



Electricity market design and evolution

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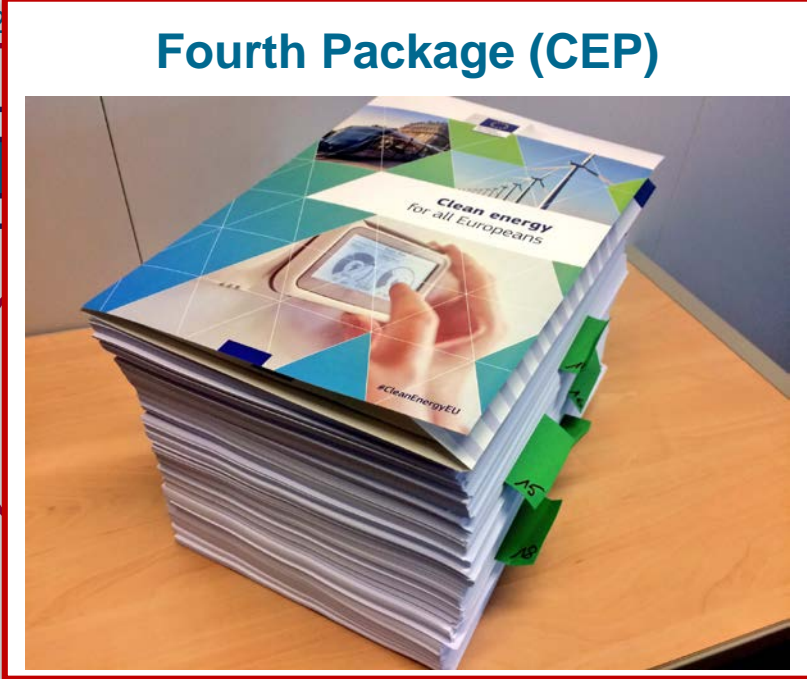
Timeline of Internal Energy Market Legislation



First Package
Electricity Directive 96/92/EC

Second Package
Electricity Directive 2001/77/EC

Third Package
Electricity Directive 2009/72/EC
Regulation (EC) 714/2009 on cross-border interconnectors



First Package
Gas Directive 98/30/EC

work
es and
elines

- Policy Objectives**
- A competitive internal energy market
 - Open and fair market
 - Cross border cooperation
 - Security of supply
 - Sustainability
 - Consumer and environmental protection

2016

Basic Highlights of the Successive Legislative Packages



First Package <i>No longer in force</i>	Second Package <i>No longer in force</i>	Third Package <i>In force</i>
<ul style="list-style-type: none"> • Partial market opening 	<ul style="list-style-type: none"> • Full market opening 	<ul style="list-style-type: none"> • Full market opening
<ul style="list-style-type: none"> • nTPA or rTPA 	<ul style="list-style-type: none"> • rTPA 	<ul style="list-style-type: none"> • rTPA
<ul style="list-style-type: none"> • Separation of accounts 	<ul style="list-style-type: none"> • Legal and functional unbundling 	<ul style="list-style-type: none"> • Effective unbundling
<ul style="list-style-type: none"> • No regulator required 	<ul style="list-style-type: none"> • Establishment of independent NRAs 	<ul style="list-style-type: none"> • Establishment of ACER, ENTSO-E and ENTSO-G
<ul style="list-style-type: none"> • Independent transmission system operation 	<ul style="list-style-type: none"> • Designation of TSOs and DSOs 	<ul style="list-style-type: none"> • Cross-border regulation • Capacity allocation and congestion management guideline • Network codes and guidelines
<ul style="list-style-type: none"> • No harmonisation 	<ul style="list-style-type: none"> • No detailed market design decisions 	<ul style="list-style-type: none"> • Harmonisation of system and market operation

Clean Energy for EU citizens package: What is in?



- ***Power market redesign:***
 - *Proposal for a revised electricity regulation – focus on wholesale markets*
 - *Proposal for a revised electricity market directive – focus on retail markets and consumers*
 - *Proposal for a revised regulation on a European Agency for the Cooperation of Energy Regulators (ACER) – new tasks and responsibilities for the Agency*
 - *Proposal for a new regulation on risk preparedness in the electricity sector – focus on government actions to manage electricity crises and prevent short-term threats to the power system.*

Clean Energy for EU citizens package: What is in? (Cont.)

- **Energy efficiency :**

- *Proposal for a revised energy efficiency directive*
- *Proposal for a revised energy performance of buildings directive*

New EU target for 2030:
from 20% to 30%

- **Renewables and bioenergy:**

- *Proposal for a revised renewable energy directive – this includes Europe’s first-ever sustainability criteria for biomass and new provisions for biofuels*

New EU target for 2030:
from 20% to 27%

- **Governance**

- *Proposal for a regulation on the governance of the Energy Union – this calls for and defines national energy and climate plans*

The 4th package – the Winter package – Clean Energy for EU citizens package (30 Nov 2016)



This is an **unprecedented** step in empowering consumers

Commission proposes new rules for **consumer centred** clean energy transition

Our proposals provide a strong **market pull** for new technologies



Market Design. Aim: more flexibility But why?

- *Article 1 of the Regulation: This regulation aims at setting the basis for ... increased flexibility*
- *Art 3 of the Directive speaks about “flexible market” and investments in “flexible generation”*
- *Challenge: increasing sharing of intermittent RES generation*
- *General perception: We have to increase flexibility, e.g. by promoting demand side response*
- *Statkraft view:*
 - *An efficient market will deliver the right amount of flexible capacity at lowest cost*
 - *“flexibility” is not a separate commodity, the energy market will give the incentives to make capacity more flexible*

The flexibility challenge.

What does the Winter package do good?

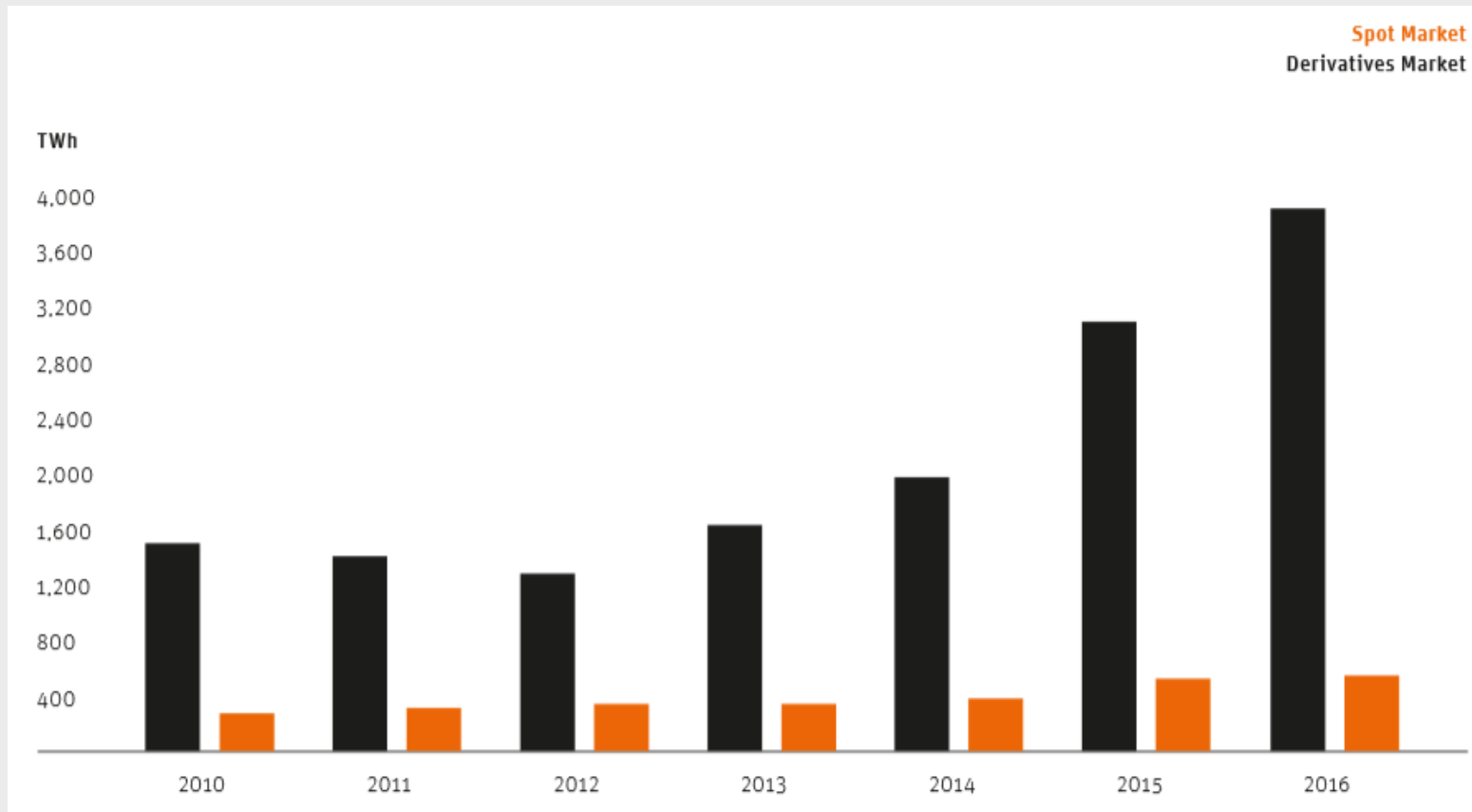
- *Removing price caps*
- *Exposing retail consumers to dynamic prices*
- *Removing regulated retail tariffs*

But ...

- *Is the focus on short term markets correct?*
- *Should “improving flexibility” be a goal in itself?*
- *Does it put consumer at center? Or does it regulate the market?*
- *It allows for scarcity pricing, but does it ensure it?*

The Evolution of Power Spot & Derivatives Volume

EPEX, EEX, PXE

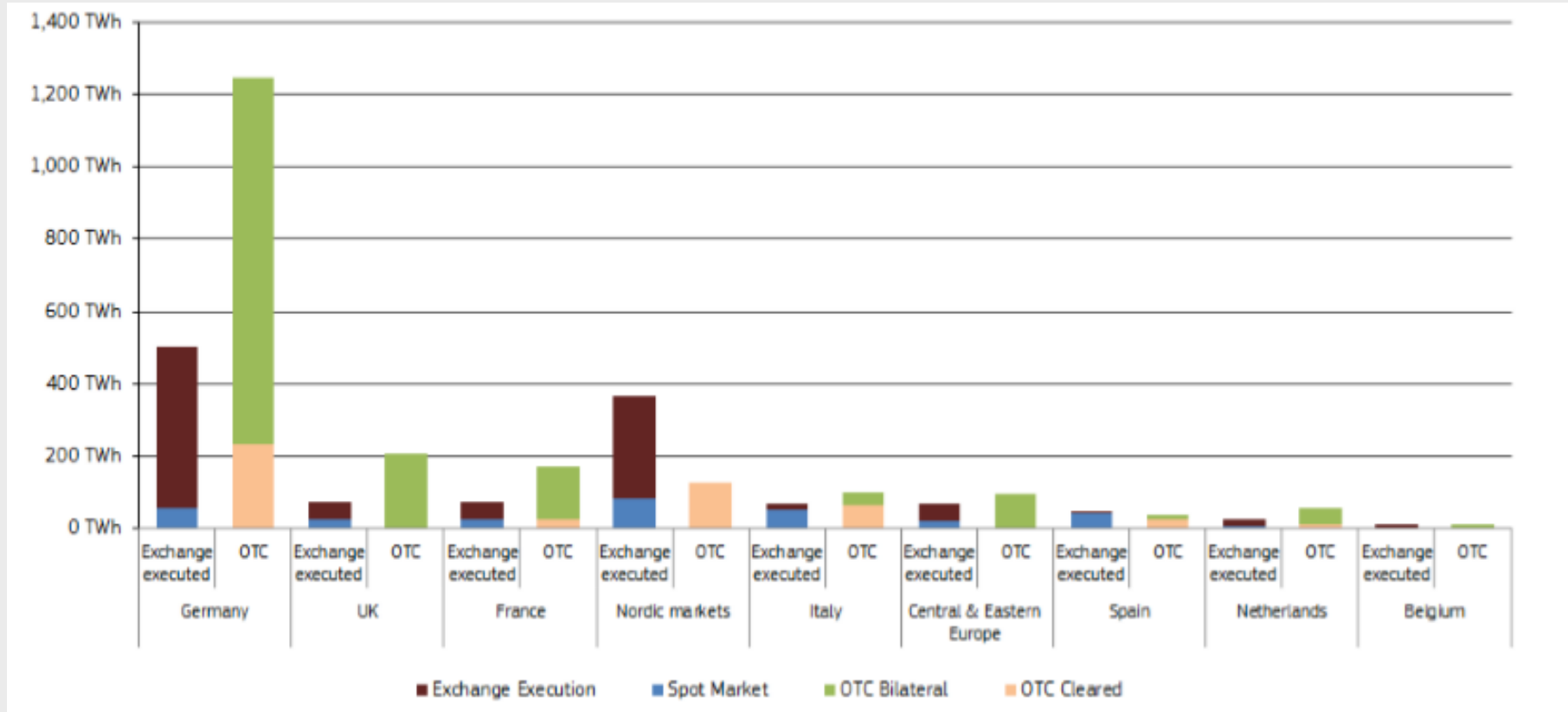


**EPEX
Spot
Market
535 TWh
Traded
volume in
2016**

**Derivatives
Market
3,920TWh
traded EEX
and PXE
volume in
2016**

Source: EEX: Markets and Products 2017

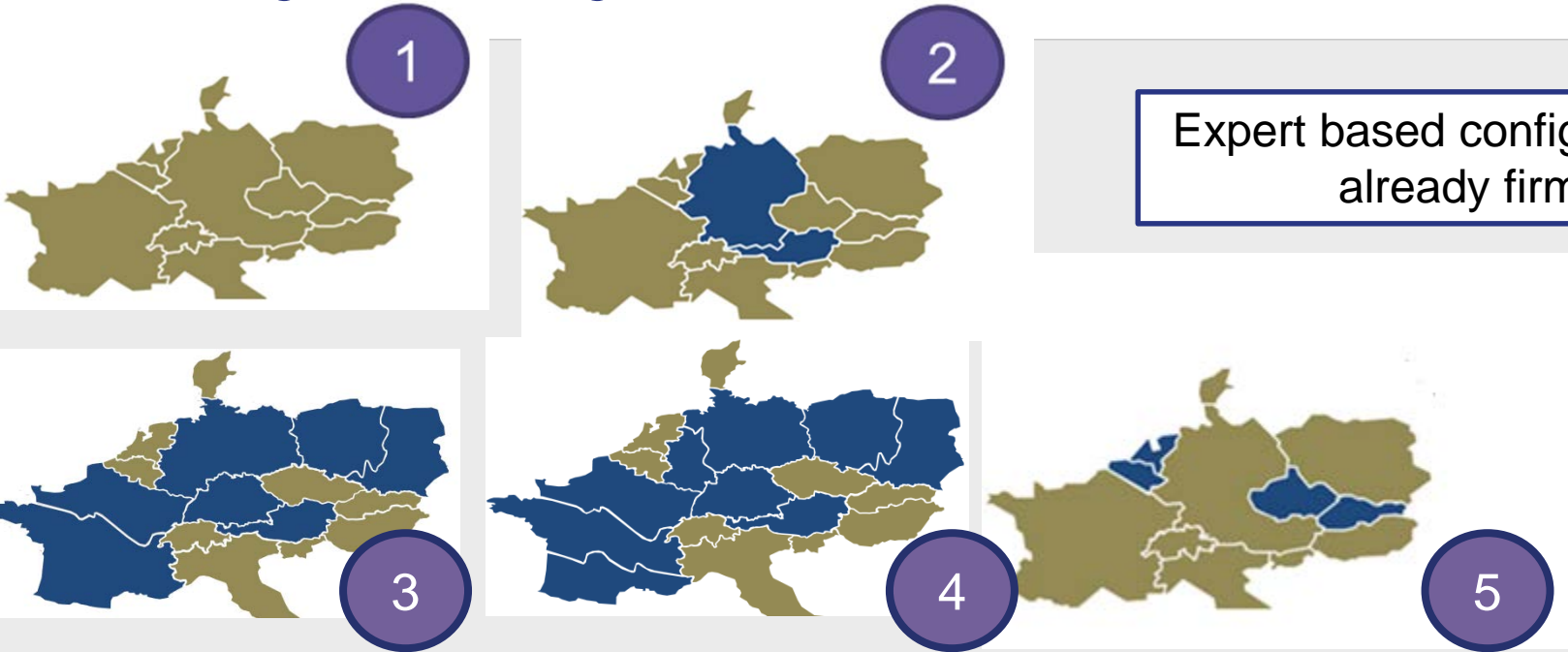
Comparison of electricity traded volumes in some important day-ahead, forward and OTC markets, first quarter of 2017



Source: Platts, wholesale power markets, Trayport, London Energy Brokers Association (LEBA) and DG ENER computations

Source: EC Quarterly Report on European Electricity Markets

Bidding Zone configurations under consideration



Expert based configurations already firm



Two additional Model based configurations were foreseen

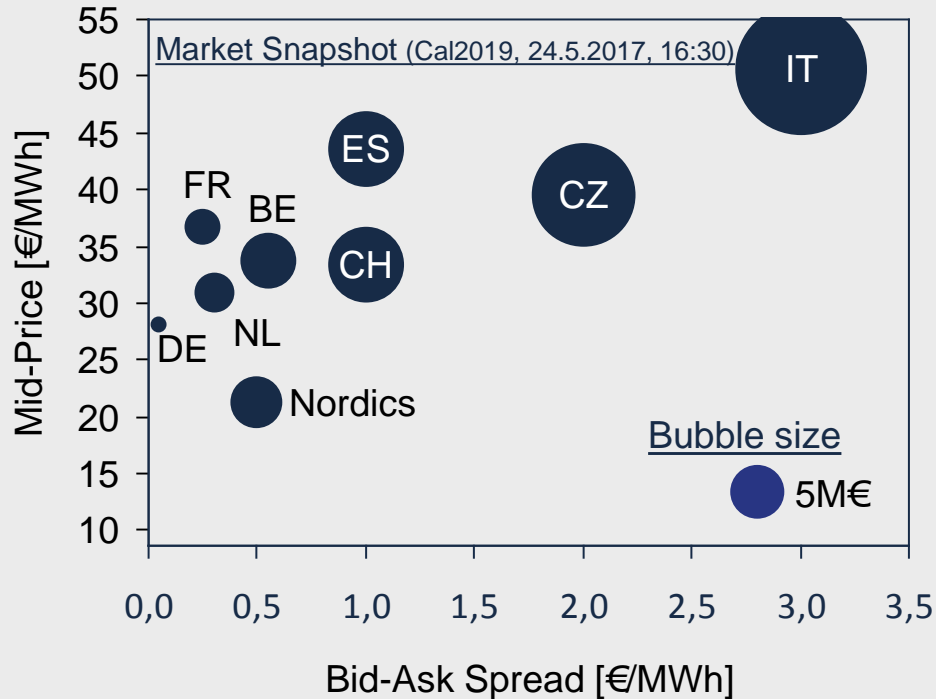
Germany Baseload*										Austria Baseload*				Germany Baseload/Austria Baseload*											
Venue	Code	Qty	Bid	Ask	Qty	Code	Venue	Last	V.Buy	V.Sell	Chang	Code	Qty	Bid	Ask	Qty	Code	Last	Code	Qty	Bid	Ask	Qty	Code	Last
+ - Mar-18	EEX	EEX	17 H	44.35	44.62	L	5 ²	EEX	44.60																
	OTC		2	44.33	44.65		10 ICA8	OTC	44.70																
	OTC	SPEC	5	36.40	36.55	L	5 EEX	EEX	36.40			5	0.10												
	EEX		2	36.37	36.58	L	5 ²	OTC	36.30																
+ - Apr-18	OTC	SPEC	10	36.30	36.65	L	10 SPEC	OTC	36.40																
	OTC	GRFN	10 H	33.50	35.10	L	25 EEX	EEX	34.85																
	EEX		2	33.47	35.13	L	5 ²	OTC	34.85																
	EEX	EEX	10 H	33.15					35.00																
OTC		2	33.12					34.80																	
+ - May-18																									
+ - Jan-18 x Ma																									
+ - Q118	OTC	PRE8	5	41.85	41.92	L	5 ²	OTC	41.90		50	151	0.15												
	OTC	SPEC	5 H	41.85	41.94	L	10 EEX	EEX	41.88																
	EEX	SPEC	5 ² H	41.85	41.95		1 ICA8	OTC	41.90																
+ - Q218	OTC	SPEC	5 ² H	32.98	33.05	L	5 PRE8	OTC	33.00		75	73	0.10												
	OTC		2	32.98	33.05	L	1 EEX	EEX	33.00																
	OTC	GFI8	5 H	32.95	33.07	L	5 ²	EEX	32.95																
+ - Q318	OTC	TFUK	5 ²	33.00	33.10		5 ²	EEX	33.05		80	20	0.13												
	EEX	EEX	1 H	33.00	33.12	L	1 EEX	EEX	33.00																
	OTC		2	33.00	33.15	L	5 GFI8	OTC	33.00																
+ - Q418	OTC	GRFN	5 H	38.50	38.70		5 ICA8	OTC	38.60		25	25	0.00	EEX	5	40.40	41.80	5 ²	41.50	EEX	5	-3.10	-1.70	5 ²	-3.00
	OTC	GRFN	5 H	38.50	38.70	L	5 ² ICA8 ²	EEX	38.60					EEX	5	39.00	41.80	5 ²		PRE8	5	-3.10			
	EEX		2	38.47	38.70		5 ² ICA8 ²	EEX	38.60												5 ²	5 ²	-3.38		
+ - Q119	EEX	EEX	10 H	38.35	38.50	L	5 GFI8	OTC	39.50																
+ - Q219	OTC	GFI8	5 H	31.5	32.20		2 PRE8	OTC	32.00																
+ - Q118 x Q21	OTC	PRE8 ²	5		8.99	L	5 EEX	EEX	8.75 ²																
+ - Sum 18																									
+ - Win 18																									
+ - Sum 19																									
+ - Win 19																									
+ - 2018	OTC	GF							36.60		169	150	0.15												
	OTC	ICA							36.60												PRE8	5	-0.75		
	OTC	GF							36.60												EEX	5	-0.75		
+ - 2019	OTC	GF							35.00		162	165	0.15								EEX ²	1	-0.85		
	OTC		2	34.98	35.00		2 ICA8	OTC	35.00												PRE8	5	-2.40		-2.50
	EEX		2	34.95	35.00		3 ²	OTC	35.00												EEX	5	-2.40		
+ - 2020	EEX		2	35.30	35.40		1 GFI8	OTC	35.30		6	17	-0.10												
	OTC		2	35.30	35.43	L	1 ² GFI8 ²	EEX	35.30																
	OTC	ICA8	5 H	35.25	35.43		1 ²	EEX	35.30																
+ - 2021	OTC	GFI8	1	36.15	36.55		5 GFI8	OTC	36.40																
	EEX		2	36.15	36.58		5 ²	EEX	36.40																
	EEX	EEX	1 H	35.65	36.60		5 GRFN	OTC	36.40																
+ - 2022	OTC	GFI8	1	38.25				39.15																	

Bid-ask spread AT:
1.4 – 2.8 Euro/MWh

Bid-ask spread DE:
0.2 Euro/MWh

No bids!
No depth

In markets with poor liquidity Cost of hedging can be significant...

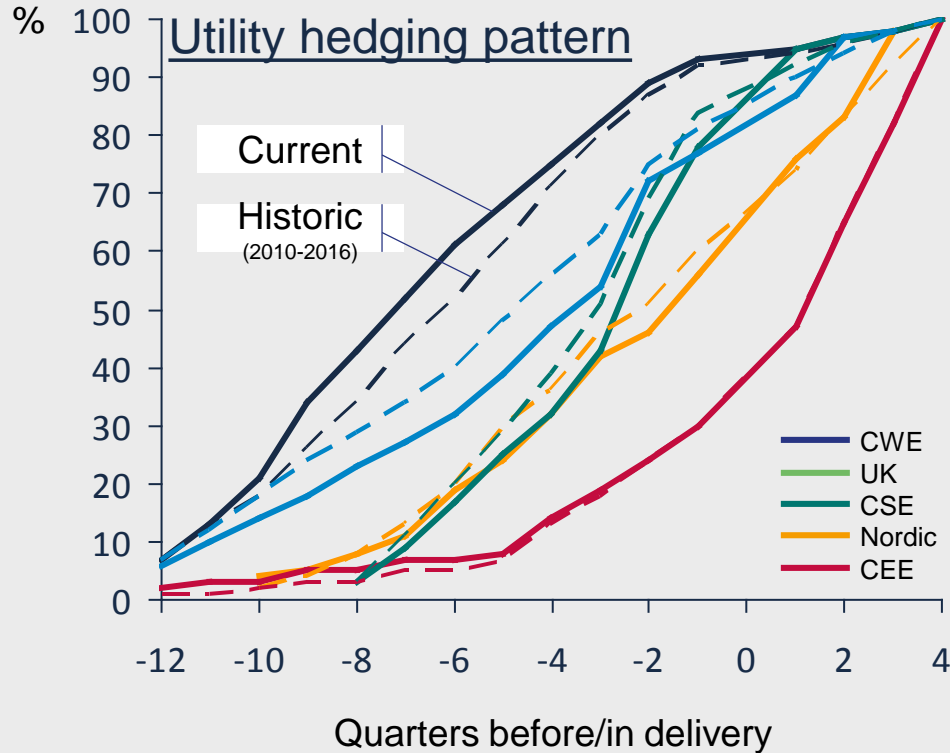


- Hedging as such comes at a cost: the transaction cost, which is a function of liquidity (i.e. bid-ask spread), market depth (i.e. potential price impact of placing relatively high volumes) and transaction fees (i.e. exchange fees)
- The bubble size equals the cost to hedge 10TWh of production or consumption 2 years ahead (i.e. hedge today the exposure in Cal2019) in the different countries, just based on the respective bid-ask spread. Costs related to market depth and exchange fees are not included.

Disclaimer: This is just a snapshot and the situation changes over time, but nevertheless it provides a good representation of current market circumstances.

Sources: Vattenfall, Montel

In markets with poor liquidity Cost of hedging can be significant...



- Cost of hedging decreases with increasing liquidity – the indices of the five different regions in the chart nicely illustrate the relationship
- The indices suggest that liquidity in CWE improved, CEE stayed stable, whereas a decrease occurred in Nordics & UK since 2010
- Cost of hedging for producers and consumers are in general the same, which means that higher liquidity and thus lower hedging costs lead to higher social welfare at large
- The analysis indicates that liquidity as such is largely connected to the size of price zones – bigger price zones foster liquidity!

Sources: <https://analytics.icis.com/>, Vattenfall

Analysis based on published data

ICIS Analytics collect and track reported hedging numbers of various European power companies. In total, the companies they follow account for around 65% of the EU ETS utility short-position within the EU ETS. Their unique historical hedging database allows them to track changes in hedging behavior continuously and compare the latest numbers with the historical averages. All displayed information originates from publicly available documents released by the companies or from official press conferences. They do not publish or share any information originating from bilateral talks with market participants. As European utilities differ in terms of how they hedge their power deliveries, ICIS Analytics incorporated indices for five different regions. The question why companies have different strategies has many different reasons, the most prominent of which are:

1. Extent of liberalization of the electricity market resulting in the necessity/ability to hedge
2. Liquidity in the forward market (i.e. cost of hedging)
3. Company structure (stock-exchange listed, state-owned, private company)
4. Risk appetite / Financial strength



Forward markets are also important for integration and financing of intermittent renewables themselves:

Investors in renewable projects normally outsource the market risks of their project by means of long-term power purchase agreements (PPAs). In the case of liquid forward markets, market participants can bid for such PPAs at more competitive prices.

The flexibility challenge.

What does the Winter package do good?

- *Removing price caps*
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Definitions: capacity and flexibility

- **Capacity: is the ability (or option) to deliver or offtake (sell or buy) electrical energy**

- **Flexibility: is the ability to use/exploit capacity with few limitations**
 - Flexibility is a characteristic of capacity
 - Flexibility has many different time dimensions
 - Example: A battery has short-term flexibility, but no longer term flexibility

Flexibility is not a
separate commodity



Contrary to common believe
the intermittency challenge

**is not in the balancing time
frame**

**but in the forward time frames
(intraday – seasonal)**

The future “flexibility challenge” in different time frames. Balancing challenge is overrated



Increasing share of intermittent (zero marginal cost) generation poses challenges in different time frames:

Balancing: probably smallest challenge

Short-term fluctuations are not extreme. Moreover RES can participate in balancing markets and DSM will play bigger role (but no need for support!)

Ramping; bigger challenge

Especially a well functioning intraday market will give price signals and incentives to invest in flexibility of assets (like low minimum load level, short start-up times, fast ramping)

Base load: biggest challenge!

Longer periods (days/weeks) with low wind, low PV, low reservoirs and high demand seem to be biggest challenge.

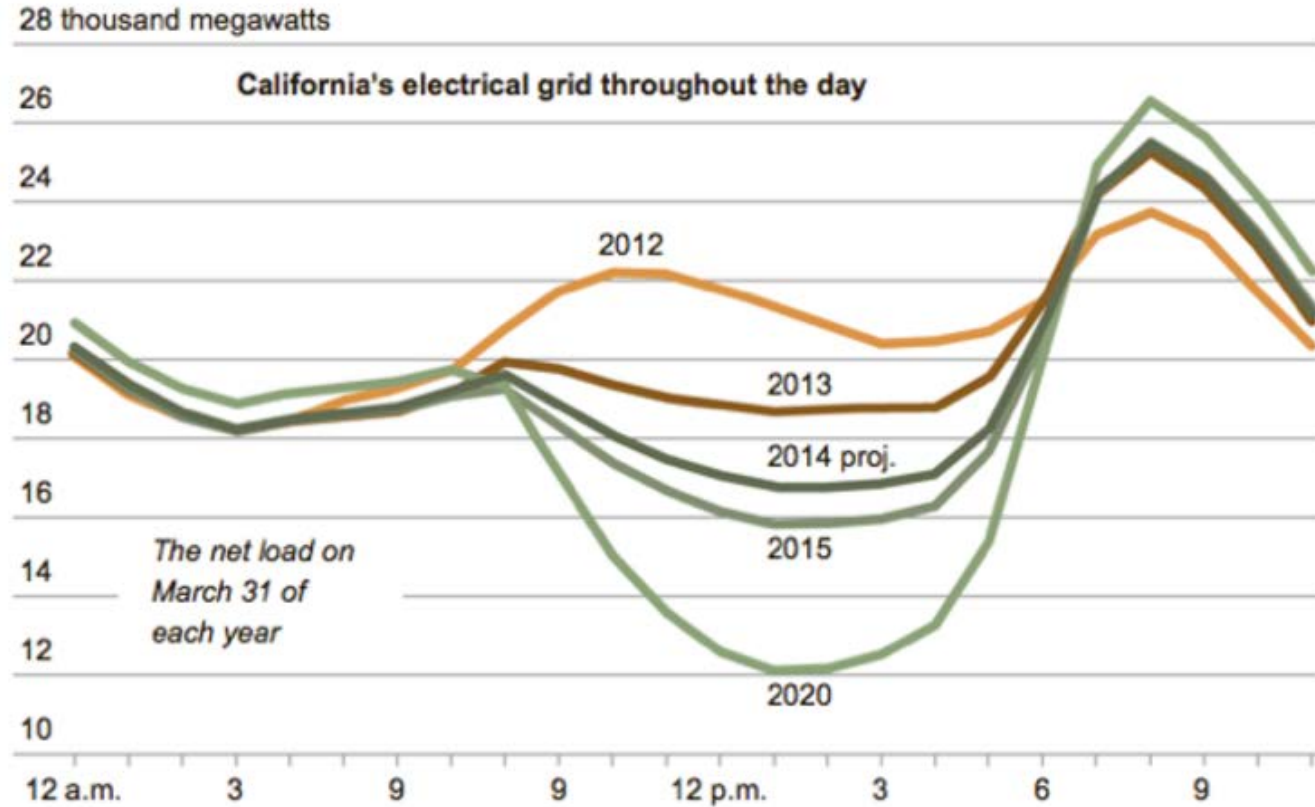
Increasing share of RES: decreasing activation of operating reserves & increasing use of intraday market



Graph: Volumes in the activated reserve markets (green) versus intraday market (red) in Germany

Source: Statkraft

Increasing share of RES: ramping challenge solved in intraday market

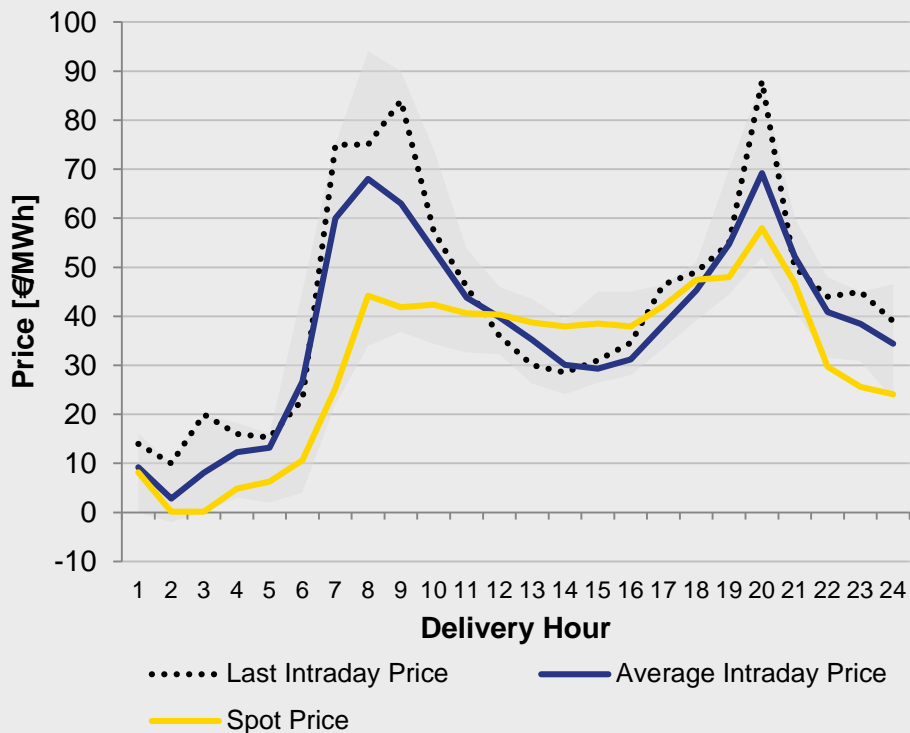


Source: CalISO

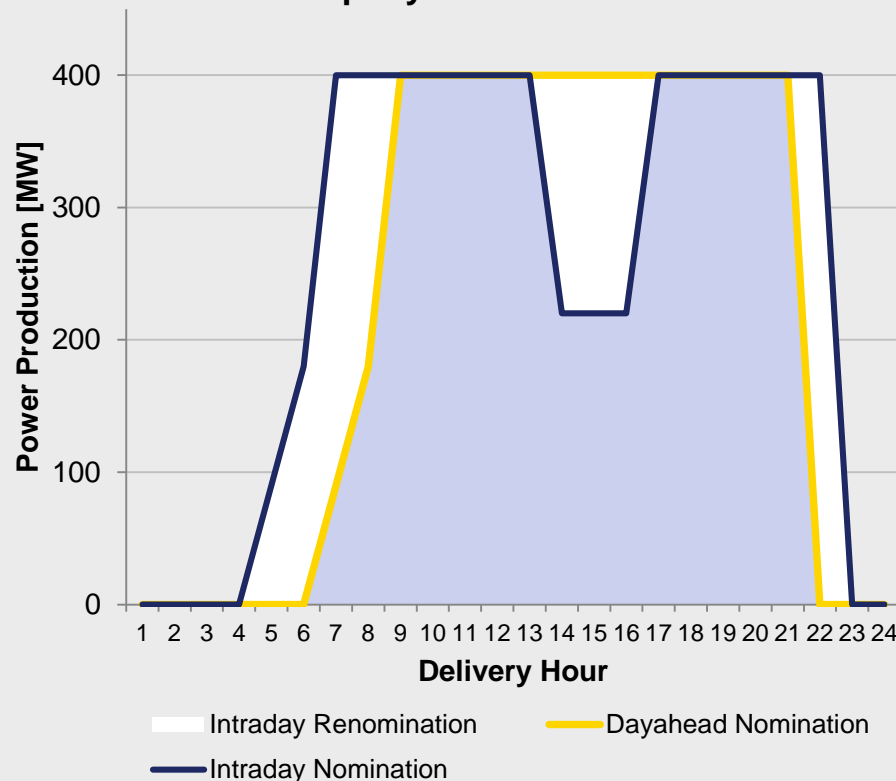
The value of intraday flexibility: Increase asset profits by short term optimization



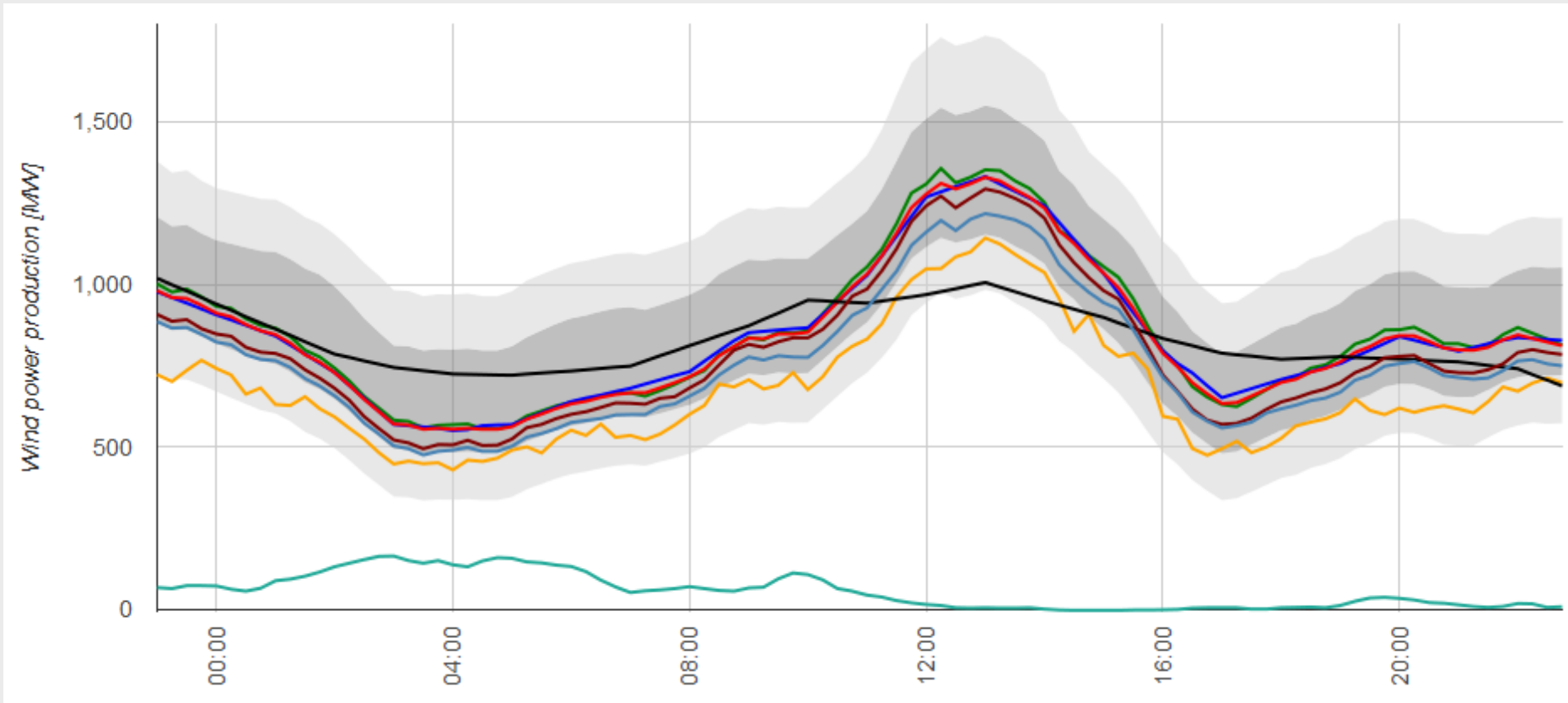
Exemplary Power Spot and Intraday Price Curves



Exemplary Asset Nominations



Forecast uncertainties of renewables: Trading 24/7 and forecast management indispensable



There is ample *flexible capacity*
in the market

Like *storage capacity*



Total installed dedicated storage capacity in the EU (plus CH and NO) is almost 50 GW

Plus about 27 GW seasonal storage capacity: 77 GW

The reservoir capacity of Lake Blåsjø is 7.8 TWh

Norway's total reservoir capacity is 85 TWh

That is 8.5 million batteries (of 10 MWh each)

Or 6 billion Tesla Powerwalls (of 14 KWh each)

There is ample *flexible capacity* in the market

Like *implicit demand side response*

Key elements for further deployment are:

- Smart meter roll-out
- Retail competition
- More price volatility



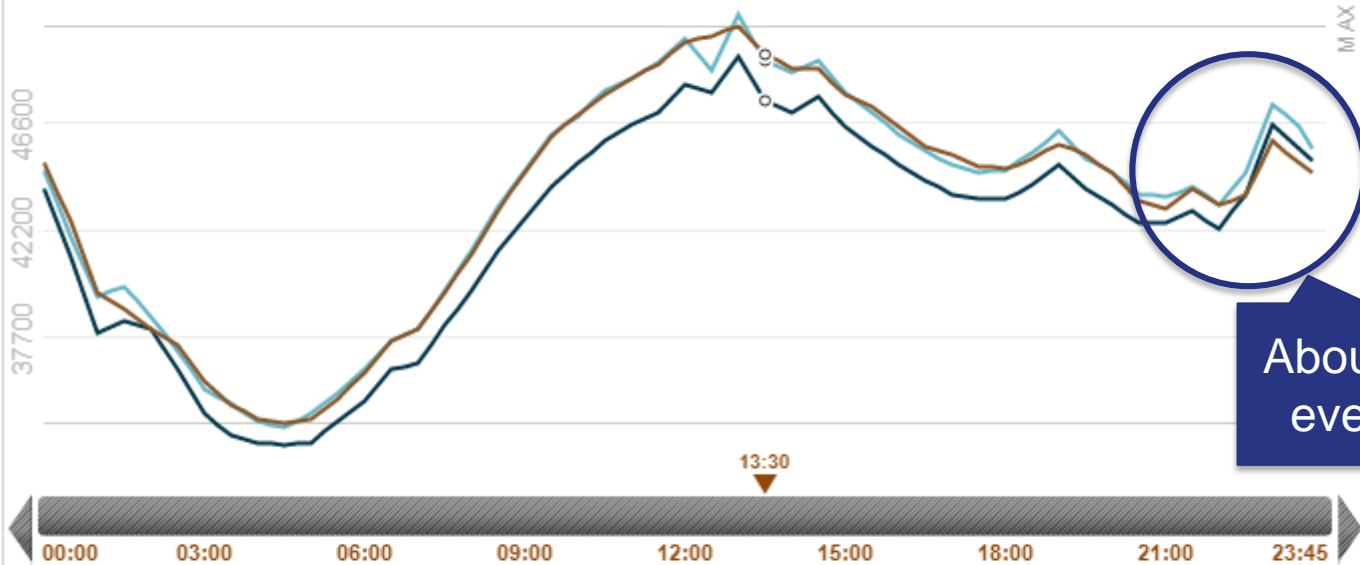
Consommation d'électricité pour la journée du :

Vendredi 18 août 2017



DONNÉES CONSOLIDÉES

MINIMUM MAXIMUM



About 3 GW every day

49331 MW CONSOMMATION	49100 MW PRÉVISION J	47500 MW PRÉVISION J-1
Consommation réalisée	Prévision réactualisée le jour même	Prévision calculée la veille pour le jour même

Types of demand response

	Implicit <i>Response on retail price</i>	Explicit <i>Response on market prices</i>
Direct <i>by consumer</i>	<ul style="list-style-type: none"> • Well known for decades • Already active to large extent • No regulatory barriers • No involvement/compensation of supplier • Will further develop with roll-out of smart meter 	<ul style="list-style-type: none"> • Already active (larger consumers) • Should be allowed (consumer should have right for this model) • Requires agreement consumer- supplier. Commercial terms to be negotiated.
Indirect <i>by aggregator (on behalf of consumer)</i>	<ul style="list-style-type: none"> • No regulatory barriers • No involvement/compensation of supplier • Likely to develop with technological developments 	<ul style="list-style-type: none"> • Relatively new business model • Should be allowed (consumer should have right for this model) • Requires agreement consumer-supplier-aggregator. Commercial terms to be negotiated.

One idea:

better allocation of XB-capacity across time frames

- ***There is a subordinate treatment of cross-border intraday trading in favour of day ahead cross-border trading.***
- ***The current methodology is designed to facilitate maximal flows on a day ahead basis, which results in an undervaluation of cross-border capacity and an inefficient use of flexible assets across borders.***
 - *Especially in periods when the day-ahead price difference is small, and when there is a likelihood that intraday prices will diverge, it is more efficient to not flow at the day ahead stage and to keep flexible assets available with the possibility to deliver flexibility across borders depending on the price developments on the intraday markets.*
- ***Allocating (i.e. reserving) the entirety of cross-zonal capacity primarily to the Day-Ahead market will not deliver the optimal social welfare in all market circumstances, since it forecloses the opportunity value of flexibility for use in shorter market timeframes.***

The flexibility challenge.

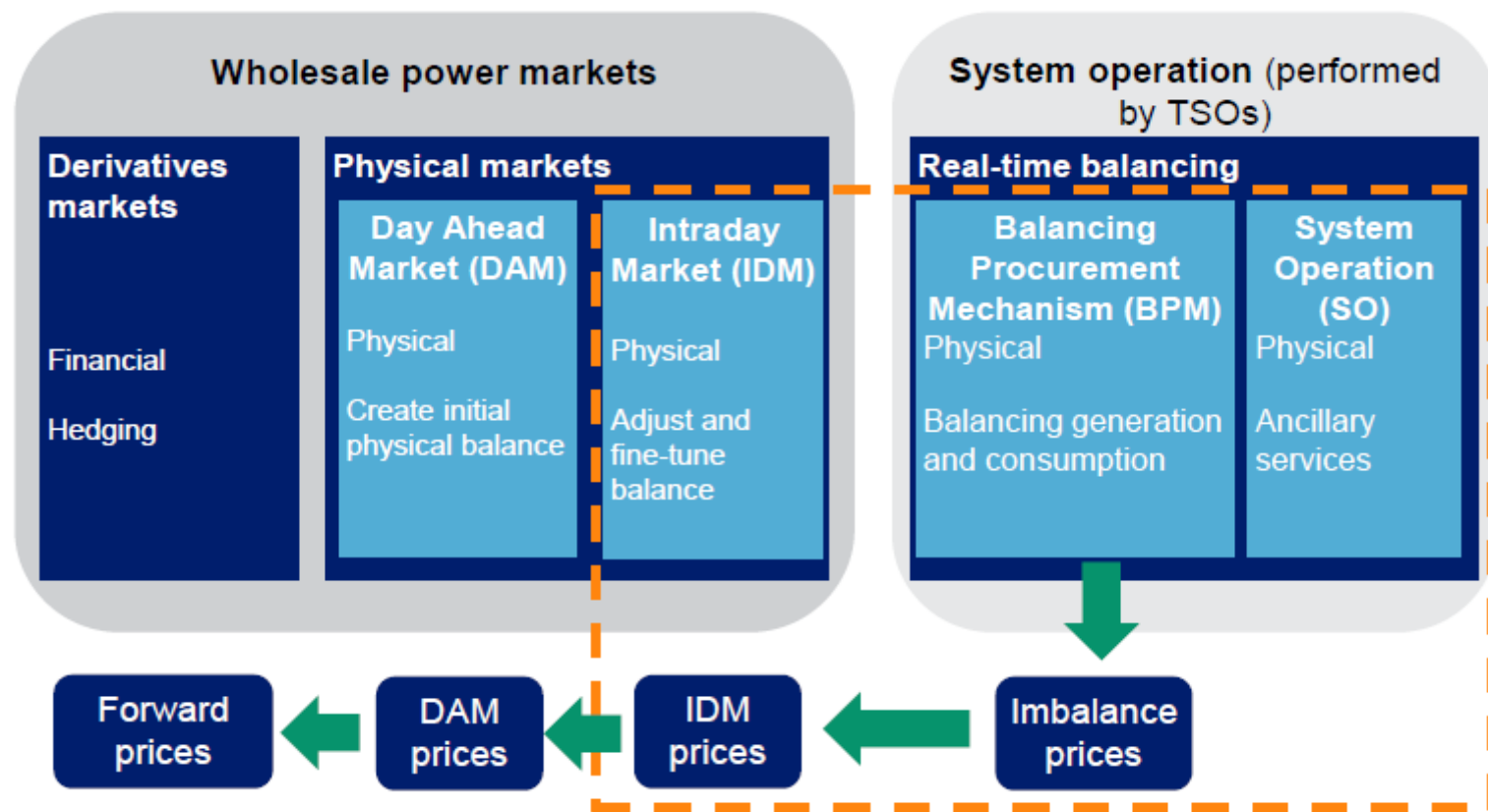
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PRICE FORMATION IN THE BALANCING TIME FRAME INFLUENCES PRICES IN OTHER TIME FRAMES



A silhouette of a city skyline, including the Willis Tower, against a sunset sky with orange and blue hues. The text is overlaid on the image.

If market participants are exposed to the real risk that the imbalance price will be set at the: *VoLL (Value of Lost Load)*

Then scarcity prices can materialise and market participants will invest in flexibility

VoLL - pricing, how?

- *Imbalance price = VoLL*
 - in case of scarcity driven brown-out
- **Not necessarily a single value per Member State**
- **Can be dependent on time, size and duration of brown-out**
- **Highest VoLL should be reference for “technical limits” in coupled markets**
- **TSOs should not buy balancing energy at prices above this value**

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CEP: an “unprecedented step in empowering consumers”?



Article 4 of the Market Directive:

Member States shall ensure that all customers are free to purchase electricity from the supplier of their choice.

Change into:

Member States shall ensure that all market actors with a connection to the grid are free to purchase and sell electricity from any other market actor or combination of actors of their choice.

Conclusion: No need for a new market design



- **Existing framework already sufficient:**
 - *It allows for “new” business models (aggregation, local energy communities, demand side response)*
 - *Flexibility is not a new commodity. Flexible capacity is valued at the power market.*
 - *Role of DSOs/TSOs should not change (they can always contract for flexibility services)*
- **But improvements are needed:**
 - *Allow for scarcity prices and ensure for VoLL pricing*
 - *Better allocation of cross-border capacity (intra-day!)*
 - *Improve basic rights of consumers*
 - *Ensure level-playing field*
 - *Stop benefits for “behind meter investments”*
 - *Better calculation of cross-border capacity*

Back-up

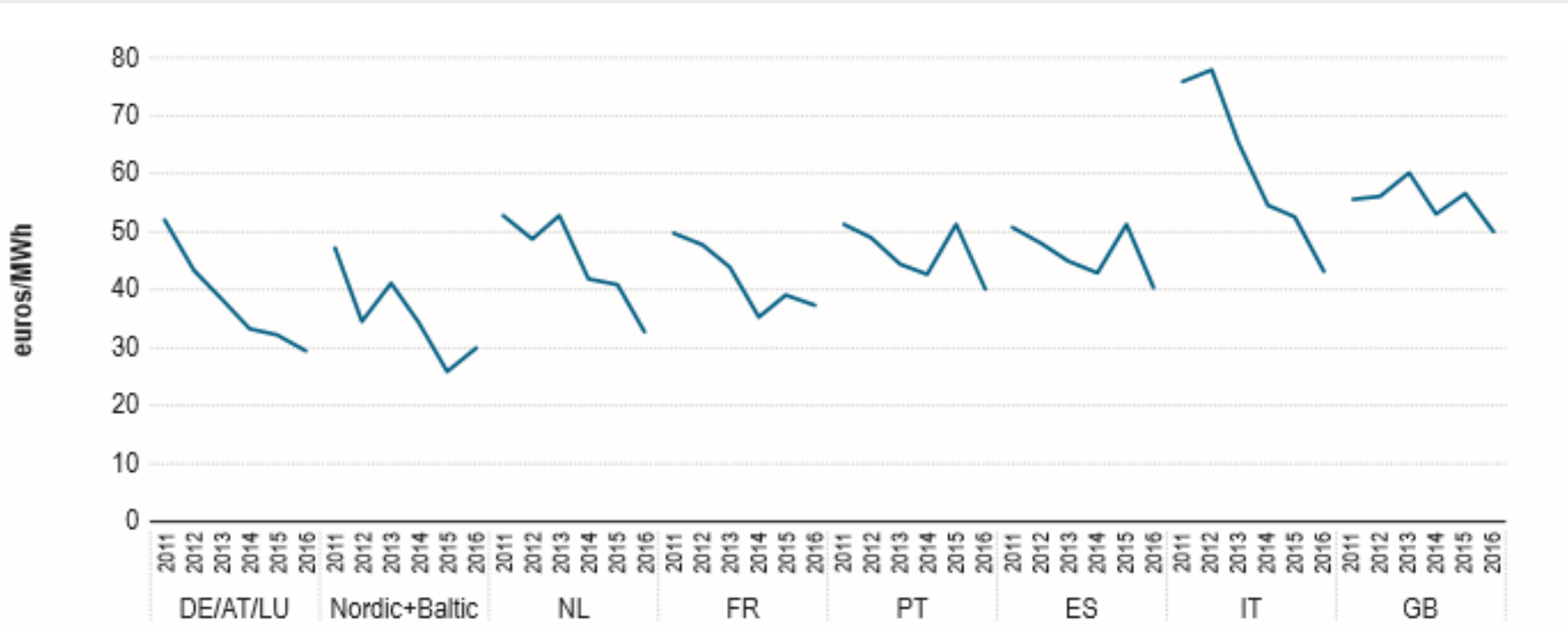


The Evolution of Wholesale Supply Businesses



Downward trend observed in electricity wholesale prices since 2011

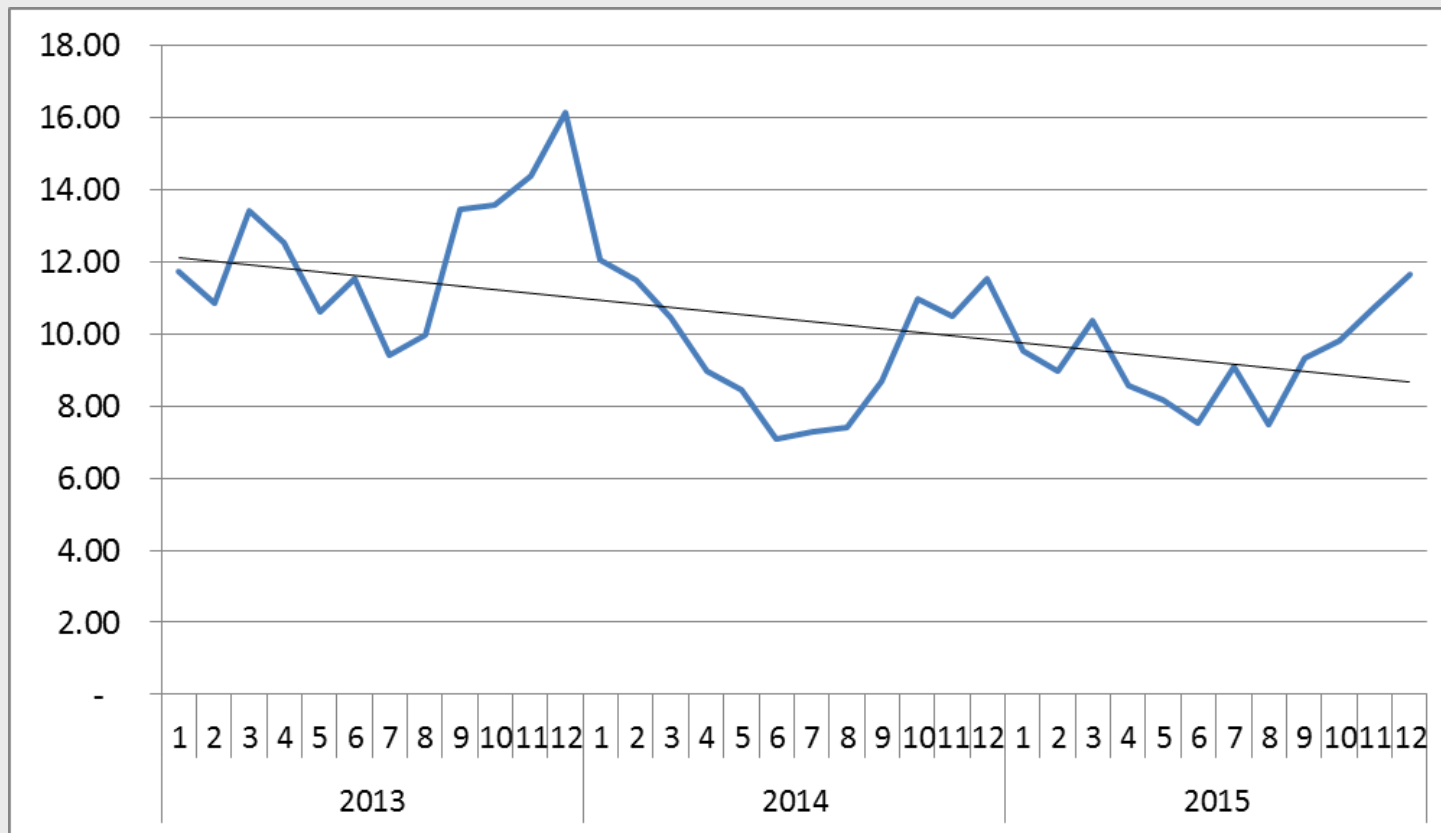
Figure: Evolution of DA electricity wholesale prices in different European power exchanges – 2011–2016 (euros/ MWh)



Source: ACER Market Monitoring Report 2016 – Electricity wholesale market volume

Source: European Network of Transmission System Operators for Electricity (ENTSO-E) and Platts (2017).

Volatility of hourly intraday prices is decreasing



I

Price signals are the basis

II

Remove barriers & distortions

III

Avoid “regulating the market”

Key priority

Price signals are the basis for investments in and dispatch of “flexible capacity” like demand side response

Allowing free price formation and scarcity prices requires to **remove barriers & distortions**

... but avoid **“regulating the market”**. Promoting certain sources of “flexibility”, will only result in higher cost, because cheaper flexibility will be pushed out of the market

Examples

Examples:

- VoLL-pricing in case of scarcity driven interventions
- Tackle “behind the meter” generation & storage

Examples:

- Specific regulations for “3rd party aggregators”
- DSOs /TSOs owning and operating storage