Increasing power system flexibility: the utility perspective

ESAP Workshop – New policies for ensuring electricity security
15th June 2018 Tokyo, Japan

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Executive Vice President Market Analytics / Market Solutions

Uniper at a glance

Our operations

Power Generation
Commodity Trading
Energy Storage
Energy Sales
Energy Services

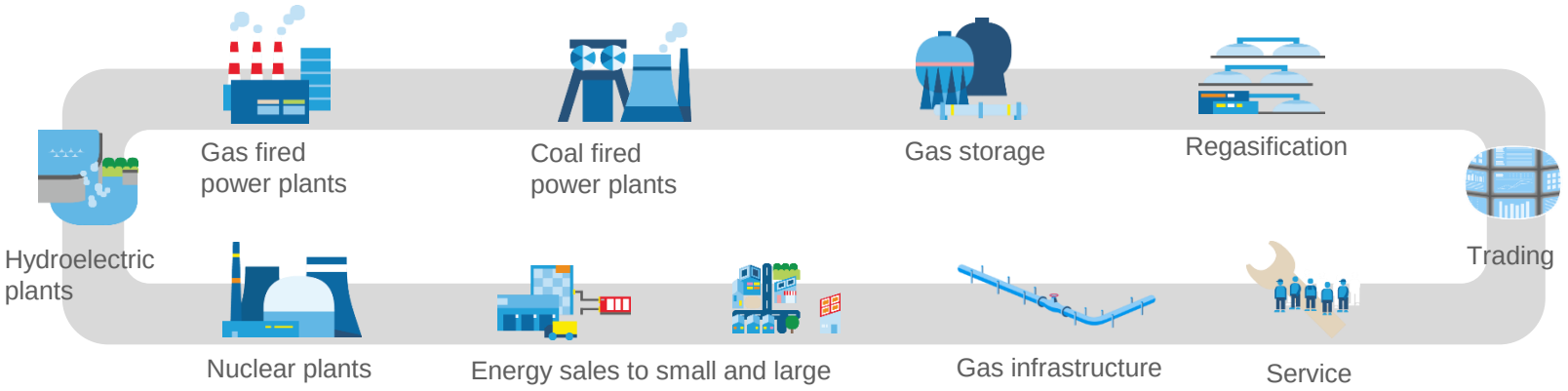
We operate in 40+ countries around the world

€1.7bn
EBITDA in 2017

100 years
Experience

~36 GW
Generation capacity

Main activities



Our strengths

Our strengths are based on our experience, expertise and curiosity

- We combine technical and commercial expertise and offer solutions for challenging questions.
- We build, optimize and operate large power plants.
- We produce and trade large quantities of energy. In these processes, we act as efficient as possible and minimize risks.
- We maintain long-standing partnerships with commercial customers, public utility companies, grid operators and our suppliers. All of these stakeholders gain mutual benefits from one another.

Our strengths lie in three areas

In Europe, we contribute to supply security by moving towards a low-carbon energy future

Our trading activities create links across international raw materials markets

We support the development of electricity markets outside Europe with our own production activities and services for third parties

Increasing power system flexibility

ESAP Workshop – New policies for ensuring electricity security

1	**Overview of liberalization in Europe**
2	**Influence of regulatory frameworks on power markets**
3	**European cooperation and integration of ancillary services**
4	**Utility strategies for new market environments**

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Liberalization process (generic description)

Similar patterns followed in US, UK and other European countries

1. **Legal unbundling** of competitive segments (production, distribution, supply), first accounting, then ownership, creating separate companies
2. Measures **preventing** a large market share of **any one single player**
3. Full control of **one authority** over issues like non-discriminatory **3rd party access to infrastructures** (grid, pipelines, entry points, storage, distribution), **network tariffs** and network **investments**
4. Freedom of **choice** for large customers to select their supplier
5. Creation of **competition in generation/procurement**
6. Competition and freedom of choice in the **retail market**

Companies need to adapt to new ways to capture value
Increased M&A activity

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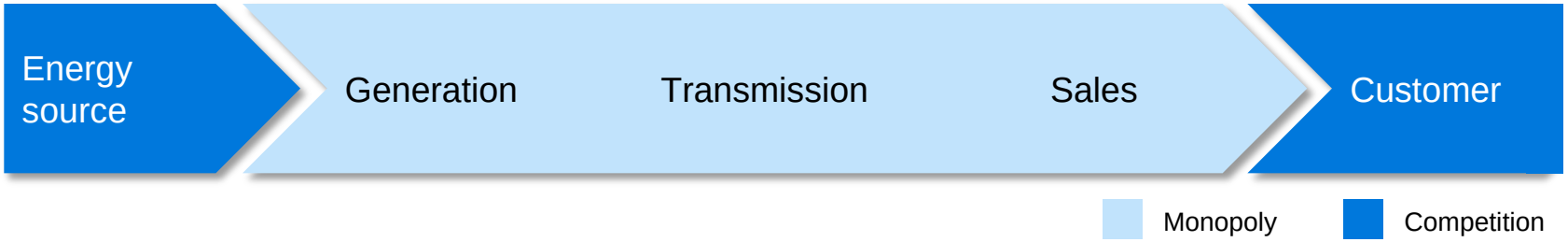
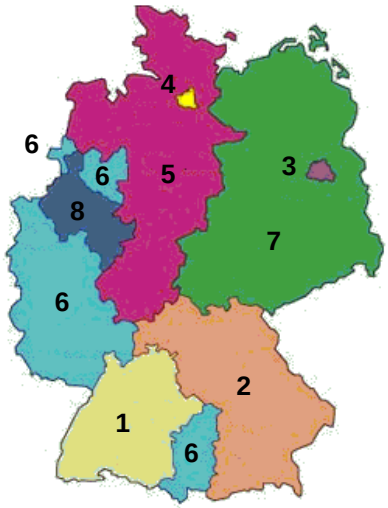
Example Germany: pre-liberalized system

Large companies as integrated regional monopolists

Vertically integrated regional monopolies



Regional power companies pre-1998



1 EnBW
2 Bayernwerk
3 BEW AG
4 HEW
5 PreussenElektra
6 RWE
7 VEAG
8 VEW

- Regional utilities existed until 1998
- Vertically integrated utilities had a legally recognized monopoly in their service area
- Bundeskartellamt (Regulator) responsible for price controls and enforcement of anti-trust laws

Liberalization changed playing field and actors

Potential new winners and losers appeared

Unbundled generation, trading and sales

Regulated | Competition

TSOs

tennet
TRANSNETBW
amprion
50hertz

Exchanges

EEX EUROPEAN ENERGY EXCHANGE
EPEXSPOT EUROPEAN POWER EXCHANGE
nordpool spot

Traders

SW//M
e·on
Morgan Stanley
METRO GROUP MADE TO TRADE.
Bank of America Merrill Lynch
Vitol
MERCURIA

Generators

RheinEnergie
SW//M
e·on
VATTENFALL
RWE
EnBW

Suppliers

wemio.de
Stadtwerke Düsseldorf
immergrün!
Yello Strom
lekker ENERGIE
WIE EINFACH

- Unbundling of generation, transmission and sales – and development of trading
- Development of liquid trading points across Europe (i.e. EEX)
- Market participants responsible for managing multiple types of risk
- Exchanges/OTC market enable hedging against market price movements

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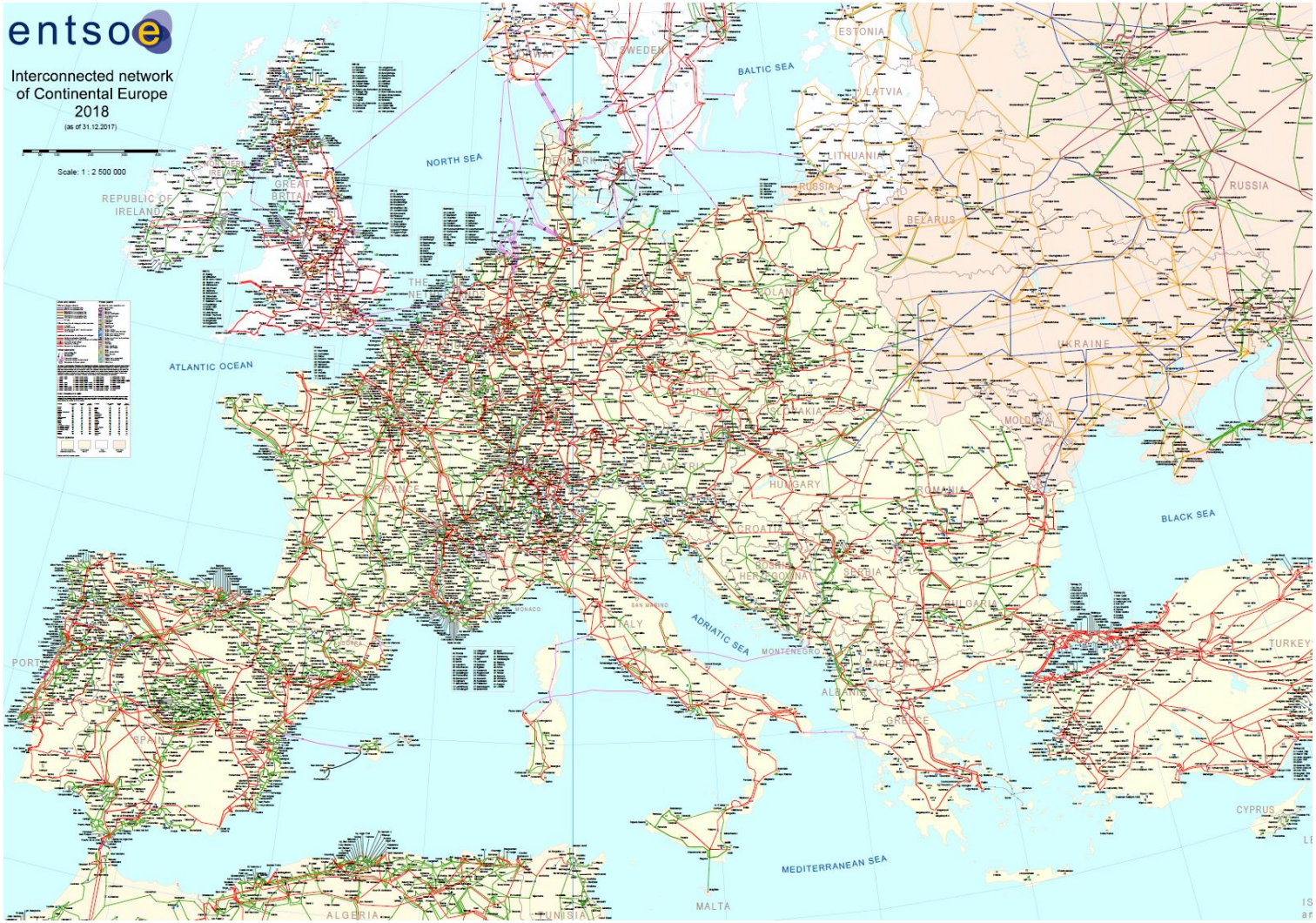
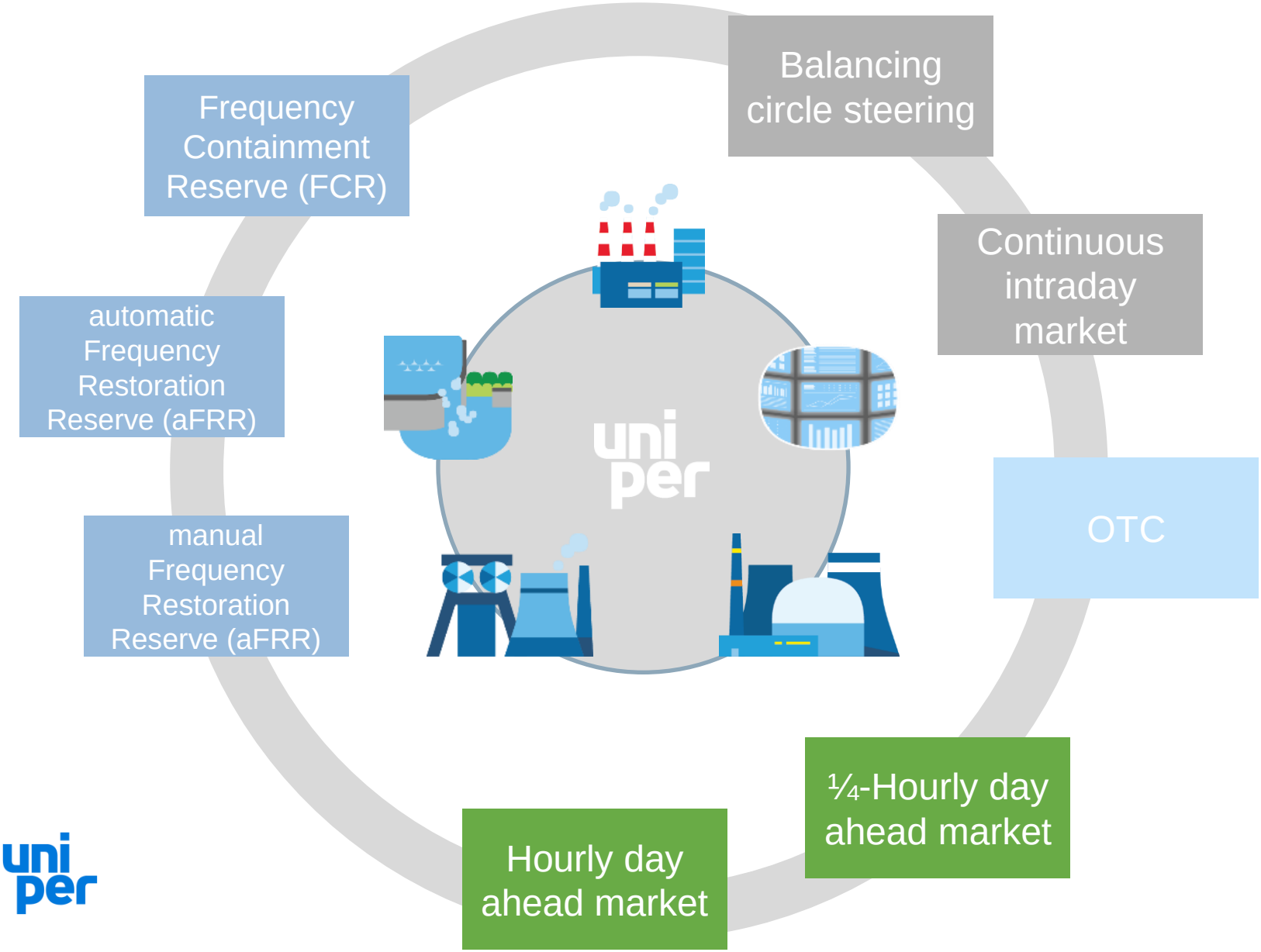
Heavily interconnected system



Source: ENTSOE

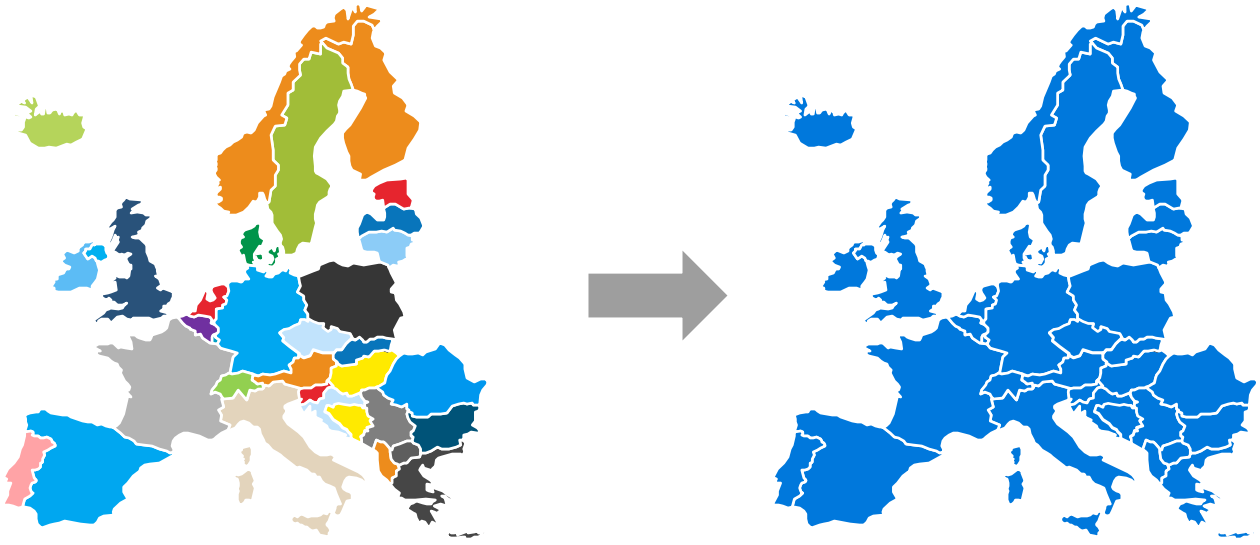
Market channels



National markets become European ones

- Individual markets developed on a national scale
- National system requirements and legal restraints led to national sets of market rules

→ **The large variation of markets is harmonized step by step to create an integrated European Power market.**



Increasing power system flexibility

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1 **Overview of liberalization in Europe**

2 **Influence of regulatory frameworks on power markets**

3 **European cooperation and integration of ancillary services**

4 **Utility strategies for new market environments**

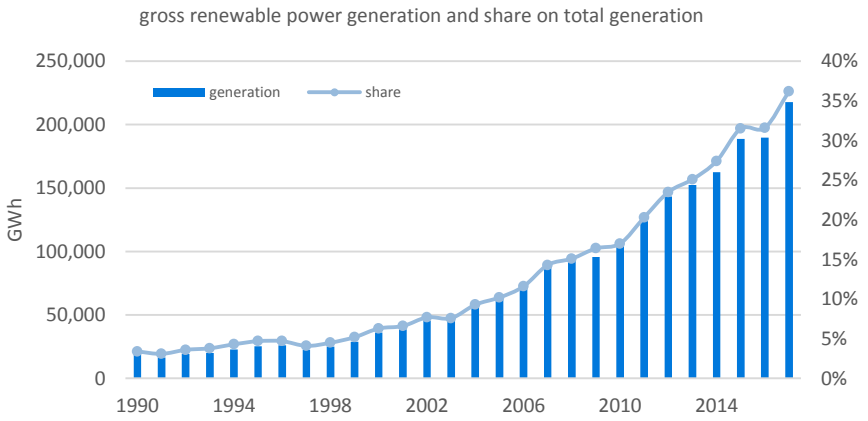
German Renewable Energy Sources Act

- The German Renewable Energy Sources Act (EEG) is a series of laws which first came it force on the 1st April 2000.
- The EEG was preceded by the Electricity Feed-in Act (1991) which entered into force on 1st January 1991 and initiated the first green electricity feed-in tariff scheme in the world.
- It regulates the prioritized feed-in of electricity from renewable sources and originally guaranteed its producers fixed feed-in tariffs.
- The EEG 2014 specified the transition to an auction system which was introduced with the current version EEG 2017

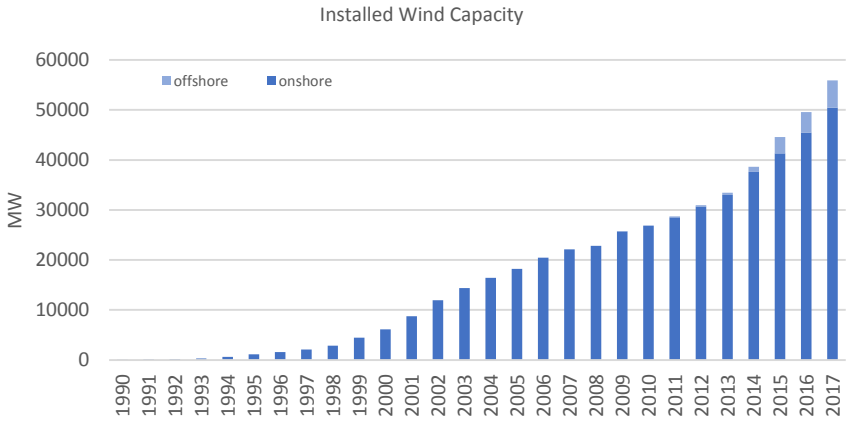
→ **The EEG is the foundation of the transformation of the German power market.**

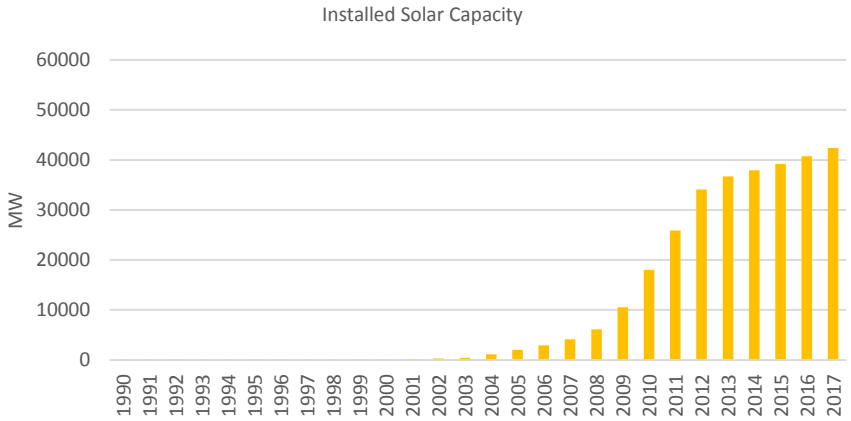
Significant increase of renewable capacity

The system changed significantly within a short period.



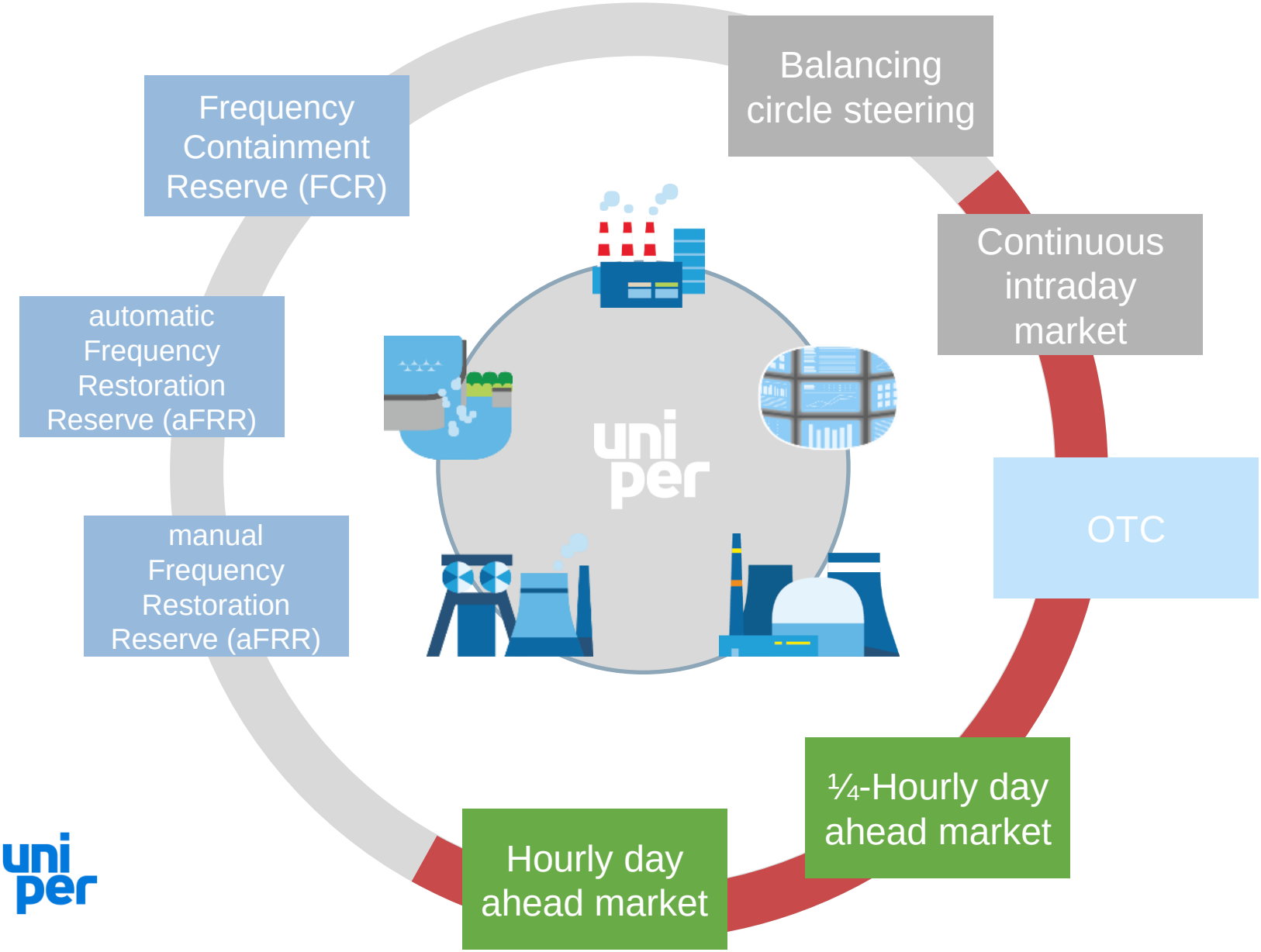
- 1/3rd (220 TWh) of the generation is covered by renewables
- 112 GW of installed renewable capacity
- Wind (56 GW) and Solar (42 GW) are the dominant technologies





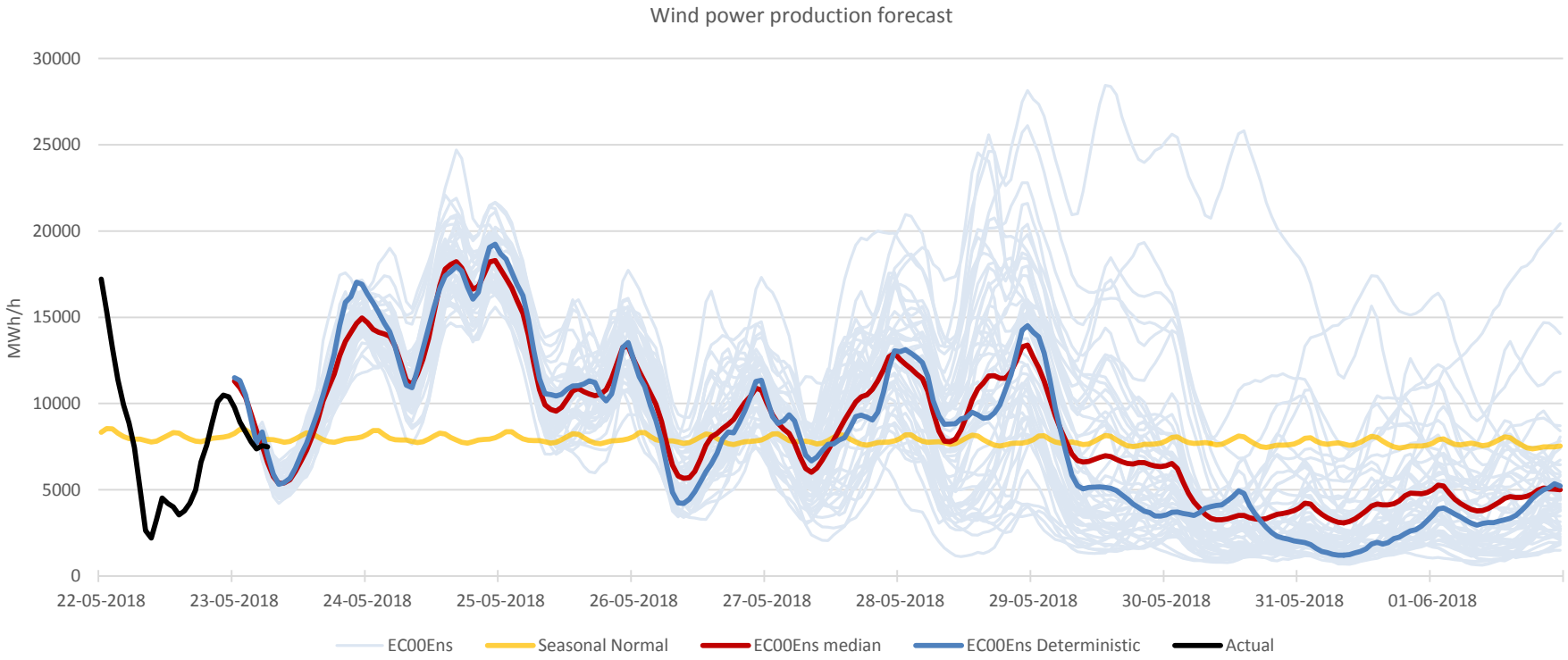
Source: BmWi, Zeitreihen zur Entwicklung der Erneuerbaren Energien in Deutschland, Feb 2018

Effects on wholesale markets



Exposure to weather increases need for flexibility

Uncertainties in the dispatch optimization are rising.



→ **A system with large installed capacity of renewables is exposed to the volatility and uncertainty of weather forecasts.**

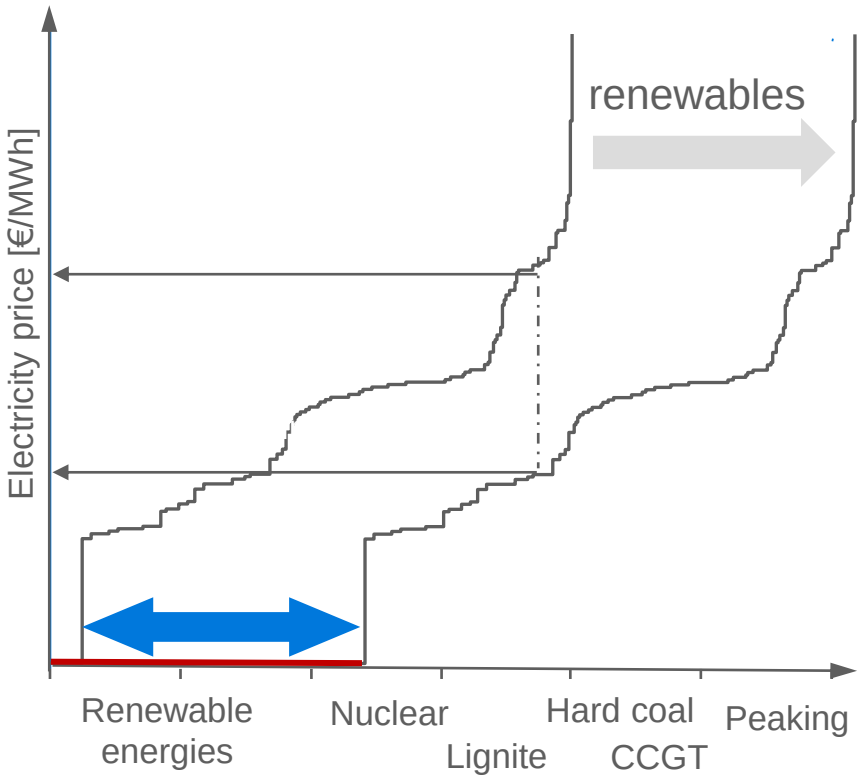
→ **Market channels are needed to cope with the uncertainty.**

Source: data by Wattsight, 23.05.2018

The merit order effect

Renewables regime fundamentally changes power market economics and plant operations

Merit order

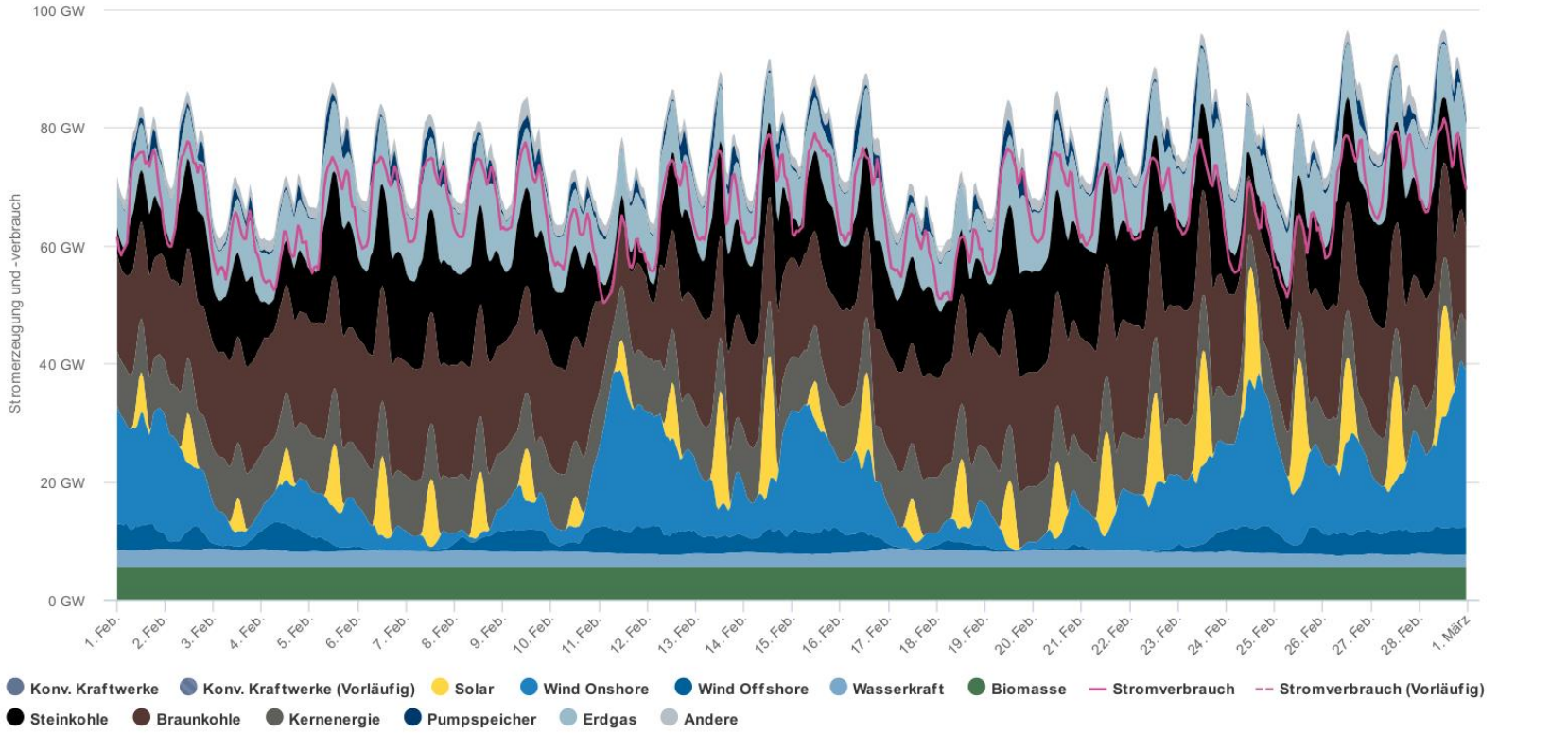


Consequences of renewables

- Less carbon emissions
- RES expansion not market-driven
- Increasing share of intermittent generation
- Decrease in wholesale power prices
- Increasing share of conventional power plants uneconomic and will be closed
- No investment appetite for conventional power plants

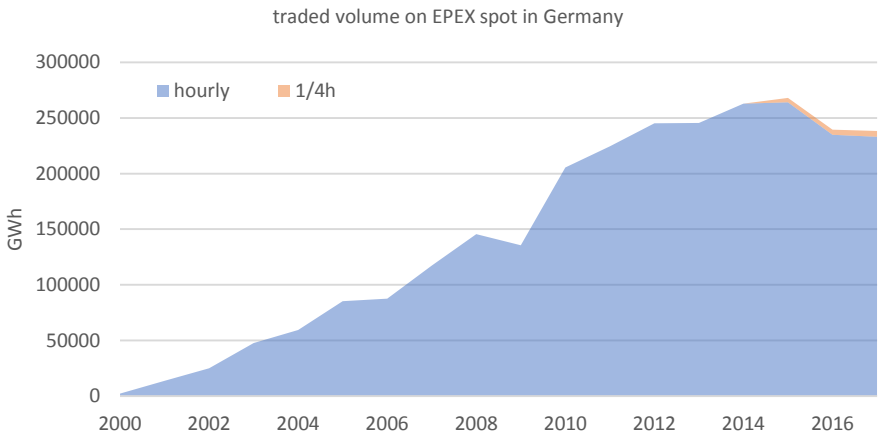
Example for power plant utilization in Germany

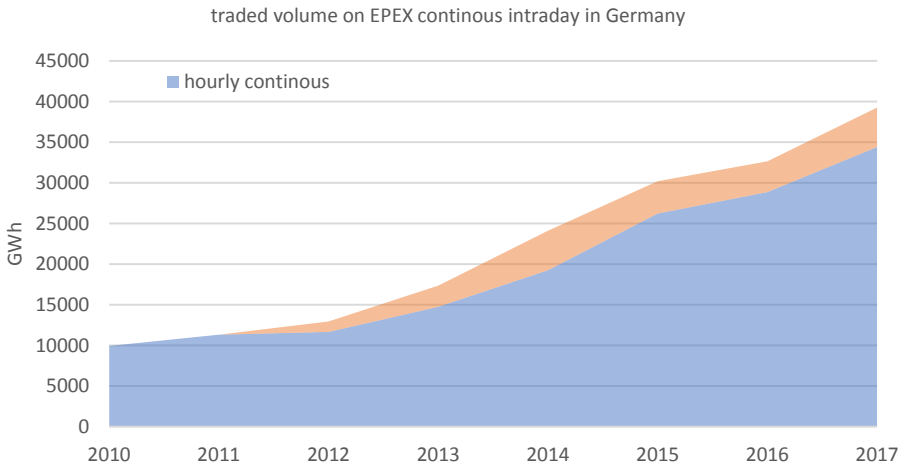
Conventional generation has to follow volatile renewables.



Liquid short term markets

Uncertainties increase the need of short term trading opportunities.





Day Ahead Auctions

- Hourly and ¼ hourly auction
- Annual trade volume increased to 240 TWh in Germany
- **Price coupling of regions** connects European exchanges and countries
- Integrated electricity market in beneficial due to increased liquidity, transparency, efficiency and social welfare

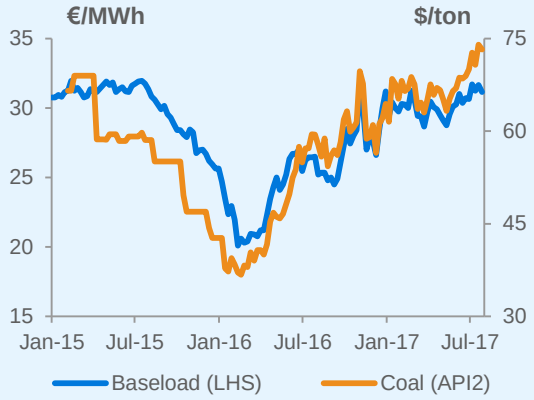
Continuous Intraday Market

- Annual trade volume reached 40 TWh in 2017
- Primary market channel to optimize and balance a portfolio close to real time
- **XBID** project establishes one single European intraday power market

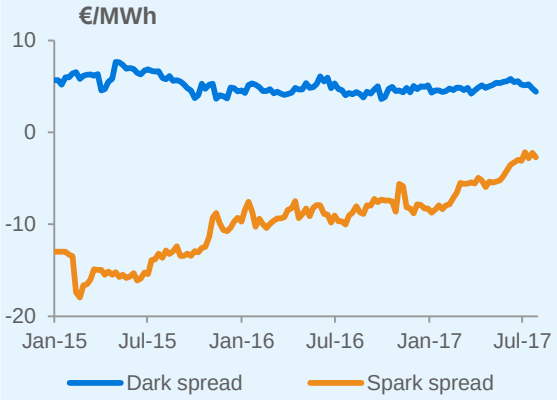
Source: EEX market data

Open markets lead to connectivity between commodities and result in volatility

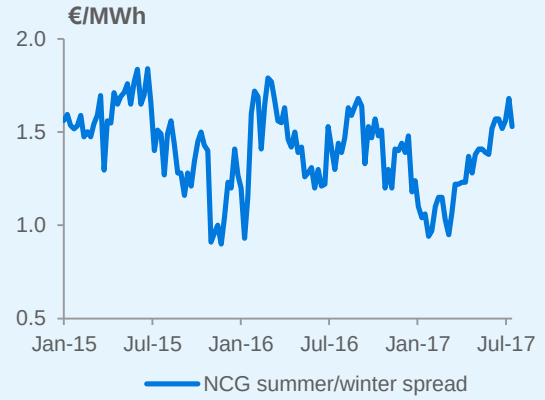
Germany – Baseload power 2018



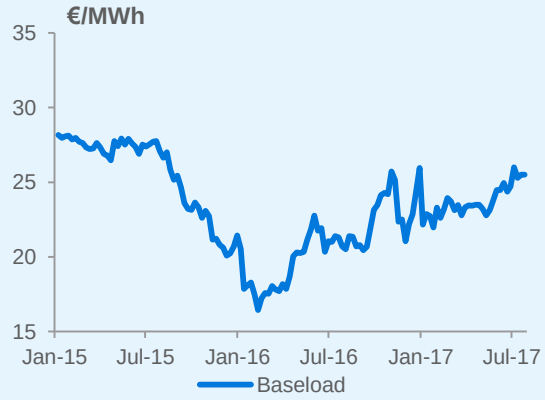
Germany – CDS, CSS 2018



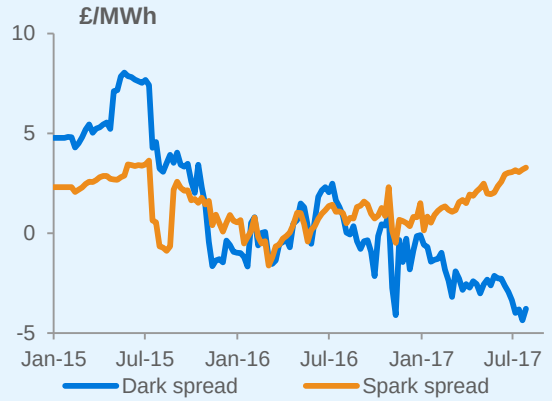
Gas Europe – summer/winter spread



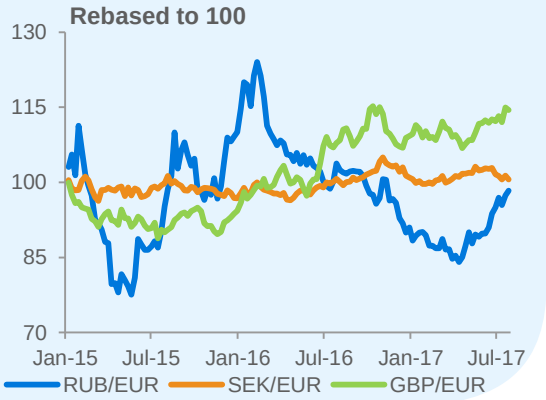
Sweden – Baseload power 2018



UK – CDS, CSS 2018



FX



Source: Bloomberg – market quotes
Note: Quotes include January 2015 until end of July 2017

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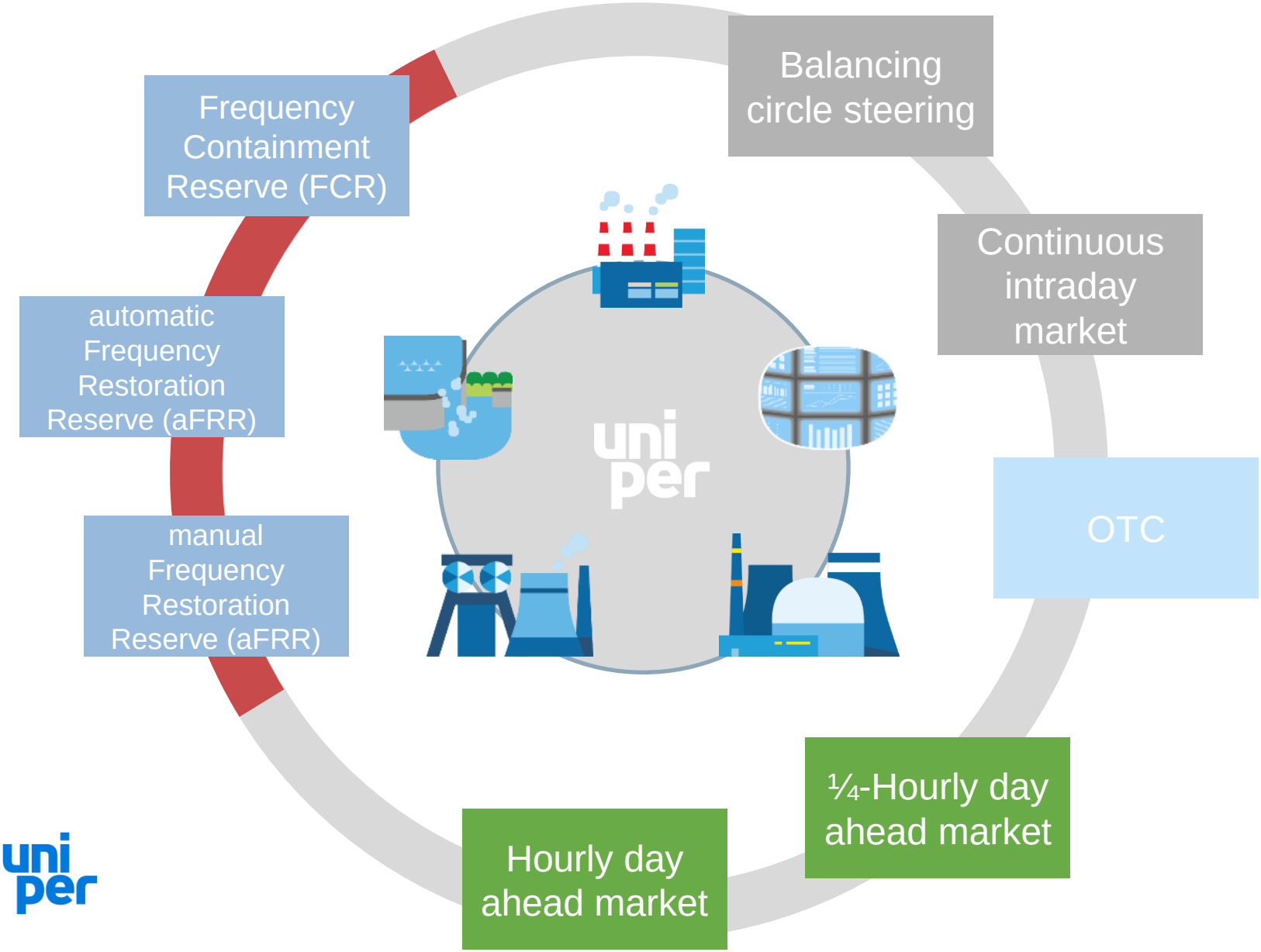
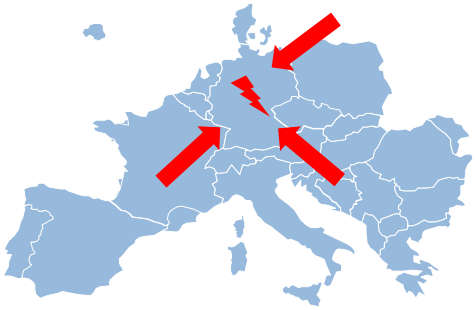
Ancillary services



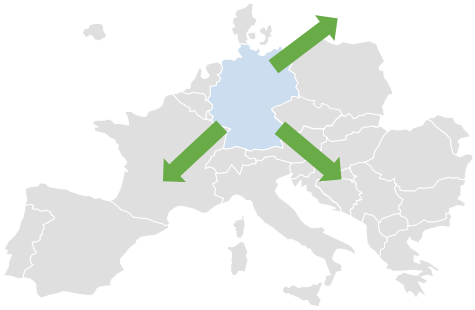
Different kinds of balancing products do exist to support grid stability

frequency containment reserves (FCR)



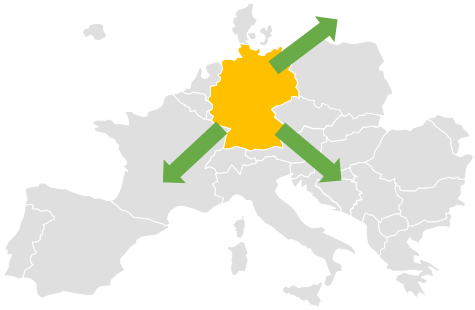
stabilization

automatic & manual frequency restoration reserves (aFRR & mFRR)



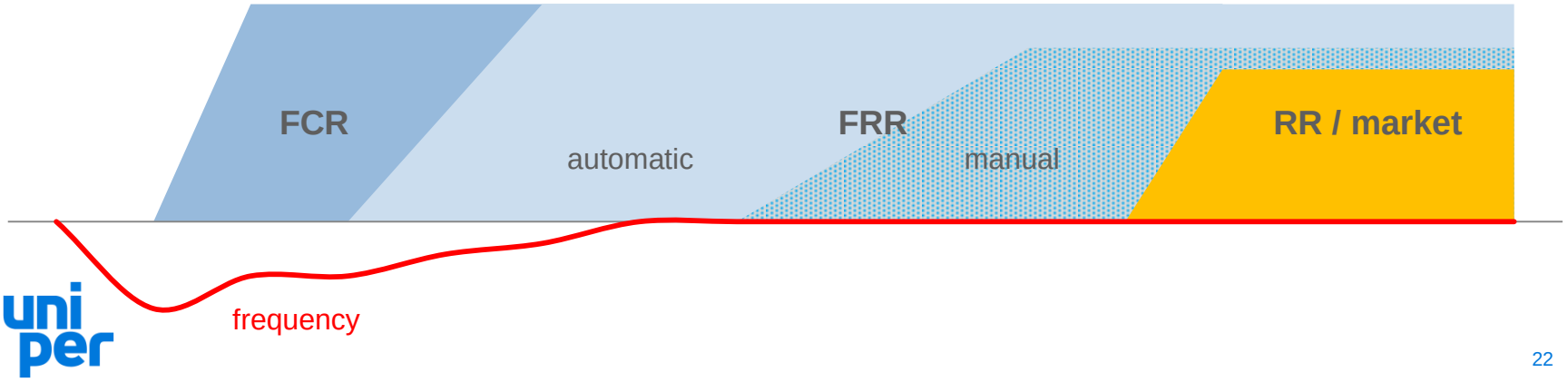
regulate FRCE to zero

replacement reserves or intraday market (RR)



release used FRR

Exemplary balancing energy activation



Network Codes foster European harmonization

Ancillary services markets evolve from protected schemes to conjoint European products.

Ancillary services are affected by two Network Codes.

System Operation Guideline

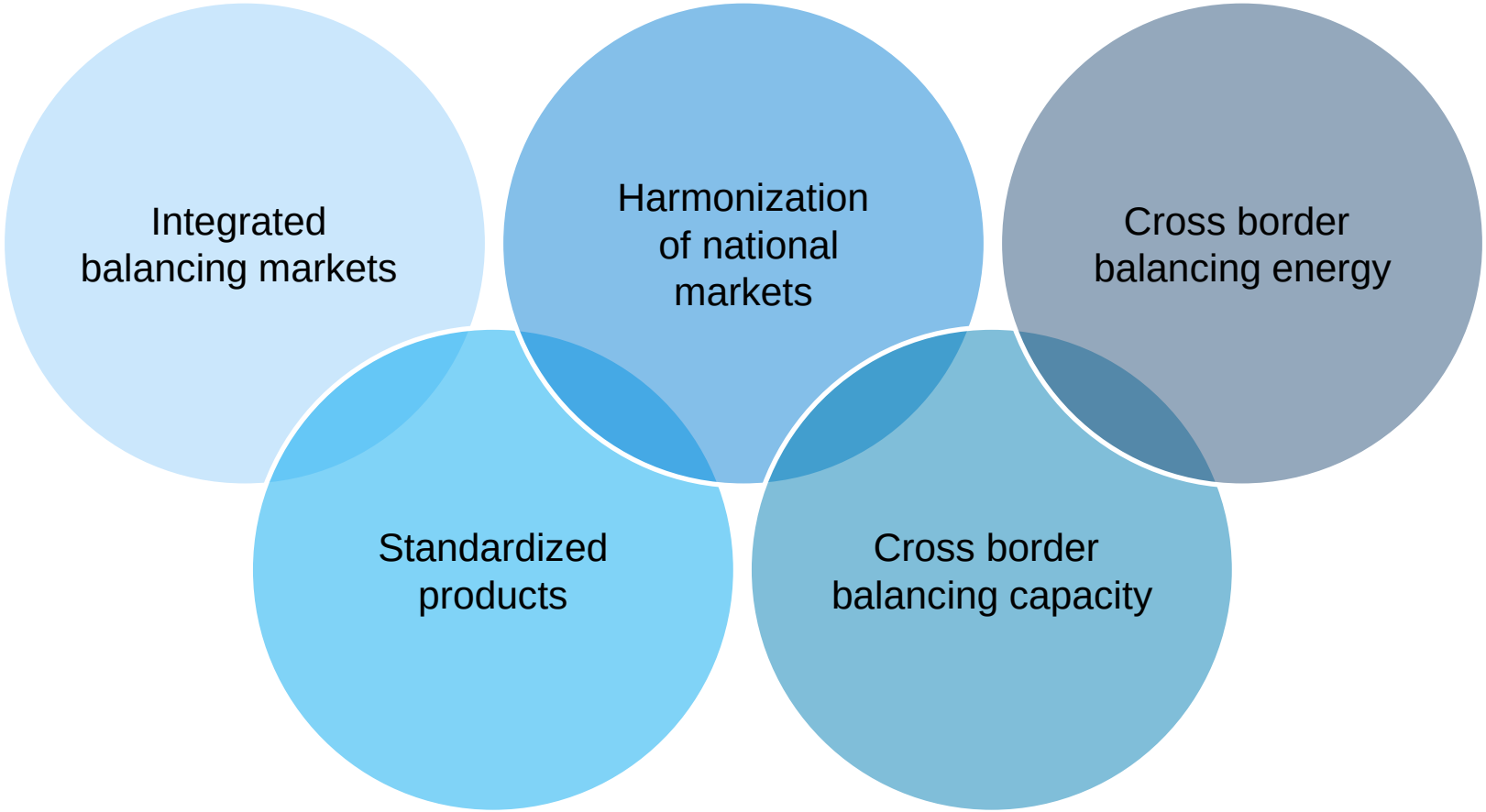
- Members approved the guideline on the 4th of May 2016
- Composition of the former network codes on Operational Planning and Scheduling, Operational Security and Load Frequency Control and Reserve
- Affects the market design and requirements of the **FCR** market

Balancing Guideline

- Members approved the guideline on the 16th of March 2017
- Affects the market design and requirements of the **FRR** and **RR** market

Network Codes

Five keys to a European Market for Ancillary Services

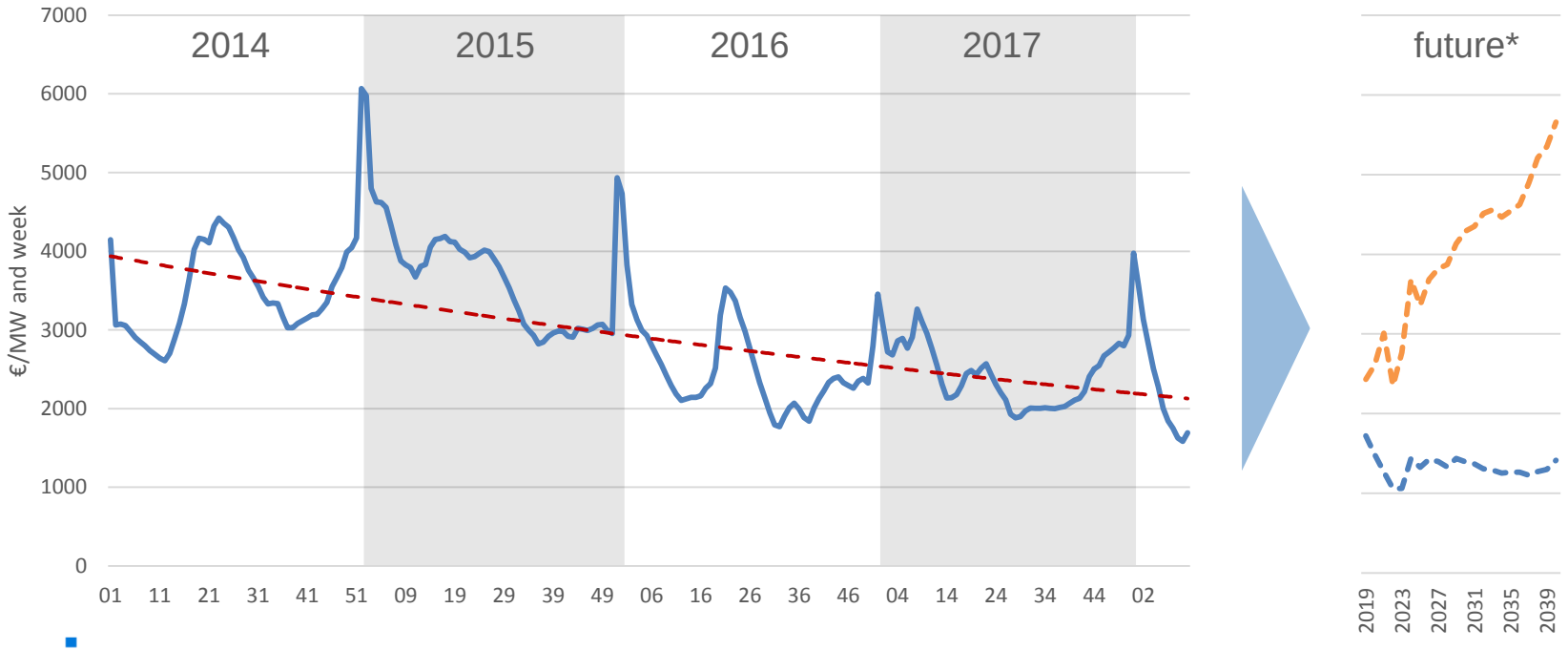


Source: ACER, Mathieu Fransen, Final steps to the European guideline on electricity balancing

Frequency Containment Reserve in Germany

Less market barriers lead to more efficient markets yet new challenges for utilities.

- Capacity prices of frequency containment reserve show a declining trend
- Changing market design reduced market barriers and fosters the integration of new disruptive technologies
- Battery penetration will be one important price driver



*Based on IHS multi client study Steady at 50

Base case scenario (no new technology and reduced thermal capacity)

Strong penetration of renewable and battery capacity

Source: regelleistung.net

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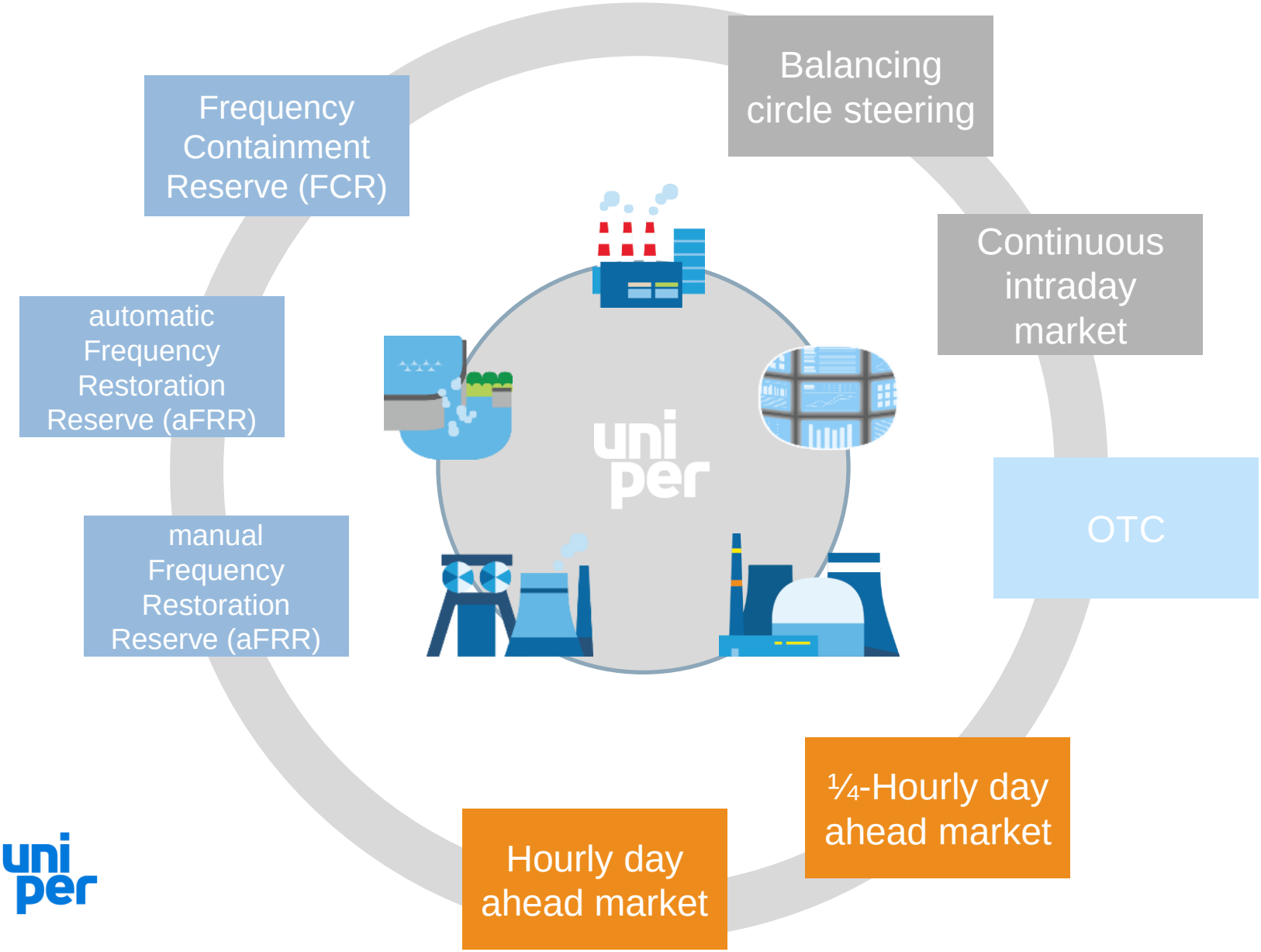
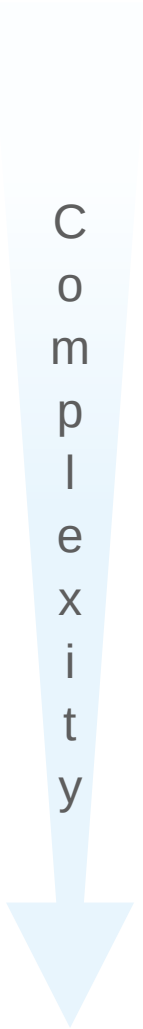
Optimization of market channels



Short term market channels in Germany

Complexity is rising significantly with short term markets.

Timing	Market	Market design	Products
Week ahead	FCR	One-shot pay-as-bid auction	1
Week ahead	aFRR	One-shot pay-as-bid auction	4
Day ahead 10 am	mFRR	One-shot pay-as-bid auction	12
Day ahead 12 am	EPEX hourly auction	One-shot uniform price auction	24
Day ahead 3 pm	EPEX quarter hourly auction	One-shot uniform price auction	96
Up to 5 min before start of delivery	Intraday market	Continuous trading	132
Real-time	Imbalance-market	TSOs charge for open positions	96



Portfolio effect – simplified

Diversified portfolios have a competitive advantage.

Market Prices	
Base week	33 €/MWh
Base weekend	20 €/MWh
Base weekday	38.2 €/MWh

Generation Costs	
Nuclear plant	8 €/MWh
Coal plant	35 €/MWh

Company A

Only nuclear asset

$$(33 - 8)\,{}^{€}/_{MWh} \times 168\,h = 4200\,{}^{€}/_{MW}$$

Company B

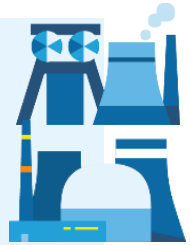
Only coal asset

$$(38.2 - 35)\,{}^{€}/_{MWh} \times 120\,h + (35 - 20)\,{}^{€}/_{MWh} \times \frac{240}{40} MW \times 48\,h = 4704\,{}^{€}/_{MW}$$

Company C

Nuclear and coal asset

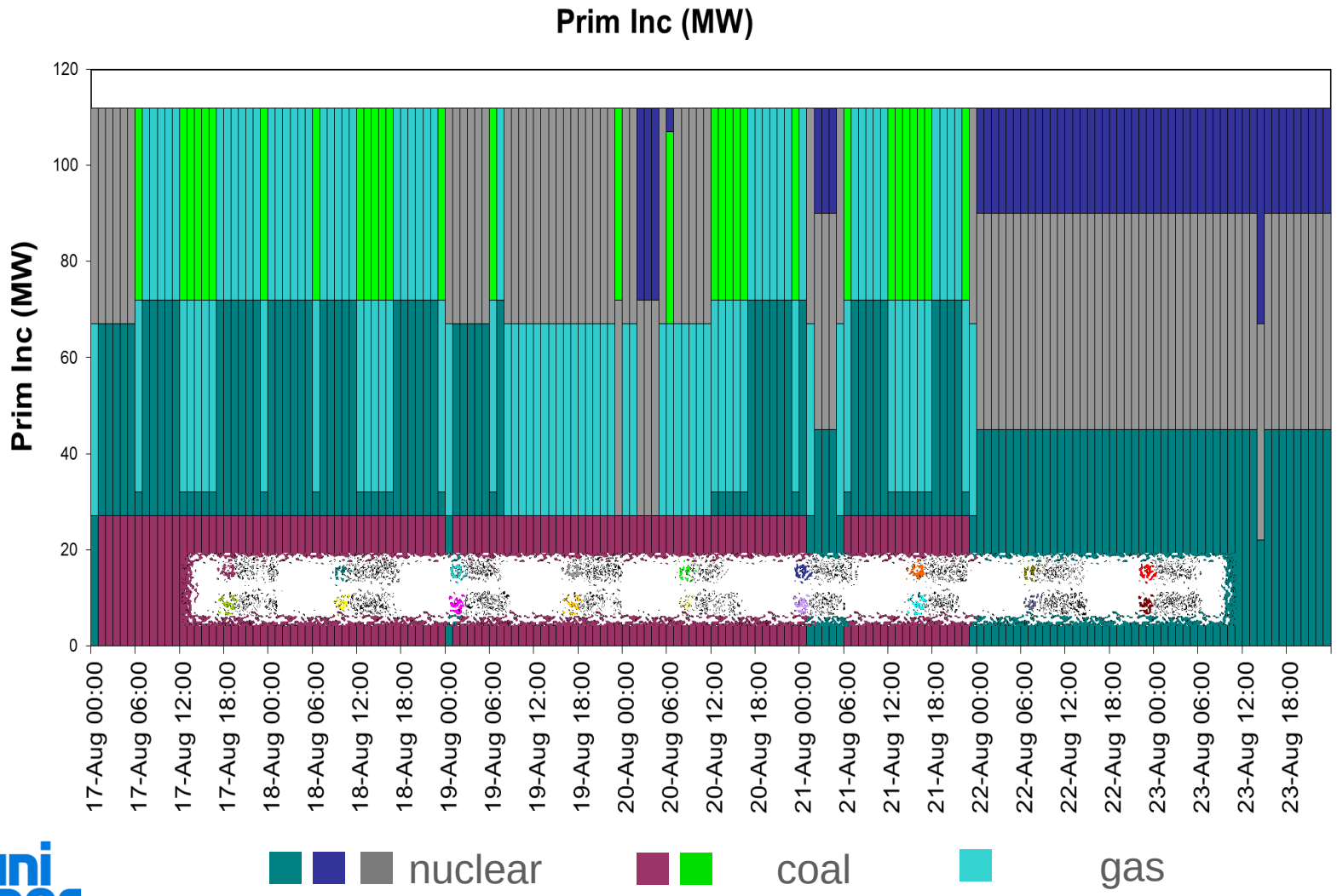
$$(38.2 - 35)\,{}^{€}/_{MWh} \times 120\,h + (20 - 8)\,{}^{€}/_{MWh} \times 48\,h = 960\,{}^{€}/_{MW}$$



Attention: Provision costs need to be calculated on a hourly basis

Portfolio usage in ancillary services

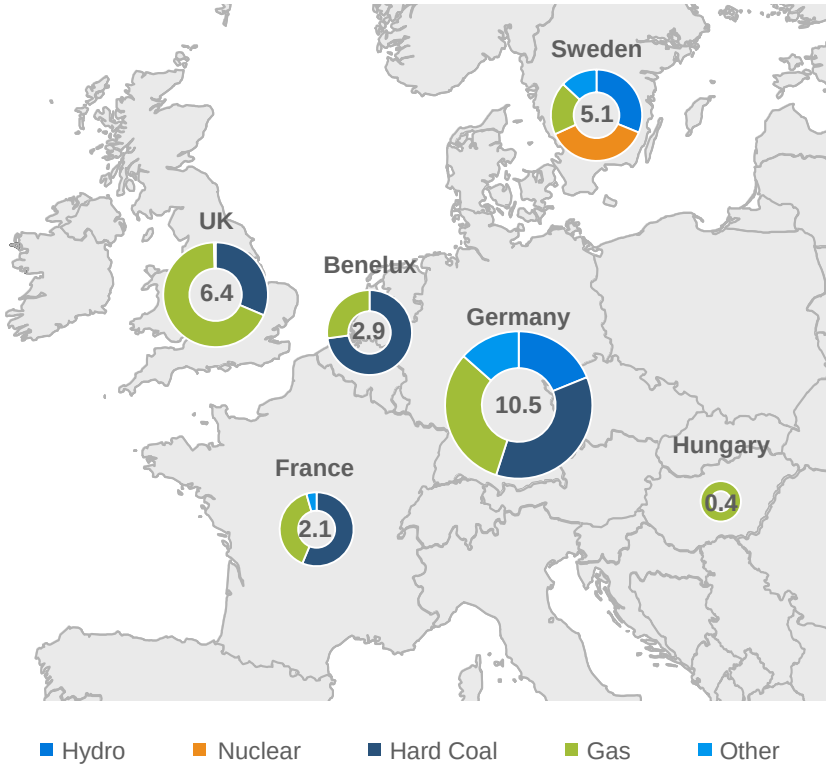
Diversified portfolios have a competitive advantage due to lower opportunity costs.



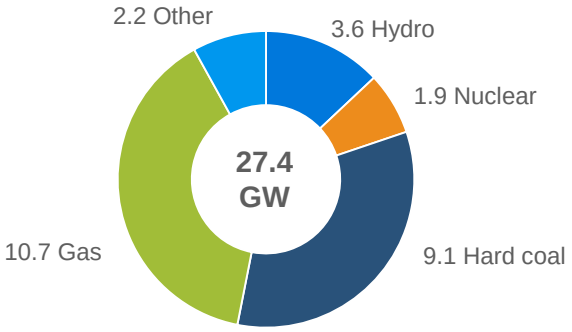
Well-diversified portfolio supports optimization

Different generation technologies and geographies

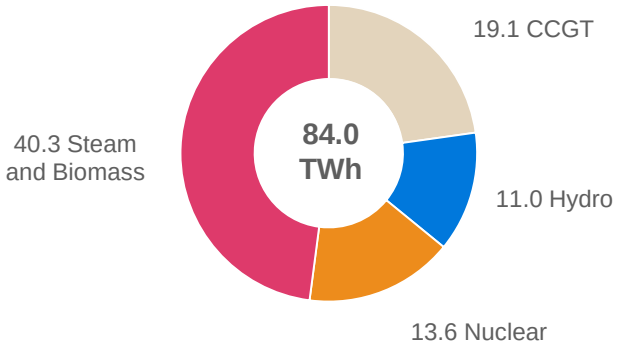
Net capacity by country and fuel type (GW)[1,2]



Net capacity by fuel type (GW)[1,2]



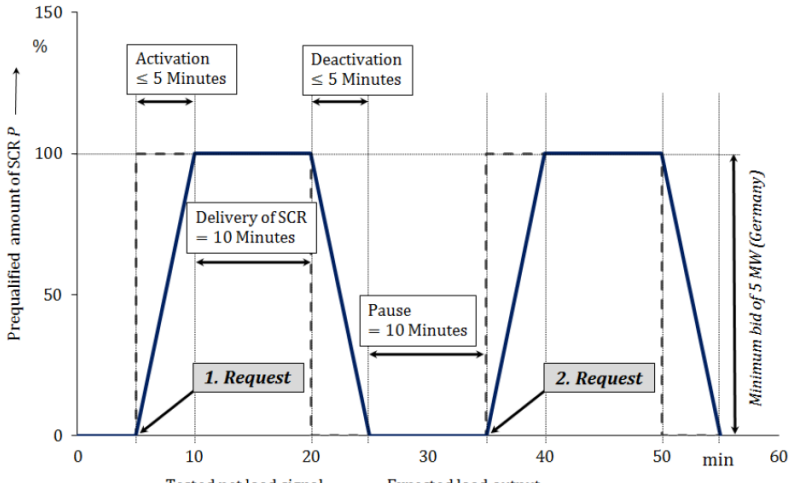
Electricity production by technology (TWh)[1,3]

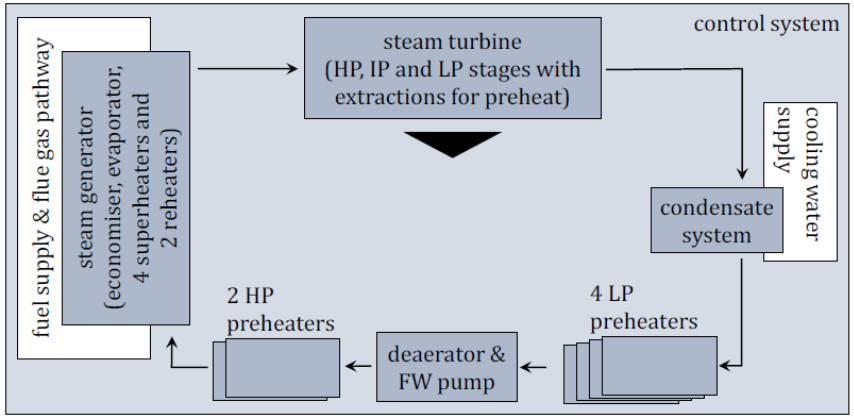


1. Net capacity for 2016 (accounting view); net generation capacity is reported for plants if plants were in operation at end of 2016
2. Excluding net generation capacities from Hydro LTCs in Austria and Switzerland of 820 MW in 2013, 629 MW in 2014, 629 MW in 2015 and 629 MW in 2016 as well as contracted generation capacities
3. Electricity production contains Pumped Storage production (2013: 0.8 TWh, 2014: 0.8 TWh, 2015: 1.0 TWh)
   Note: Deviations may occur due to rounding

Advanced asset modelling & simulation

Prequalified capacity of coal fired plant increased



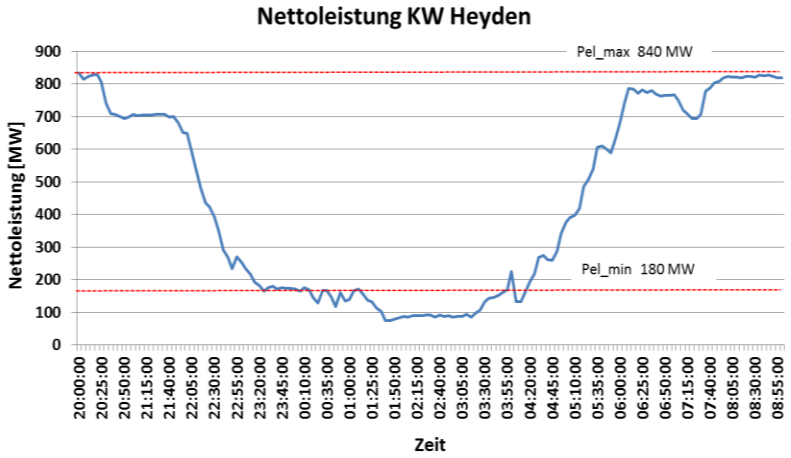


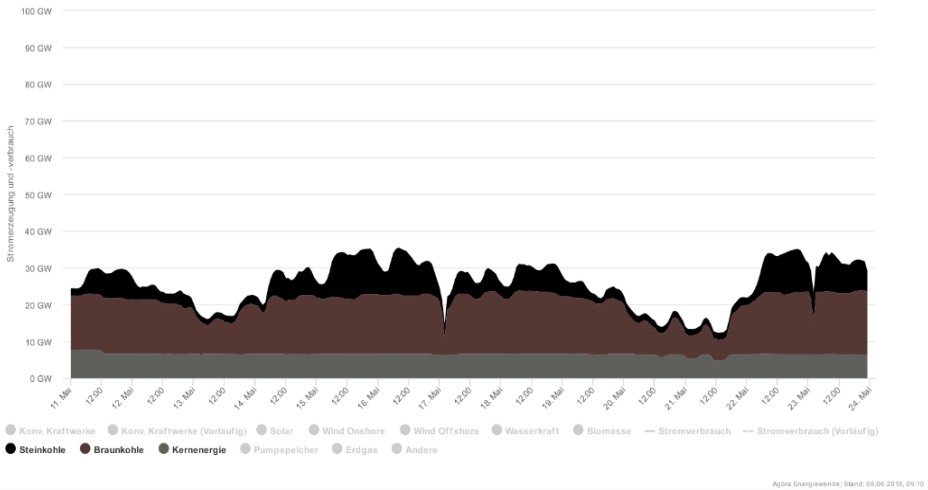
Dynamical simulation of aFRR

- Development and deployment of a dynamical simulator to improve SR capability
- Dynamical simulator reduces expensive and time consuming real plant tests
- Simulator includes detailed models of steam generator, turbine, boiler feed water pre-heating system, pumps, air system, flue gas system, mills and existing control system.
- Prequalified capacity could be increased.
- Further improvements are expected.

Asset flexibility improvement

minimum load of coal fired plant reduced by coal mill optimization





Single coal mill mode

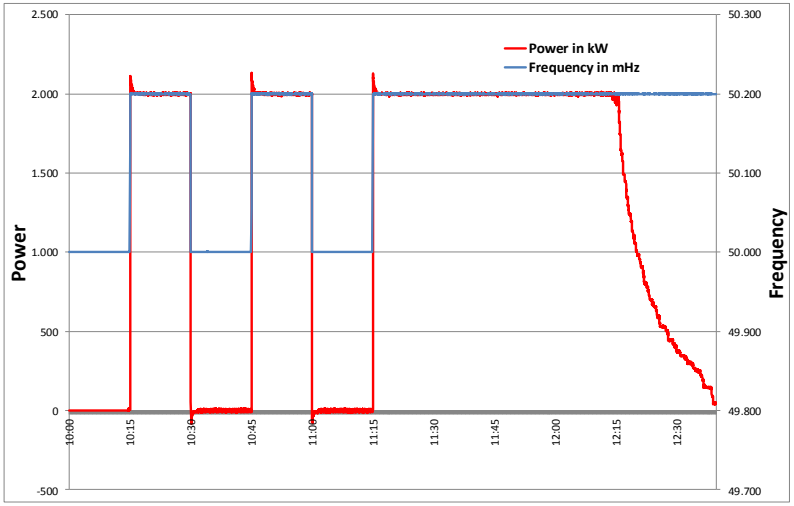
- Reduction of Pmin by ~50%
- Very stable operation at 15% of the boiler load and thus about 10% of the rated power of the plant
- Results are used to follow-on upgrades at French thermal plants Emile Huchet 6 and Provence 5

New technologies used to optimize portfolio

Hybrid battery storage system in operation for grid services

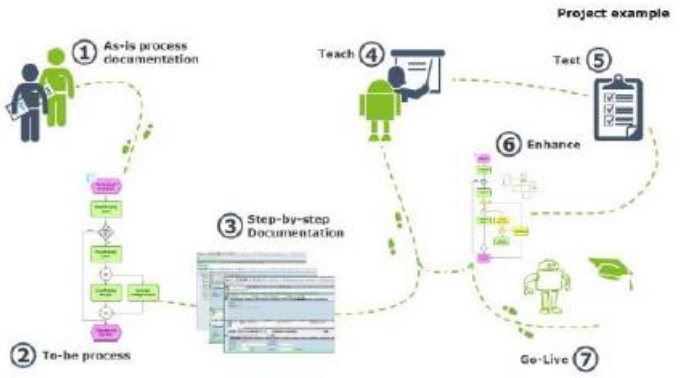
M5BAT

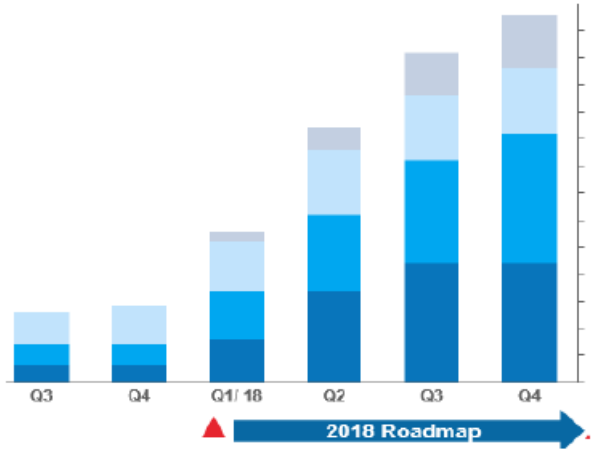
- Unique hybrid battery storage combines different battery technologies to evaluate technology specific characteristics
- Testing new applications
- Generating synergies in the portfolio
- Very suitable to provide grid services for TSOs and DSOs due to immediate reaction to charging and discharging requests



Digital transformation for competitive advantage

Enhanced trading systems and capabilities





Cloud

- Required for increased performance and data
- Acceleration of end of day batch processing and intra day calculations
- Lower total cost of ownership
- Provides the business with a security stack and integration into the downstream systems

Robotic Process Automation

- Contributor to Uniper's transformation
- RPA benefits are beside cost savings, improved quality and speed and better compliance
- Integrating digital workforce requires fundamental changes and needs employee acceptance

Increasing power system flexibility

The utility perspective: Conclusions

1. **Liberalization and regulation have constantly changed the environment for generation and trading in Europe**
2. **Flexibility and agility were and still are key to stay competitive including new technologies and digitalization**
3. **To be able to react quickly, dispatch operations are centralized and closely linked to trading**
4. **Cooperation with power plant operations is very strong to enhance and use all plant flexibilities**

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Speaker’s Biography

Gregor Pett, Executive Vice President Market Analytics/Market Solutions, Uniper, Düsseldorf

More than 23 years energy industry experience (incl. more than 16 years in executive positions). Wide range of in depth energy market expertise: trading, optimization, risk management, commodity market analysis and market design, corporate restructuring and change management.

- Since 2017 Executive Vice President Market Analytics/Market Solutions: responsible for commodity market analytics and market solutions.
- 2014-17 Director Market Operations, Uniper (until Dec 2015 E.ON Global Commodities SE), responsible for wholesale market pricing and commodity market analysis. Corporate restructuring projects. 2017: Interim Director Power Trading and Optimization.
- 2008 - 2014 Senior Vice President, E.ON SE responsible for commodity risk management and steering of commercial operations across the group
- 1994 – 2008 various roles within the gas business of Ruhrgas/E.ON Ruhrgas: Technical planning, gas supply negotiations, gas portfolio planning, risk management and commercial gas portfolio optimization
- Membership of various E.ON group supervisory boards including E.ON Global Commodities, E.ON France and E.ON Energie.
- 2009-2016 member/Chairman of the Energy Trading Steering Committee in German Energy Industry Association BDEW, Member of the BDEW Market Design and Gas Market Design Project Groups
- Member of the Energy Business Council, International Energy Agency, Paris. Regular peer reviewer of IEA publications
- Member 131. Baden-Badener Unternehmergespräche (since 2012)
- Degree in Physics (1994)

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