 2003: **UKPX integrated into APX**

2006: Launch of the first Market Coupling in continental Europe

2008 / 2009: Creation of EPEX SPOT SE, merger of power markets in DE, FR, CH, AT & LU

2010: Launch of Market Coupling in Central West Europe (CWE)

2011: European Commission announces target date 2014 for the Internal Energy Market;

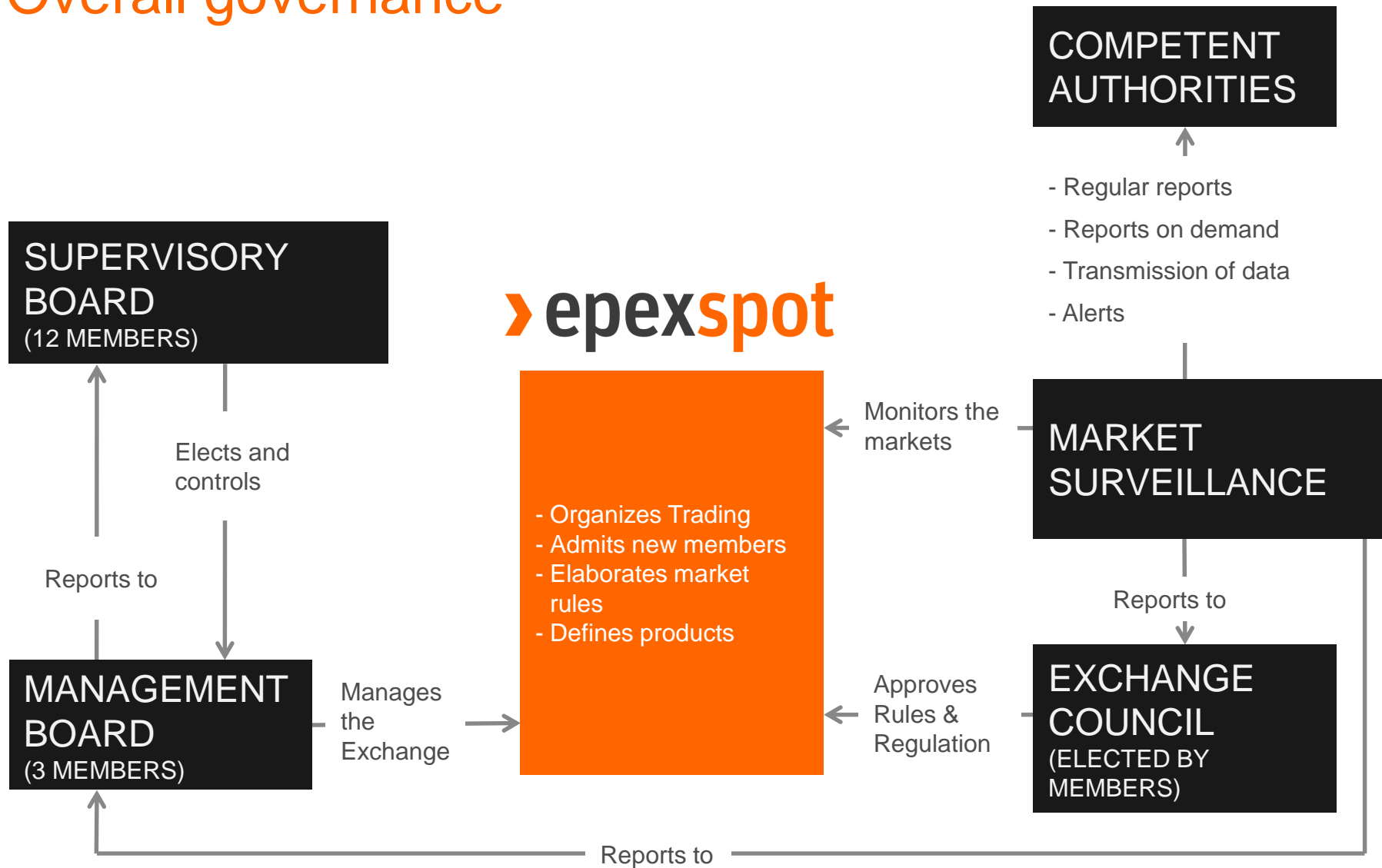
2014: **Launch of Price Coupling in North-Western Europe;**

2015: **Merger of EPEX and APX**

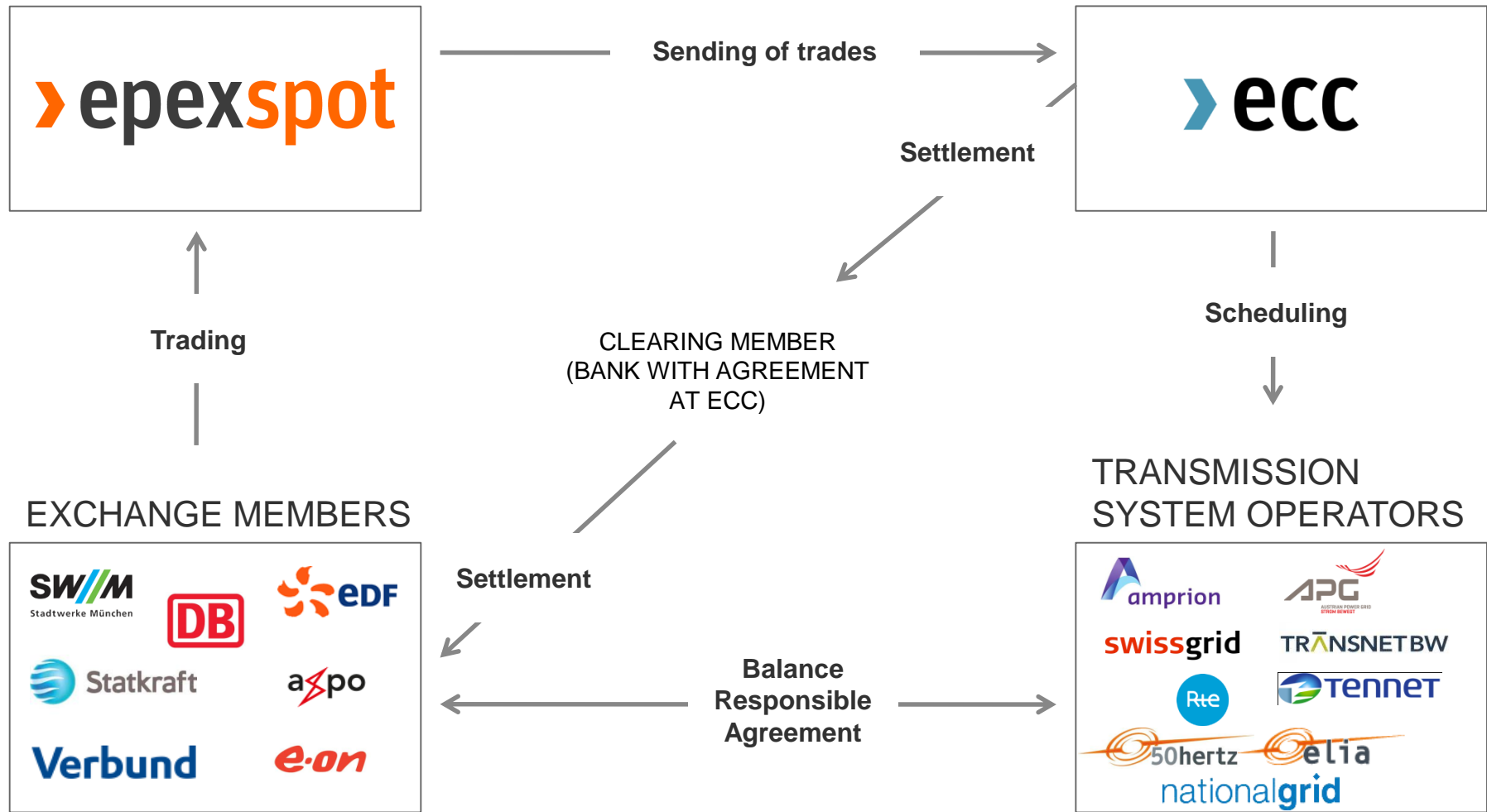
2018: Launch of XBID

**THE CREATION OF EPEX SPOT AND THE DEVELOPMENT OF POWER TRADING IS
ONE OF THE MOST VISIBLE RESULTS OF THE LIBERALIZATION OF THE EUROPEAN
POWER MARKET**

Overall governance



Trading on the Exchange

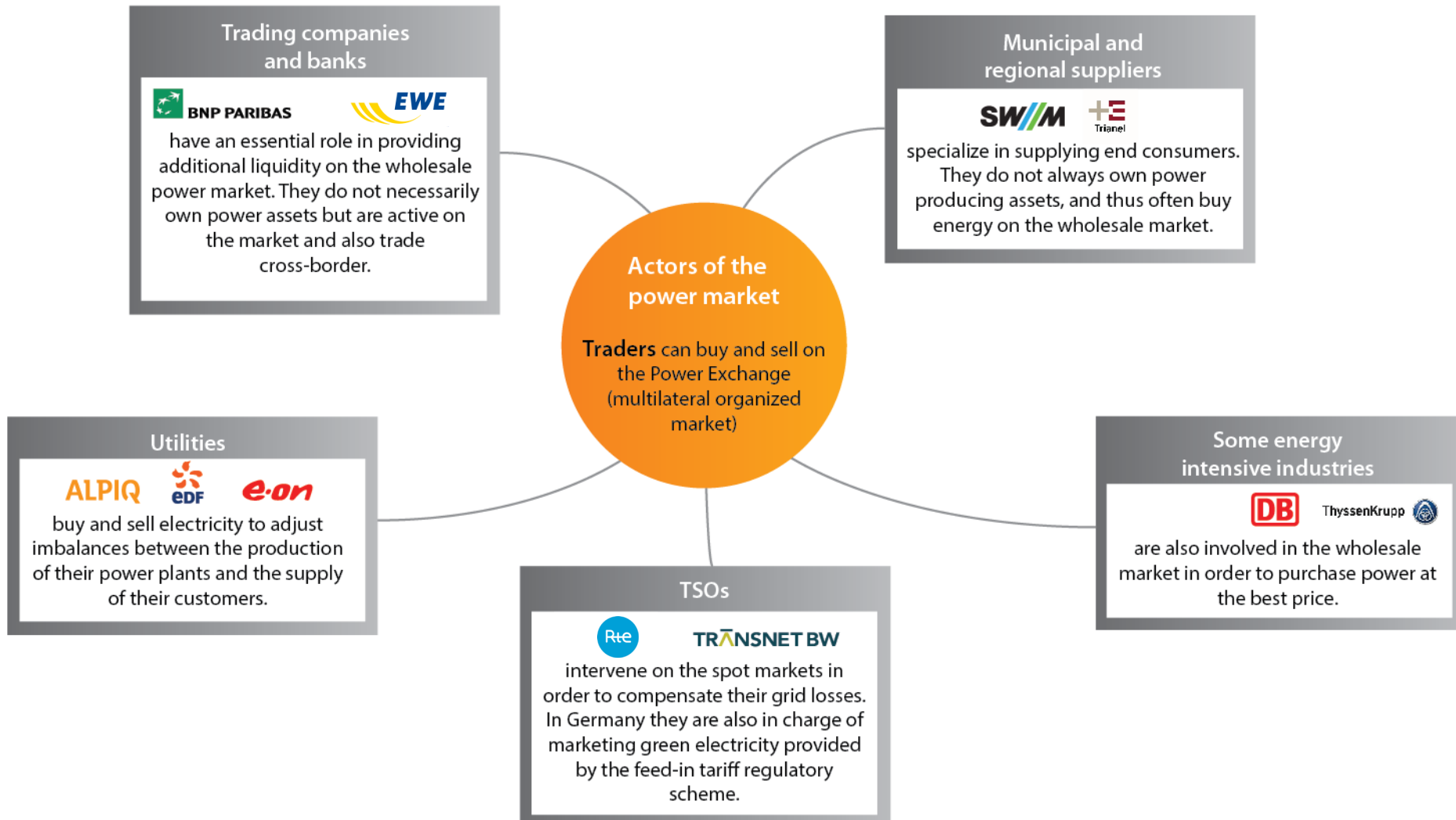


Source: EPEX SPOT



Clearing at ECC

Who are sellers and buyers on EPEX SPOT?



The markets of EPEX SPOT

Markets and services of the European Power Exchange EPEX SPOT

Current EPEX markets

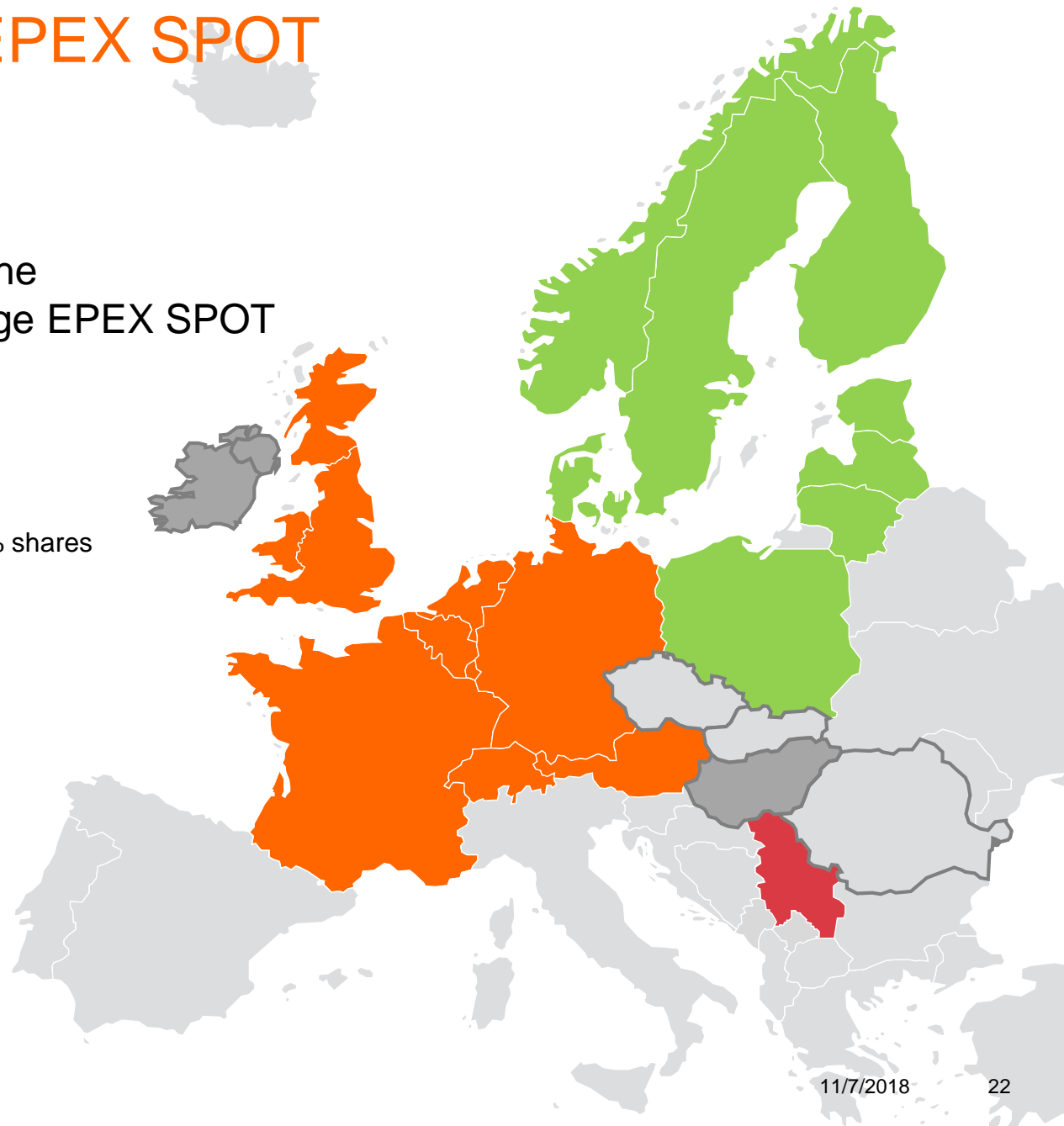
Market Expansion

Market operation services and 25% shares

Market operation services

Market coupling services

- 21 borders
- Area of 1600 TWh consumption
- Over 285 Exchange Members
- 535 TWh of traded volume in 2017



Market review 2017: Volumes and delivery zones

DE/AT/LU: 280 TWh

Thereof intraday: 47 TWh

Share in consumption: 50%

Delivery zones: 50Hertz, Amprion, APG, TenneT,
TransnetBW



FR: 110 TWh

Thereof intraday: 4 TWh

Share in consumption: 23%

Delivery zone: RTE



NL: 35 TWh

Thereof intraday: 1.5 TWh

Share in consumption: 31%

Delivery zone: TenneT



UK: 66 TWh

Thereof intraday: 15 TWh

Share in consumption: 22%

Delivery zone: National Grid



BE: 19 TWh

Thereof intraday: 1 TWh

Share in consumption: 22%

Delivery zone: Elia



CH: 25 TWh

Thereof intraday: 2 TWh

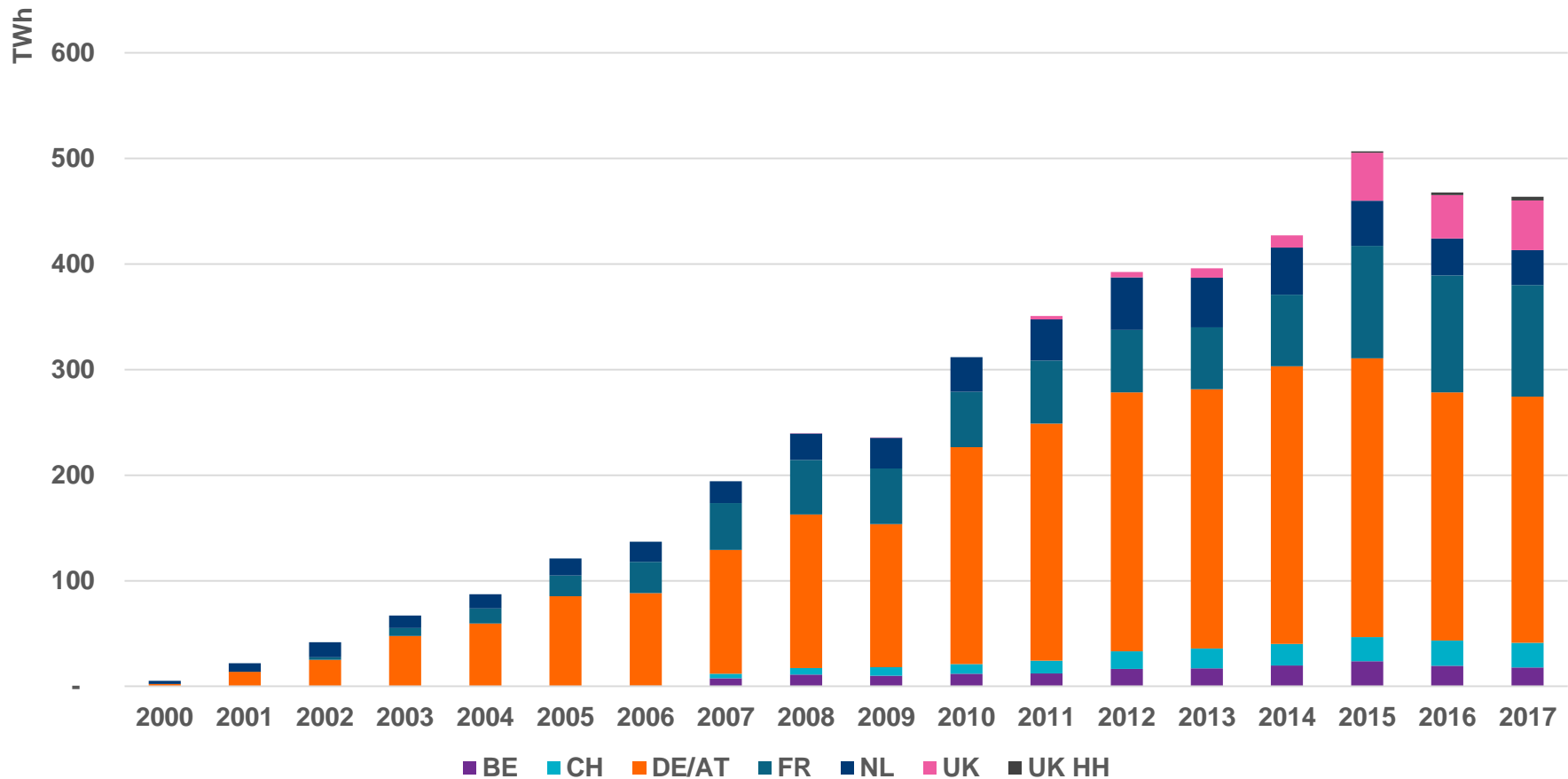
Share in consumption: 42%

Delivery zone: Swissgrid

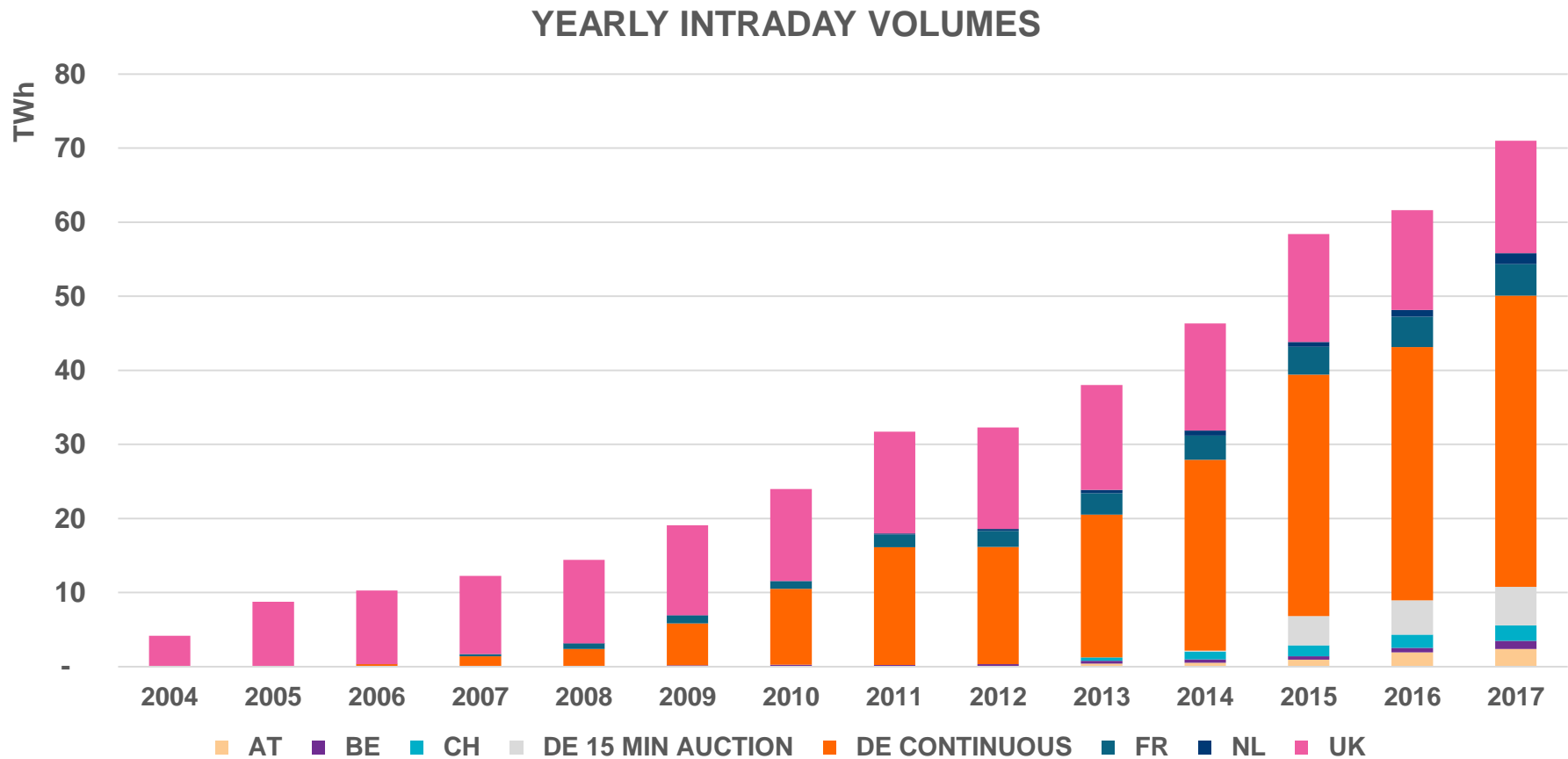


Day-Ahead markets: Traded volumes

EPEX SPOT YEARLY DAY-AHEAD VOLUMES



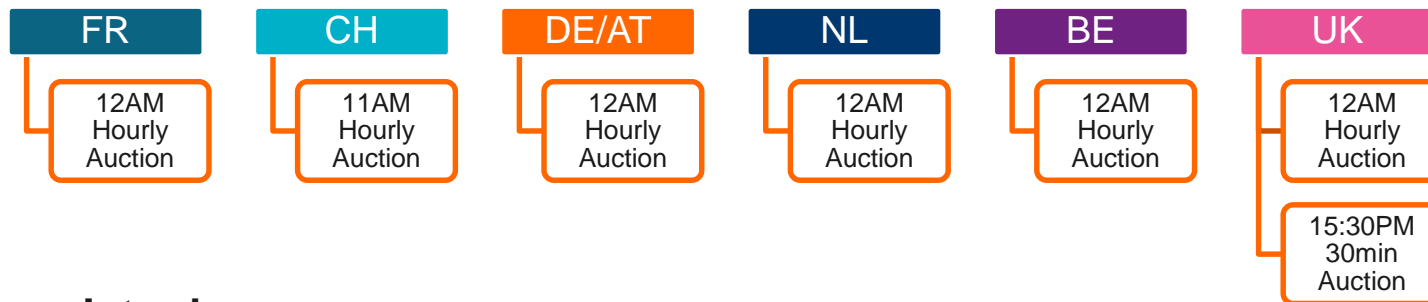
Intraday markets: Traded volumes



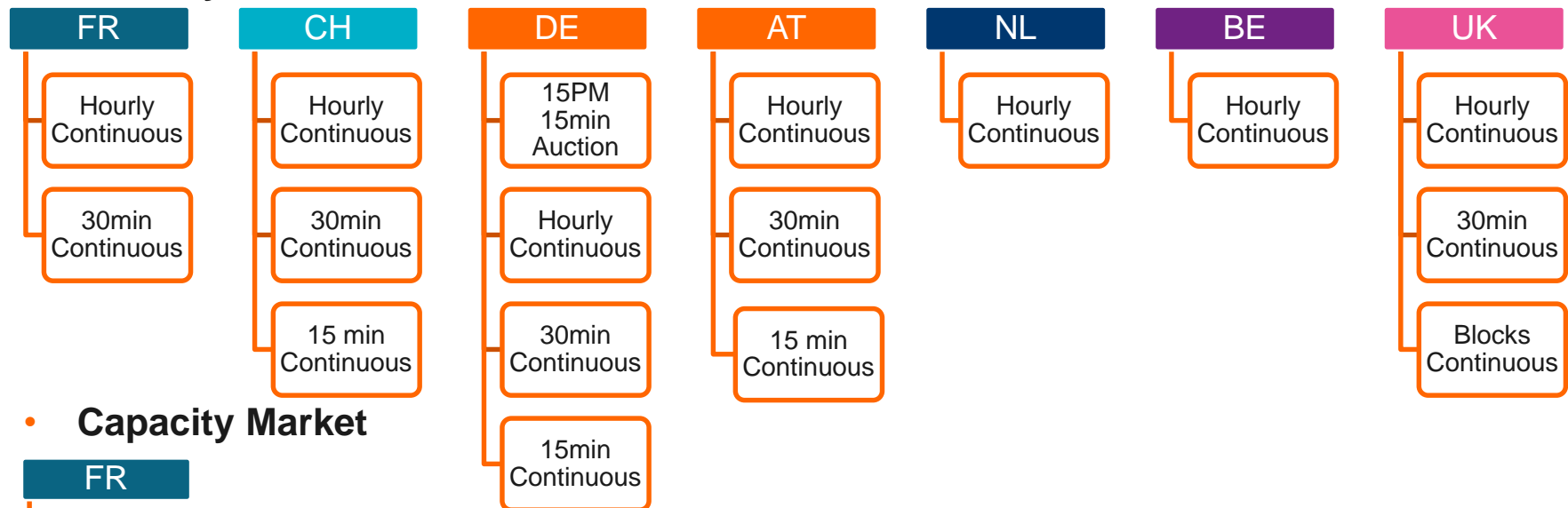
- Intraday markets are very active both locally and cross-border
- Cross-border trades represent on average 20% of total traded volume

Multiple market segments to answer all market participants' needs

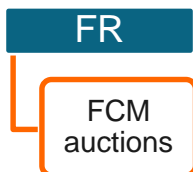
- Day-ahead



- Intraday



- Capacity Market



Products – how Day-Ahead and Intraday complement each other

DAY-AHEAD MARKET

Hourly auction (all markets)

- Auction at noon, 7 days a week, year-round
- 24 hours of the following day are traded
- Hourly and block contracts available for trading
- Integrated in Multi-Regional Coupling which encompasses Germany/Austria/Luxemburg, France, Belgium, the Netherlands, Great Britain, the Nordics and Baltics, Spain, Portugal, Italy and Slovenia
- Reliable and robust trading platform through the EPEX Trading System (ETS) using the Euphemia algorithm for European coupling

Half-Hour Day-Ahead 15:30 auction (UK)

- Auction at 3:30 pm, 7 days a week, year-round
- 48 half hours of the following day are traded

INTRADAY MARKET

Continuous trading (all markets)

- Continuous trading and price formation, 24 hours a day, 7 days a week, year-round
- Hourly and block contracts available for trading
- In the NL, BE and DE contracts can be traded until 5 minutes before the delivery; in AT, FR and UK 30 minutes and in CH 60 minutes before the beginning of delivery
- 15-minute contracts on German, Swiss and Austrian markets and 30-minute contracts on UK, DE, FR, CH market allow flexible balancing of portfolio
- Cross-border trading between DE, FR, AT & CH on the one hand and between NL, BE & NO
- Trading on the M7 trading system

15-minute opening auction (Germany)

- Auction at 3 pm, 7 days a week, year-round
- 96 quarters of the following day are traded
- Reliable and robust trading platform through the EPEX Trading System (ETS) using the Euphemia algorithm



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Day Ahead market



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A Short History of European Market Coupling Initiatives

Two « Target Models » for market integration, now set in the EU Law

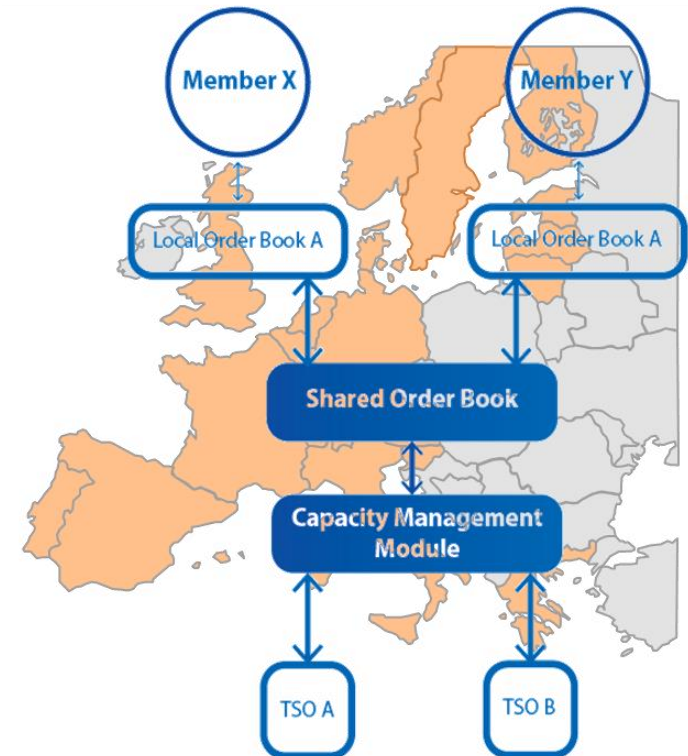
Day-Ahead Market Coupling



© 2018



Intraday Market Coupling



11/7/2018

30

Roles and Functions of the stakeholders

Transmission system Operators (TSOs)



Power Exchanges (EPEX SPOT)



Clearing House



Market Coupling initiatives since 2006

2006

TLC: Trilateral Coupling



Market Coupling initiatives since 2006

2006 TLC: Trilateral Coupling

2010 CWE Market Coupling : Central Western Europe



Market Coupling initiatives since 2006

2006

TLC: Trilateral Coupling

2010

CWE Market Coupling : Central Western Europe

2014

February: NWE Market Coupling : North-West
Europe



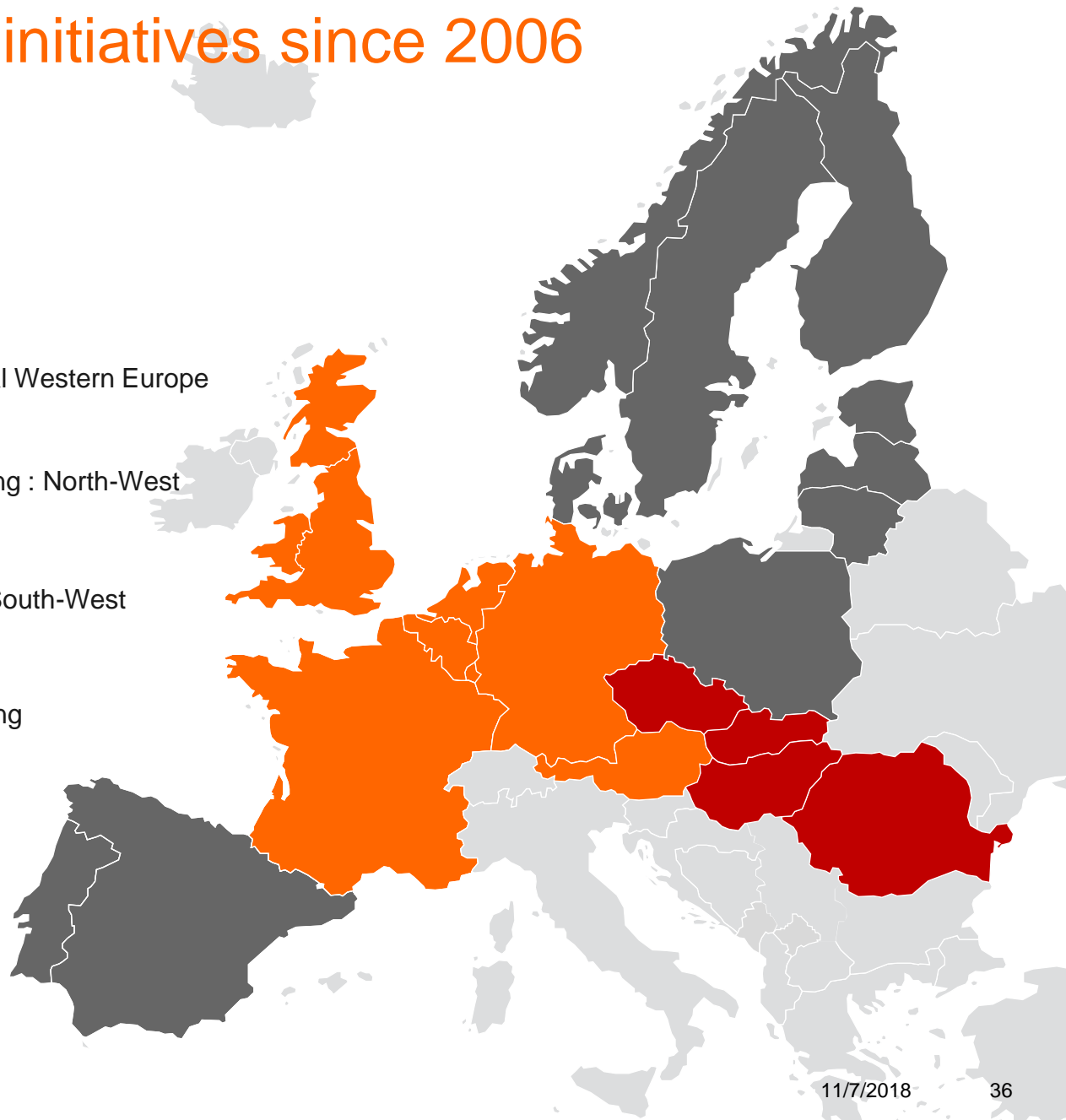
Market Coupling initiatives since 2006

- 
- 2006 TLC: Trilateral Coupling
 - 2010 CWE Market Coupling : Central Western Europe
 - 2014 February: NWE Market Coupling : North-West Europe
 - 2014 May: SWE Market Coupling : South-West Europe



Market Coupling initiatives since 2006

- 
- 2006 TLC: Trilateral Coupling
 - 2010 CWE Market Coupling : Central Western Europe
 - 2014 February: NWE Market Coupling : North-West Europe
 - 2014 May: SWE Market Coupling : South-West Europe
 - 2014 End of the year: 4MMC Coupling




Market Coupling initiatives since 2006

- 
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Market Coupling initiatives since 2006

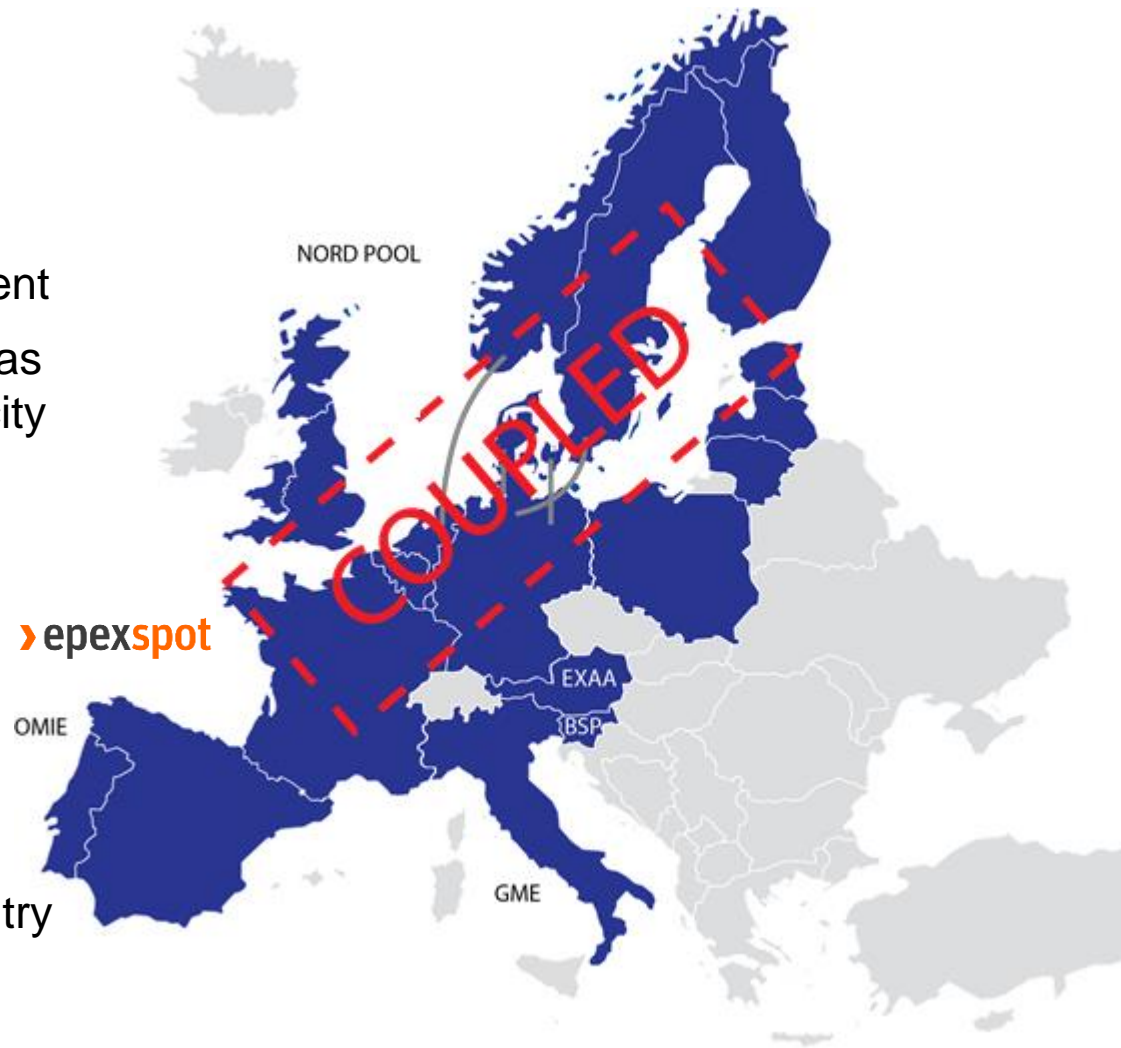
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 - 2010 CWE Market Coupling : Central Western Europe
 - 2014 February: NWE Market Coupling : North-West Europe
 - 2014 May: SWE Market Coupling : South-West Europe
 - 2014 End of the year: 4MMC Coupling
 - 2015 February: Italy and Slovenia
 - 2016 July: Austria-Slovenia



European Market Coupling Benefits



- 1 Optimal use of interconnectors facilitating congestion management
- 2 Price convergence of market areas in case of sufficient border capacity
- 3 Smoothing effect on negative or positive price spikes
- 4 Attenuation of extreme weather conditions (i.e. cold wave, storm front) on other market areas
- 5 Higher security of supply through market integration and no longer depending on the individual country



Day-Ahead Market

DAY-AHEAD AUCTIONS

Market Areas:

Belgium, France, Germany/Austria/Luxembourg,
UK, The Netherlands, Switzerland

- Auction, 7 days a week, year-round
- 24 hours of the following day are traded
- Hourly and block contracts available for trading
- Integrated in Multi-Regional Coupling which encompasses EPEX markets, the Nordics and Baltics, Spain, Portugal, Italy and Slovenia
- Reliable and robust trading platform through the EPEX Trading System (ETS) and using the Euphemia algorithm

Closing of order books (CET):

All coupled markets: 12:00

CH: 11:00

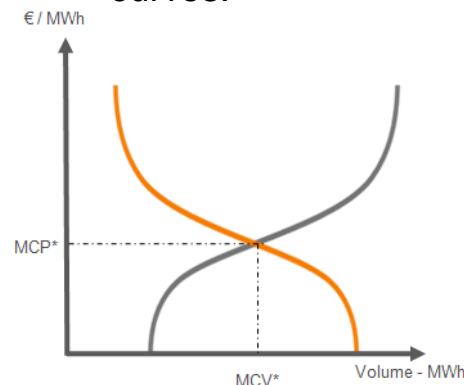
Publication of market results:

All coupled markets: 12:55

CH: 11:10



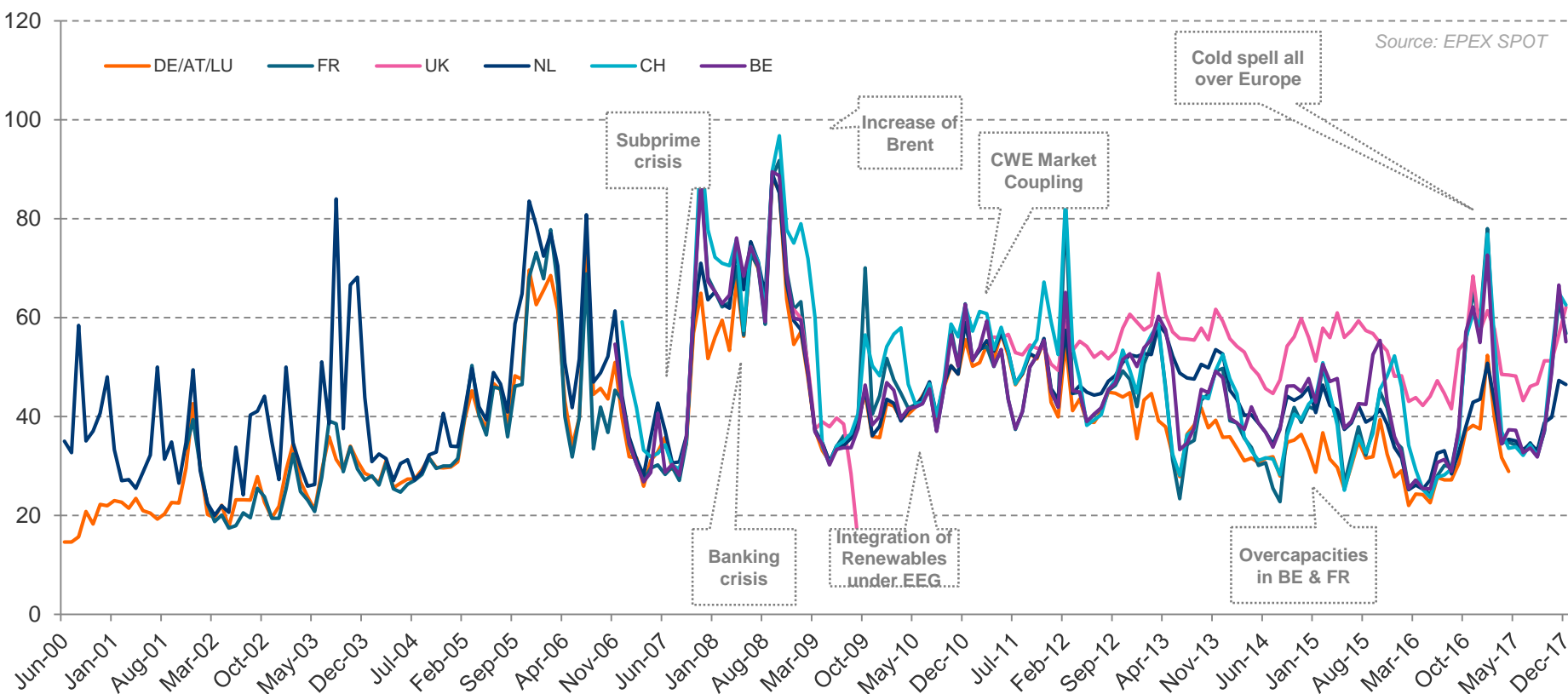
- During the auction, all orders in the order book will be matched to trades at a specific moment.
- The buy entries are aggregated to form a demand curve, and the sell entries are aggregated to form an offer curve.
- The Market Clearing Price (MCP) and the Market Clearing Volume (MCV) are determined at the intersection point of the two curves.



MCP: Market Clearing Price

MCV: Market Clearing Volume

Day-Ahead markets: Price evolution



Market	2009	2010	2011	2012	2013	2014	2015	2016	2017
DE/AT/LU (Phelix)	38.85	44.49	51.12	42.60	37.78	32.76	31.63	28.98	34.19
FR	43.01	47.50	48.89	46.94	43.24	34.63	38.48	36.75	44.97
CH (Swissix)	47.92	51.02	56.18	49.52	44.73	36.79	40.30	37.88	46.00
NL	39.16	45.38	52.03	48.00	51.95	41.18	40.05	32.24	39.31
BE	39.36	46.30	49.37	46.98	47.45	40.79	44.68	36.61	44.58
UK (in £)	-	-	47.18	44.51	49.68	42.02	40.43	40.43	45.32



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Intraday market: integrating renewables

Reasons for trading on the Intraday market

1

✓ Adjust purchase and sale based on the results of the day-ahead auction

2

✓ Run and plan power generation closer to delivery

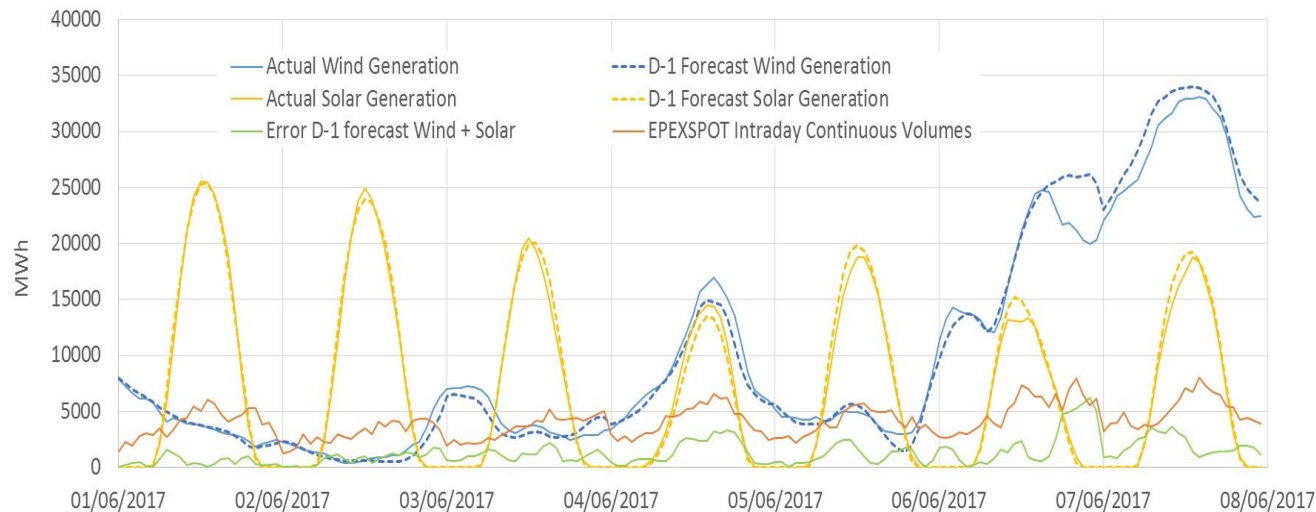
3

✓ Manage unforeseen events such as power plant outage

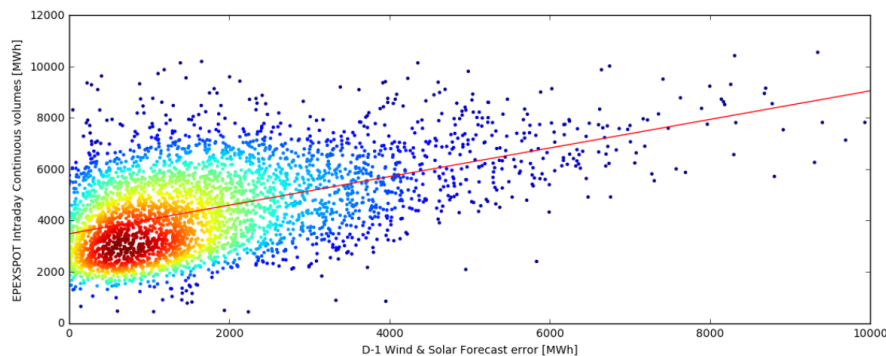
4

✓ Enable arbitrage between neighboring countries, provides opportunities for cross-border trading

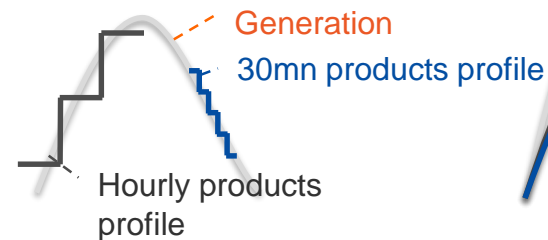
Flexibility to adjust to RES production



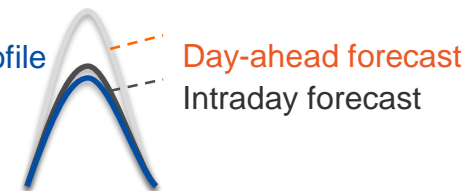
- Forecast deviations:
Wind & Solar forecasts can vary significantly from day-ahead forecast to last intraday-forecast.
- Intraday continuous volumes are correlated to the forecast errors on wind and solar generation.



Generation Ramps



Forecast Deviations



Continuous Intraday Market Principles

- The system matches compatible orders in real time according to the priority rules: price and time priority in serial processing
- The offers are entered in real time and can be viewed anonymously by all participants
- The offers are classified in the order book according to: - their position (purchase or sale) - the price limit - the time of submission
- The best offers from the order book are matched. An offer is executed against a corresponding offer at the same price (or at a better price).
- Orders are executed in real time, either entirely or partially, at the best price available in the system according to the priority rules. Different types of orders can be submitted (FOK, IOC, Iceberg, AoN,...)
- Orders entered in one of the order books of the continuous intraday market (DE, FR, AT, CH, BE, NL) may be matched to orders from other order books, provided that:
 - Cross-border schedules are possible,
 - Availability of XB capacity.
- Where cross-border allocations are not possible, only local trading is open.

The screenshot displays the EPEX Spot Market Overview interface. It includes a top menu bar with 'General', 'Profile', 'Layout', 'Connection', and 'Help'. Below this is a 'Market Overview' section with tabs for 'Hourly', 'Quarterly', and 'Daily'. The main area shows a table of orders with columns: R, Exch, Area, Ctrct, Phas, BAcc, BQty, BP-VWA, Bid, Ask, AP-VWA, and AQty. The table is divided into two sections: 'Order Book Details' and 'Market Overview'. The 'Order Book Details' section shows a list of orders with their respective prices and quantities. The 'Market Overview' section shows a summary of the market, including the best bid and ask prices, and a list of recent trades. The interface also includes a 'My orders' section on the right and a 'Message' section at the bottom right.

R	Exch	Area	Ctrct	Phas	BAcc	BQty	BP-VWA	Bid	Ask	AP-VWA	AQty
12-20	EPEX	CON	12-20	CON	100.0	100.0	39.33	40.50	45.00	43.61	100.0
13-15	EPEX	CON	13-15	CON	100.0	100.0	39.33	40.50	45.00	43.61	100.0
16-20	EPEX	CON	16-20	CON	100.0	100.0	39.33	40.50	45.00	43.61	100.0
17-20	EPEX	CON	17-20	CON	100.0	100.0	39.33	40.50	45.00	43.61	100.0
18-20	EPEX	CON	18-20	CON	100.0	100.0	39.33	40.50	45.00	43.61	100.0

Automated trading applications spread across the market

- Automated trading apps are developed either in-house or by ISVs and automate power trading on the basis of algorithms. The apps are connected through EPEX SPOT open API.
- More than 60 applications (read/write) and 12 certified ISVs connected to the exchange
- This enables market participants to **react quickly to fluctuations in power production / demand**. Renewable energy has direct impacts on the intraday market. Its volatility is several times higher than that of financial markets.
- Open customer positions can be covered according to MP specifications/risk profiles.
- Pre-defined and customized strategies.
- Trade outside of regular business hours
- Helps traders achieve better prices.
- Limit management for transactions at extreme price settings or large quantity variations.
- Stop losses in case of unexpected market developments.



MISC

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New challenges to the power market

The current power system is expected to be **facing significant challenges in the future**, regarding the integration of much more decentralized intermittent energy resources.

- How to make the power system more efficient and able to deal with foreseen challenges?

Current wholesale market

- Considering very large price zones
- Intra-zonal grid topology not considered at the moment (study on zone splitting carried out at Entsoe level)

Future challenges

- Adapt the power system to the integration of much more decentralized intermittent energy (wind and solar power)
 - Find a way to handle congestions

New technologies

- The development of new technologies (Internet of Energy, smart grids, demand response, blockchain, smart metering, etc.) has the potential to meet our future challenges.

New paradigm for the future power system

- Design a new way of functioning for the power system that will overcome the foreseen challenges
- The use of new technologies will need to be integrated and organized such that the whole system remains efficient

High-level objectives

The concept in a few words:

Implementation of a market-based congestion management platform efficiently centralizing local flexibility offers to allow System Operators to reliably and economically relieve physical congestions and bottlenecks from the grid.

A clear and transparent market mechanism

- **Clear and transparent market rules** for actors participating in the market-based congestion management
 - Asset Certification by the SOs, Verification of the physical impact, Strict Compliance
- Definition as an addition to all existing wholesale markets to solve specific local issues.

Development of distributed flexibility

- **Unveil the potential of distributed flexibility**
 - Provide transparent locational flexibility prices and foster the development of distributed flexibility (demand-side management, renewables, aggregators, batteries...).
- The platform can become **the short-term activation mechanism of long-term local flexibility contracts** if there are any, but also **be open to any other flexibility provider**.

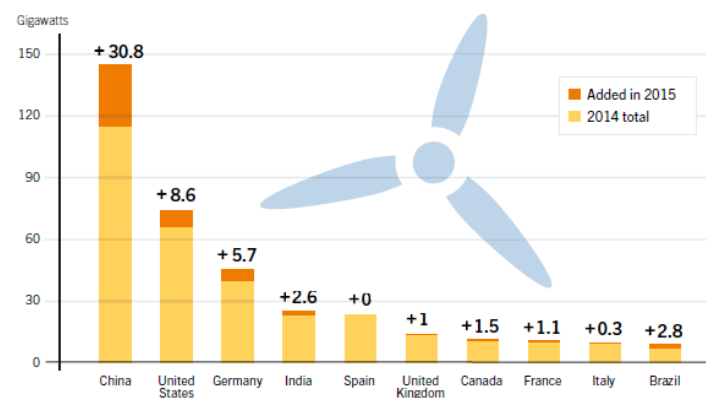
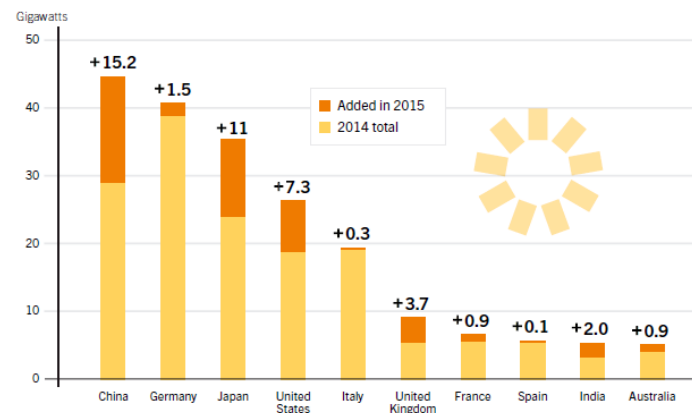
Coordination between System Operators

- **Clear guidelines and communication protocols to increase and develop the cooperation between TSOs and DSOs**. It is a key element to reach optimality in the congestion management solution and avoid inefficiencies.
- **EPEX SPOT is a neutral and objective third party** that will be able to efficiently run the platform, adapt to current System Operator processes and Grid management rules, and ensure compatibility with the current European zonal markets

Local flexibility markets: what is the rationale?

- In recent years, Germany have seen significant increases of wind and solar capacity. Installed capacity of wind and solar in Germany has reached almost 100GW in 2017
- **Is reliable power supply possible using 100% renewables?**
- Network congestions are likely to increase in the future. The copper plate could be challenged in the coming years.
- The usage of flexibility in supply & demand in transmission and distribution grids is necessary to guarantee a sustainable and reliable energy system
- Local markets are seen as a market-based "software" solution to many problems currently occurring because of the growing share of renewable energies and distributed generation. A complement to grid expansion (i.e. "Hardware" solutions).
- Integration of new resources: DSM, Storage at locational level could be achieved more efficiently with Locational Price signals

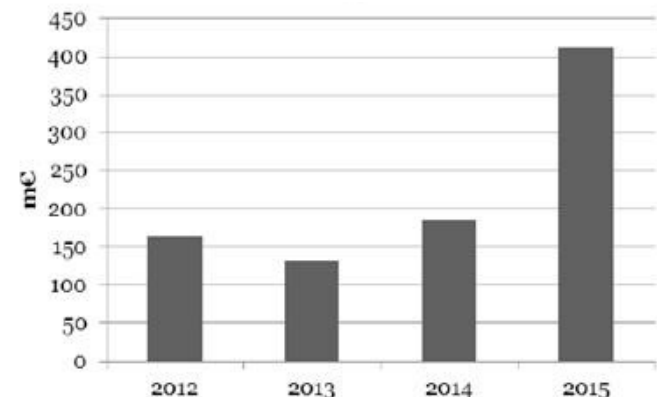
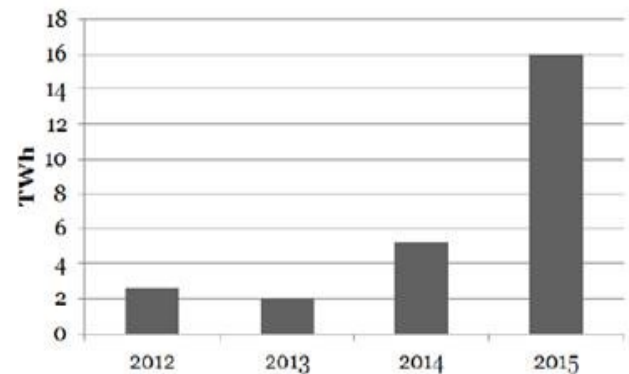
Solar and Wind Installed Capacity



The cost of balancing the grid likely to increase in the future

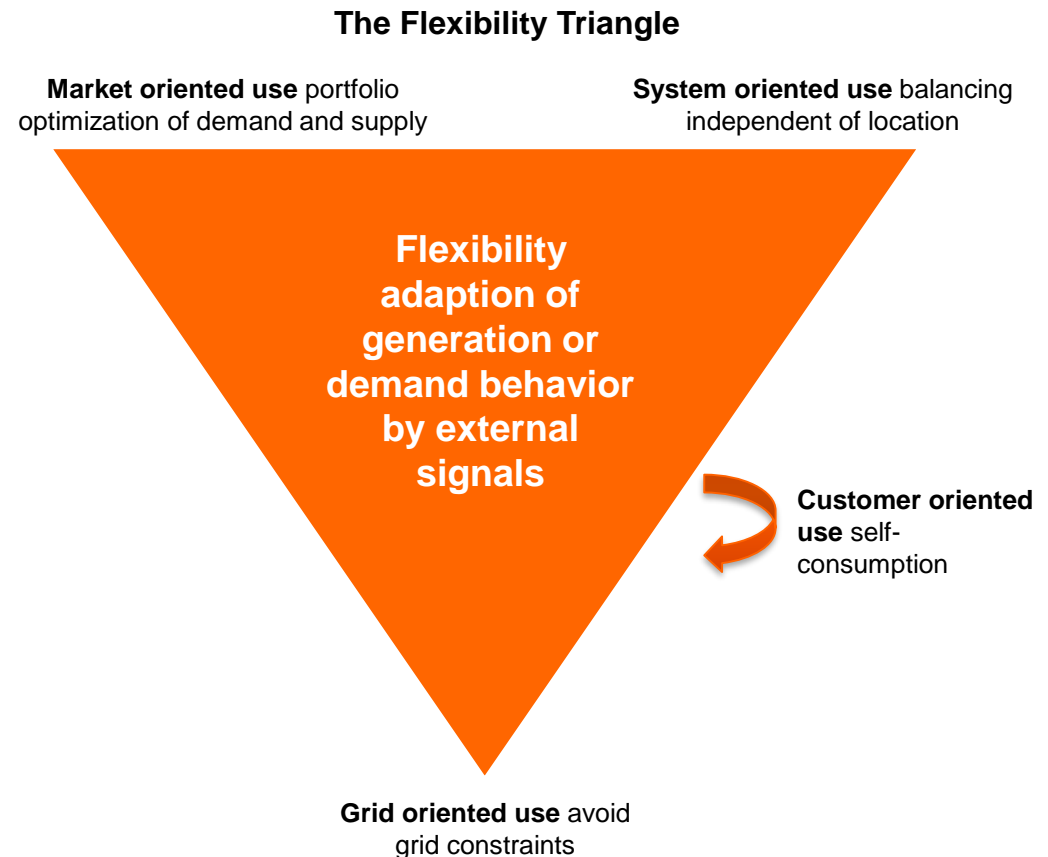
- Congestions are becoming more frequent and the energy called for re-dispatching is increasing significantly. As of today, most power management interventions are resulting in cutting RES (i.e. Eisman rule)
- The re-dispatch remuneration has so far been regulated based on the marginal/fuel costs costs. According to a recent court decision in Germany, opportunity costs will have to be remunerated by the TSOs.
- A market-based solution that will allow locational price signals to emerge and flexibility options to be developed further.
- In all designs the issue of market power needs to be carefully taken into account. Some locations are likely to have very limited competition. Although a voluntary design does not force the network operators to either open a local OBK or purchase flexibility from the local OBK once it is operational, flawed incentives (i.e INC/DEC) can hamper the efficiency of the mechanism.
- Beyond the usual regulation/monitoring by authorities there is a multitude of solutions that can help mitigate local market power.

Redispatching (a) energy and (b) total cost in Germany in 2012-2015



The concept of flexibility market / platform

- All active flexibility participants : consumers, producers and storage operators are possible flexibility providers.
- Flexibility is provided, when the participant adapts his production / consumption pattern by an external signal.
- The grid oriented allocation of flexibility can be used for a capacity management in the grid. Thereby flexibility becomes an economical option to defer or even substitute grid expansion.
- Flexibility traffic light concepts enable system operators to allocate available flexibility in order to comply with grid restrictions.



Source: Based on S. Ohrem, D. Telöken (2016)

Portfolio of projects and initiatives

EPEX SPOT is involved in several initiatives aiming at the creation of a design and pilot-projects for market-based congestion management.

- **SINTEG (DE)** gives us access to a wide range of stakeholders incl. TSOs, DSOs, traders, software providers, manufacturers,... and financing from the BMWi + exemptions from regulatory framework.
 - ENERA (w/ EWE, Tennet DE): EPEX is an associate partner to develop a pilot in EWE area (Bremen/Hamburg)
 - WindNODE (w/ 50Hz): EPEX is an observer.
- **USEF (NL):**
 - EPEX SPOT could start implementation of a pilot in Nijmegen, NL
 - ENERA could also become the pilot for the USEF framework (NL). Discussions between ENERA and USEF have started.
 - EPEX SPOT will be a USEF board member
- **SMILE (FR):**
 - Initiative to make use of recent smart technologies in order to develop distributed flexibility (Brittany region)
 - EPEX SPOT will join the SMILE association and collaborate with RTE and Enedis to build local flexibility markets
- **Romande Energie / Swiss Grid:**
 - Apply the concepts we have developed in Switzerland, to solve current congestion and redispatch issues efficiently.
- Lazarettgarten (Luxemburg) with LO3 and Enovos.



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Thank you for your attention!

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