Trends and developments in the EU Wholesale Power market

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RWTH Aachen

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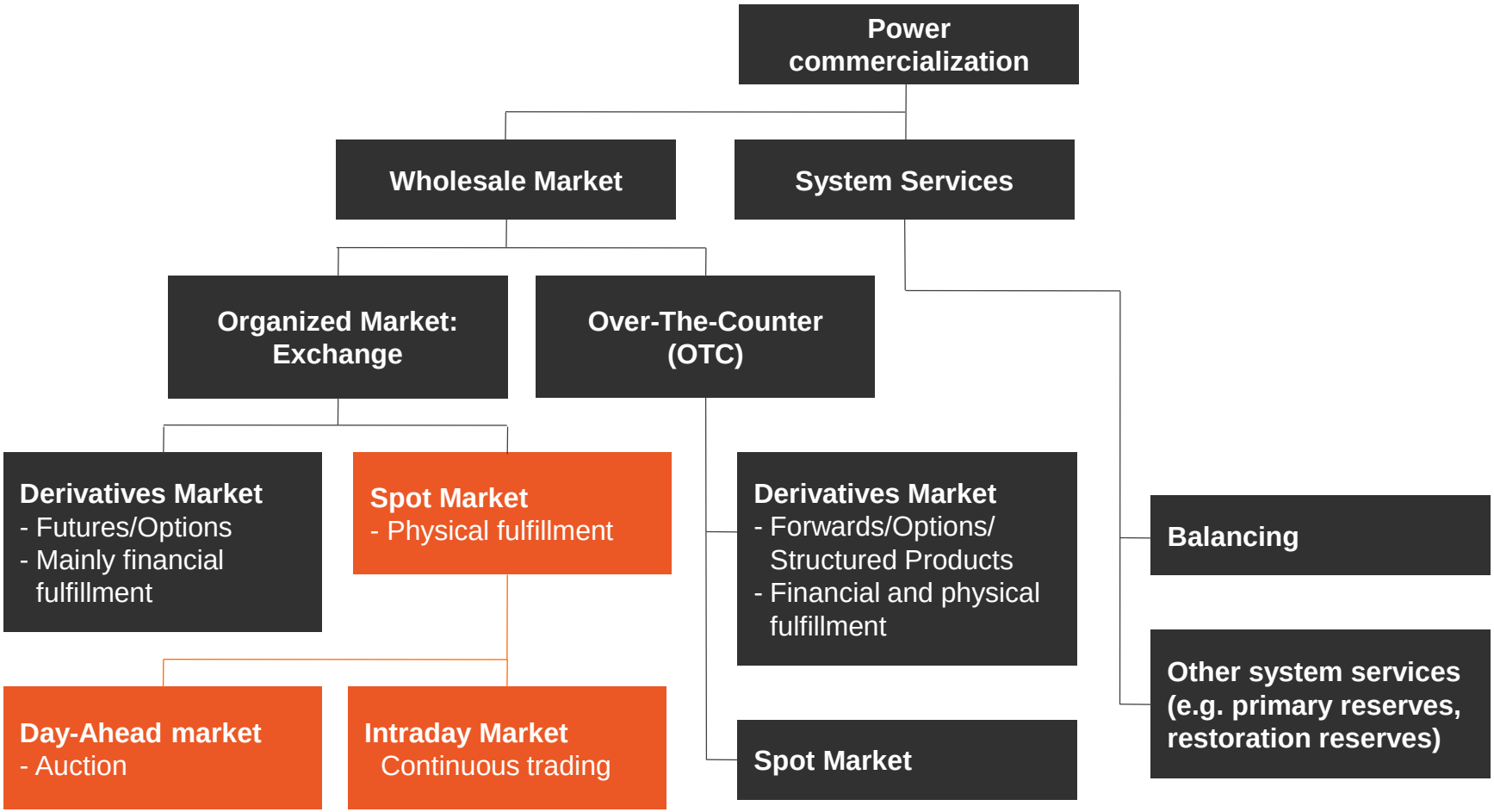
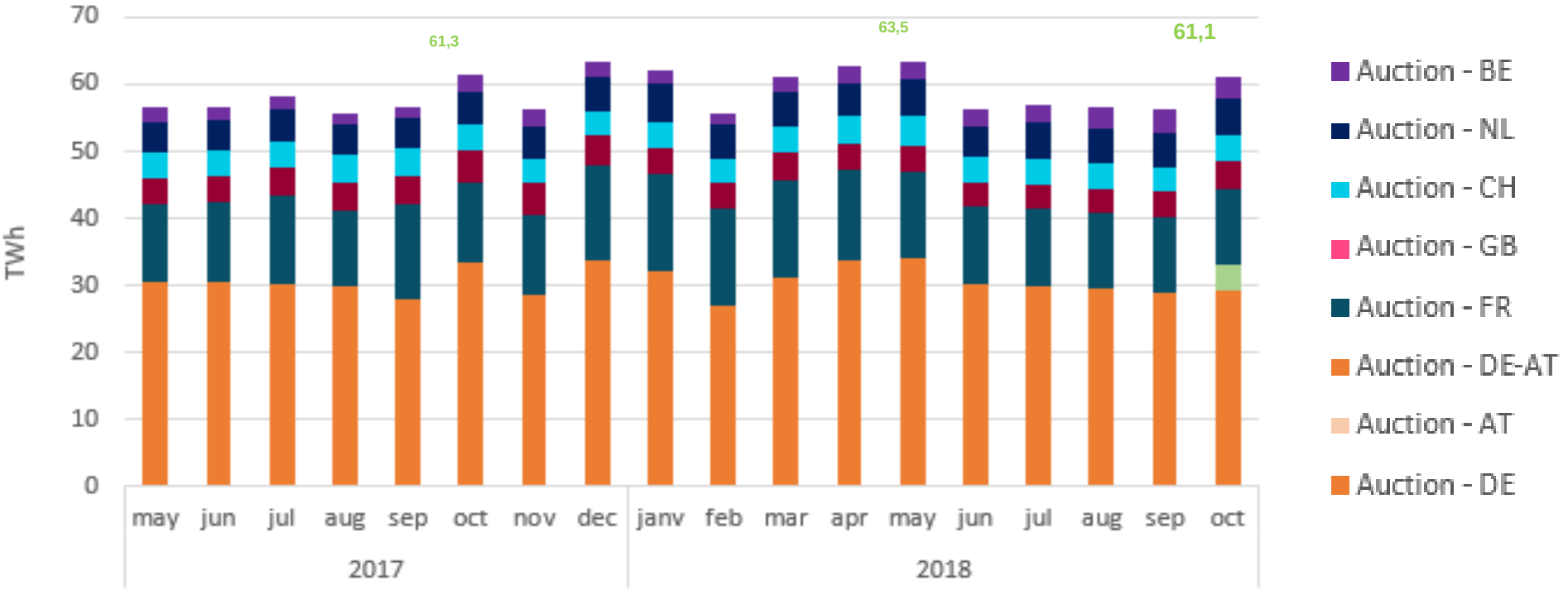
Ways of trading power on European Wholesale markets



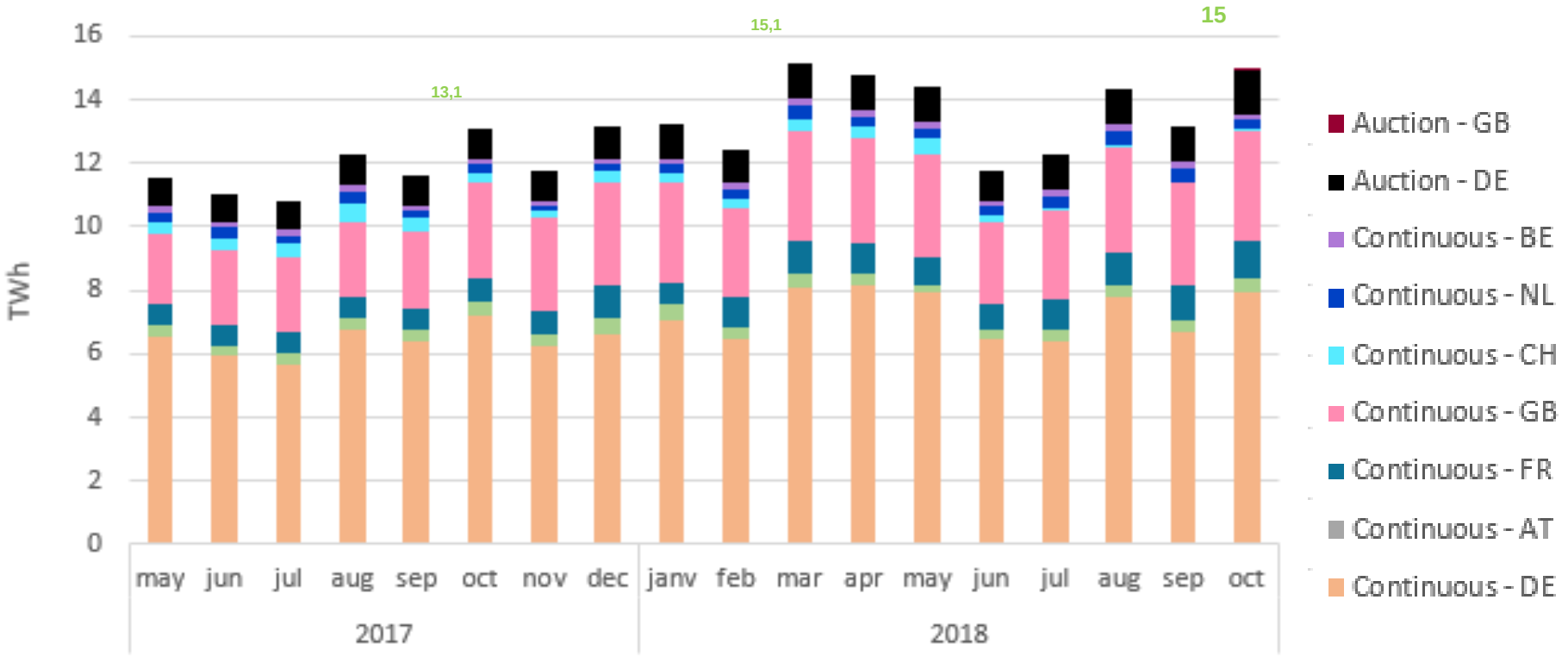
EPEX SPOT Volumes: Day-Ahead Market

- October **Day-ahead** volume seem almost at the same level as October 2017 at 61 TWh :
  - **BE market** keeps good developments (+0.9 TWh) compared to September 17 (+28%) at the same level as the past two months
  - The DE-AT split does not change the overall **DE and AT markets** volume compared to October 2017 (-0.4 TWh with -1%). First month of standalone **AT market** reaches 3.7 TWh
  - **GB market** sees its best month of 2018, yet still below October 2017 (-0.6 TWh)



EPEX SPOT Volumes: Intraday Market

- **Intraday** volume is back to best level with progress in almost all market areas at 15 TWh in October 2018, reaching almost March 2018 record of 15.1 TWh
  - **DE continuous** represents the most important year-on-year growth (+0.67 TWh with +8%)
  - **3 monthly records : GB** (+0.5 TWh vs. Oct. '17), **FR** and **DE** (+0.37 TWh vs. Oct. '17 each)
  - **CH market** at 0.1 TWh compared to Sept. (+0.06 TWh) but far from October 2017 (-90%)

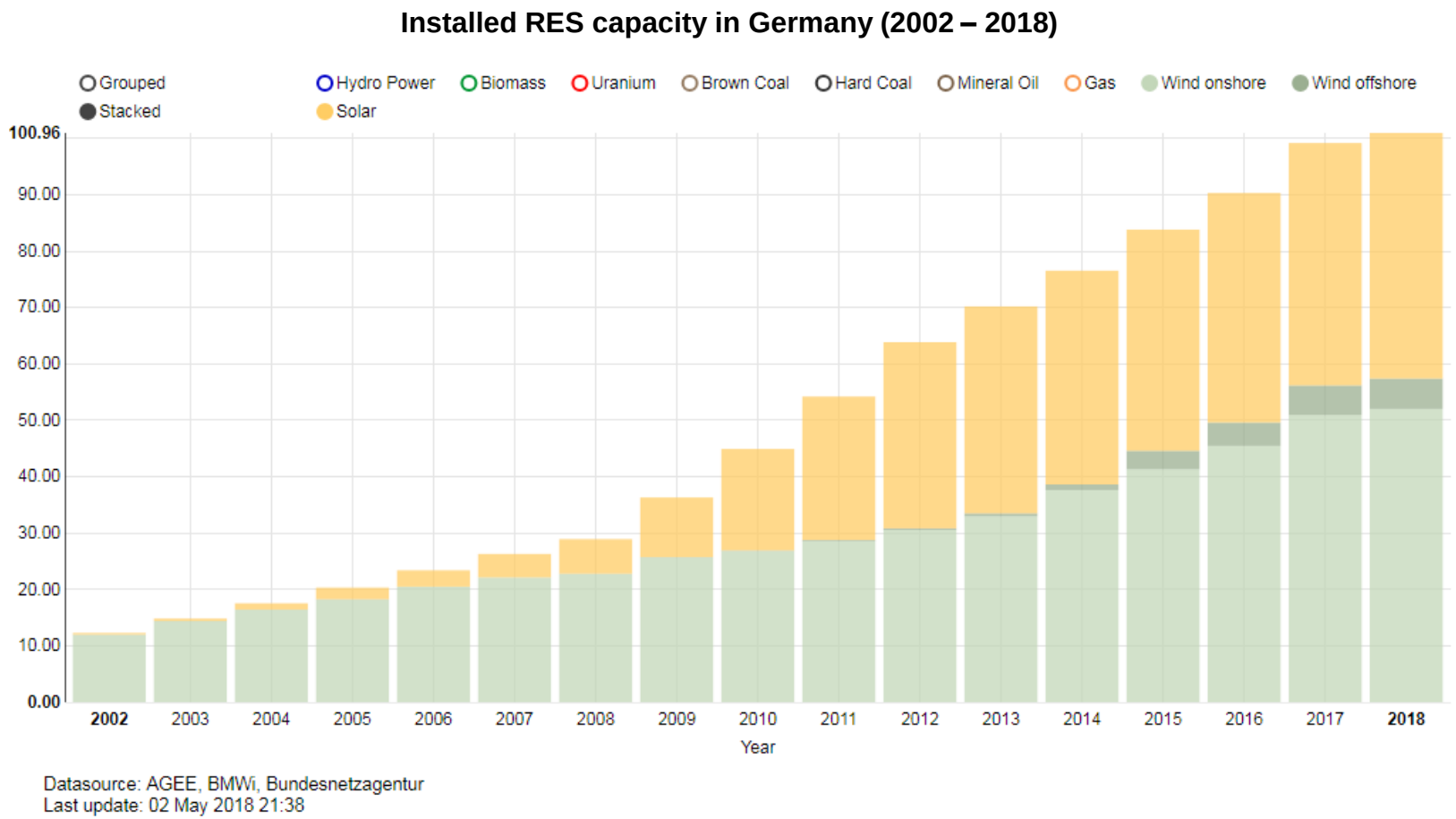


Item II. Wholesale market trends and developments

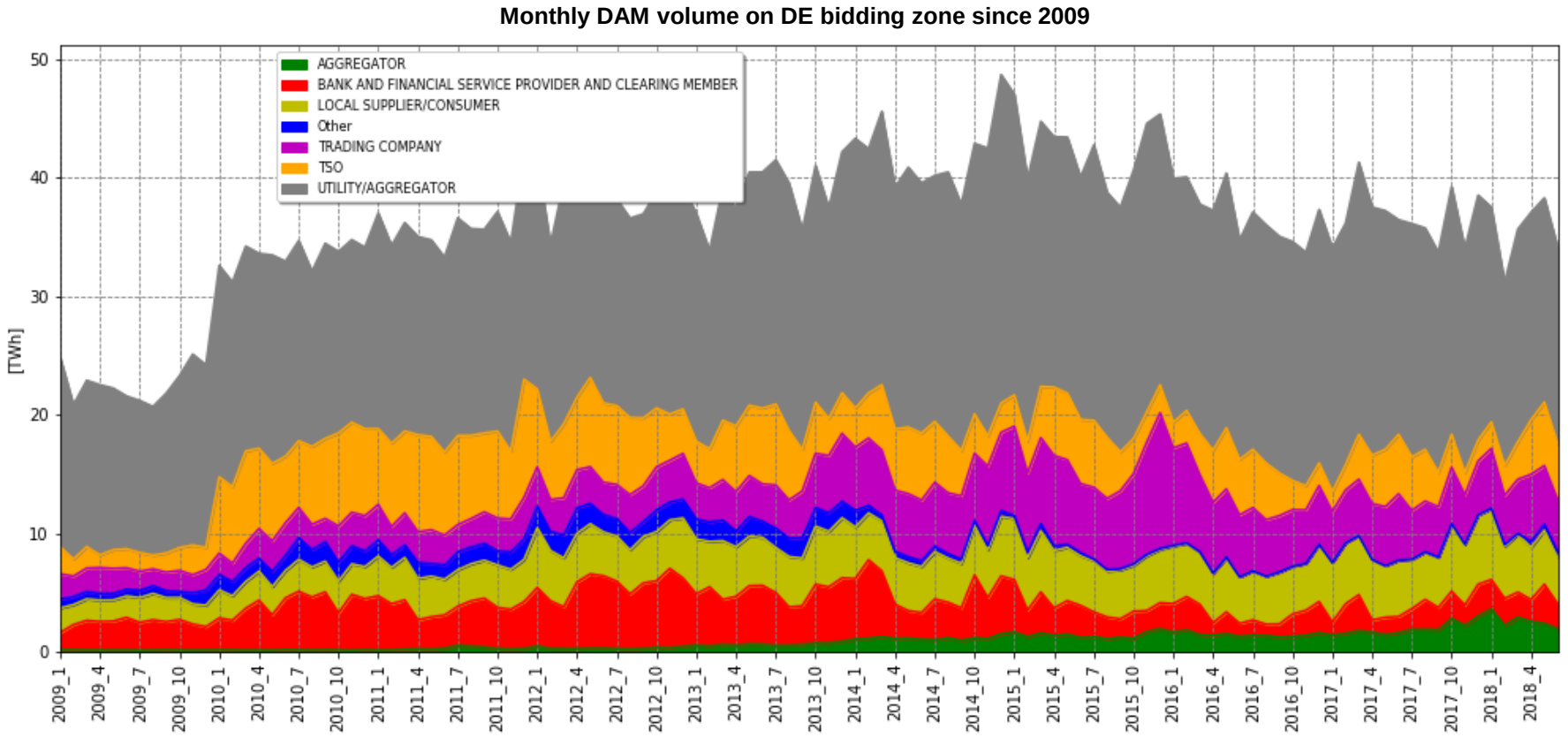
10.30 – 11.30

Item I.	Long-term trends and developments
Item II.	Local flexibility markets
Item III.	Appendix: enera initiative

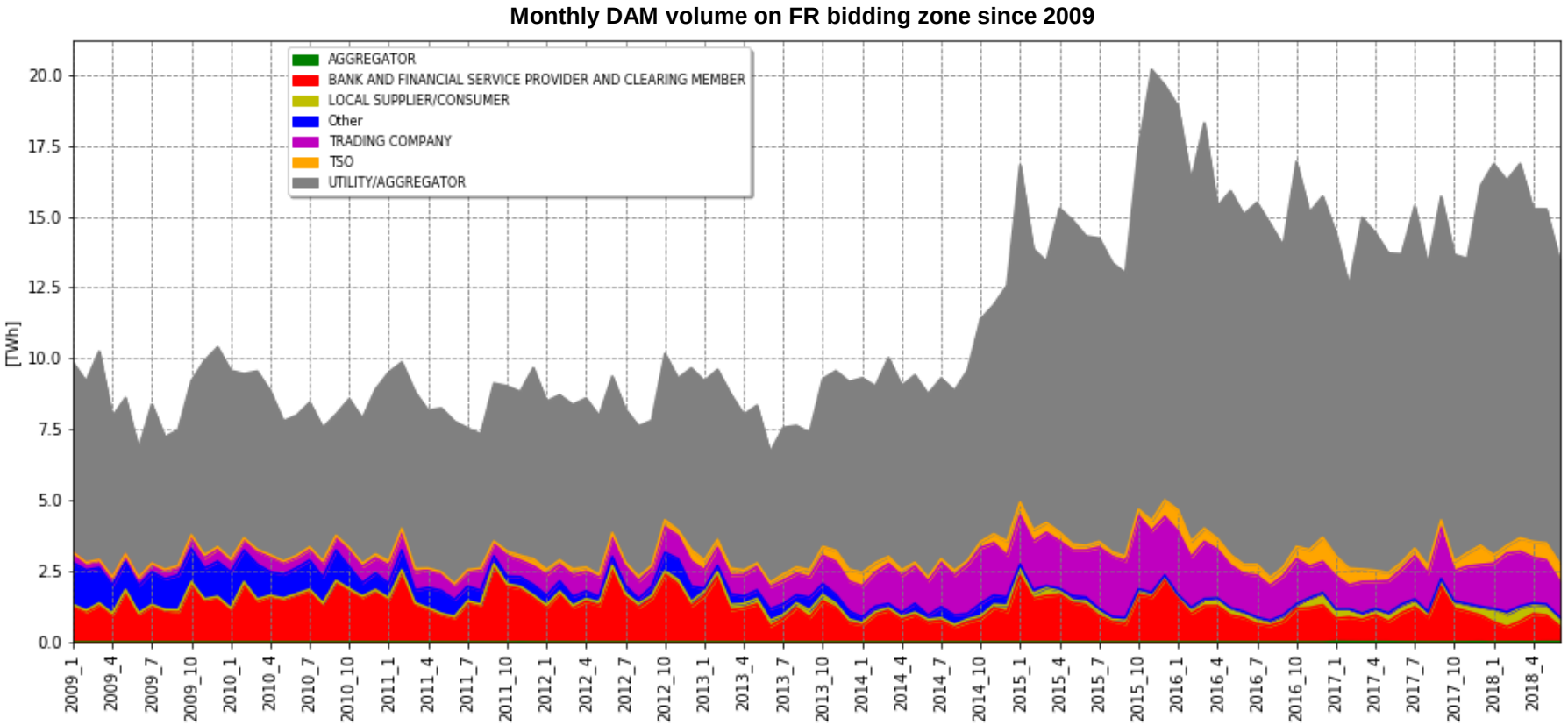
Skyrocketing intermittent RES installed capacity in Germany and other European countries



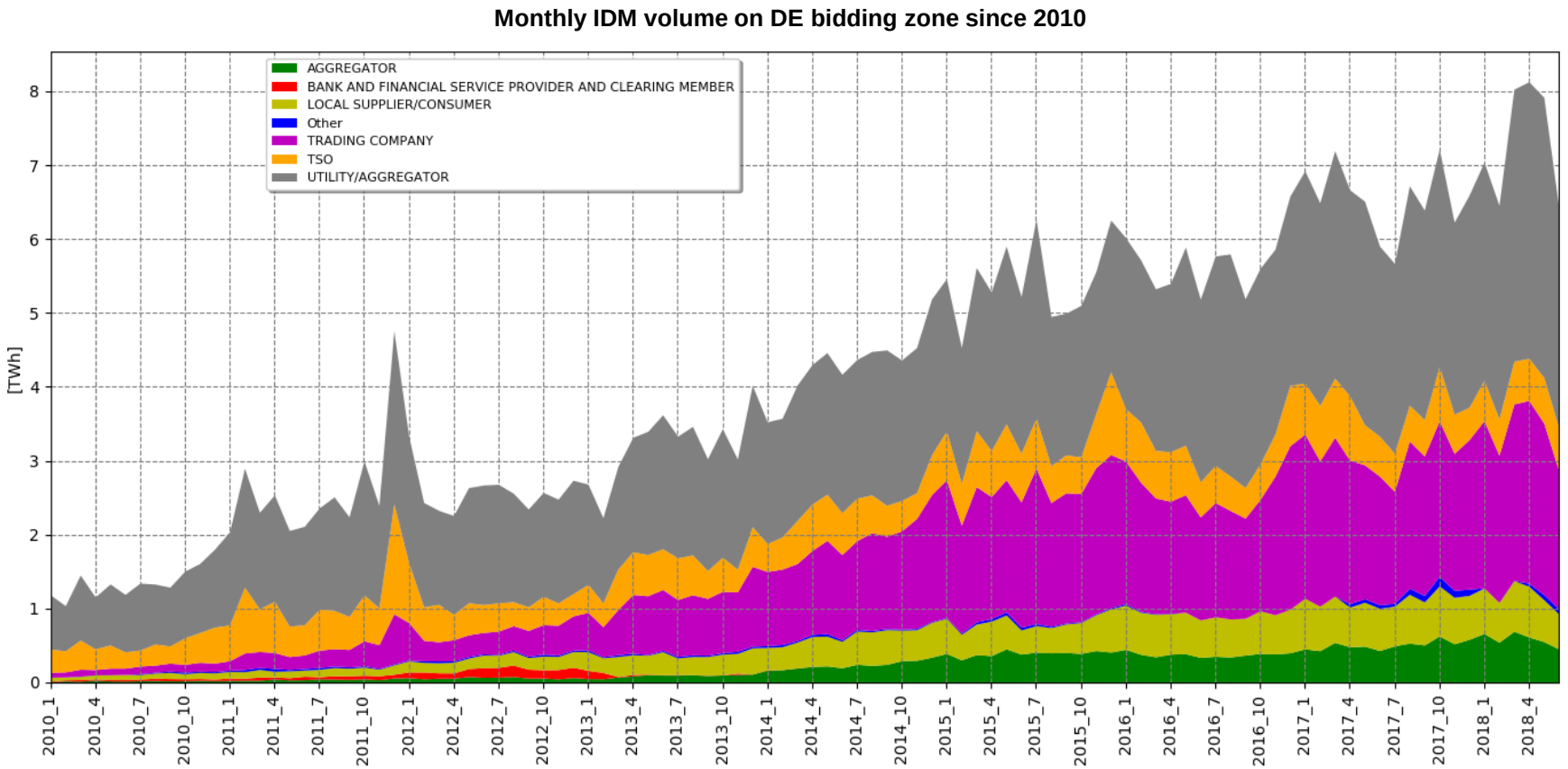
DAM DE volumes



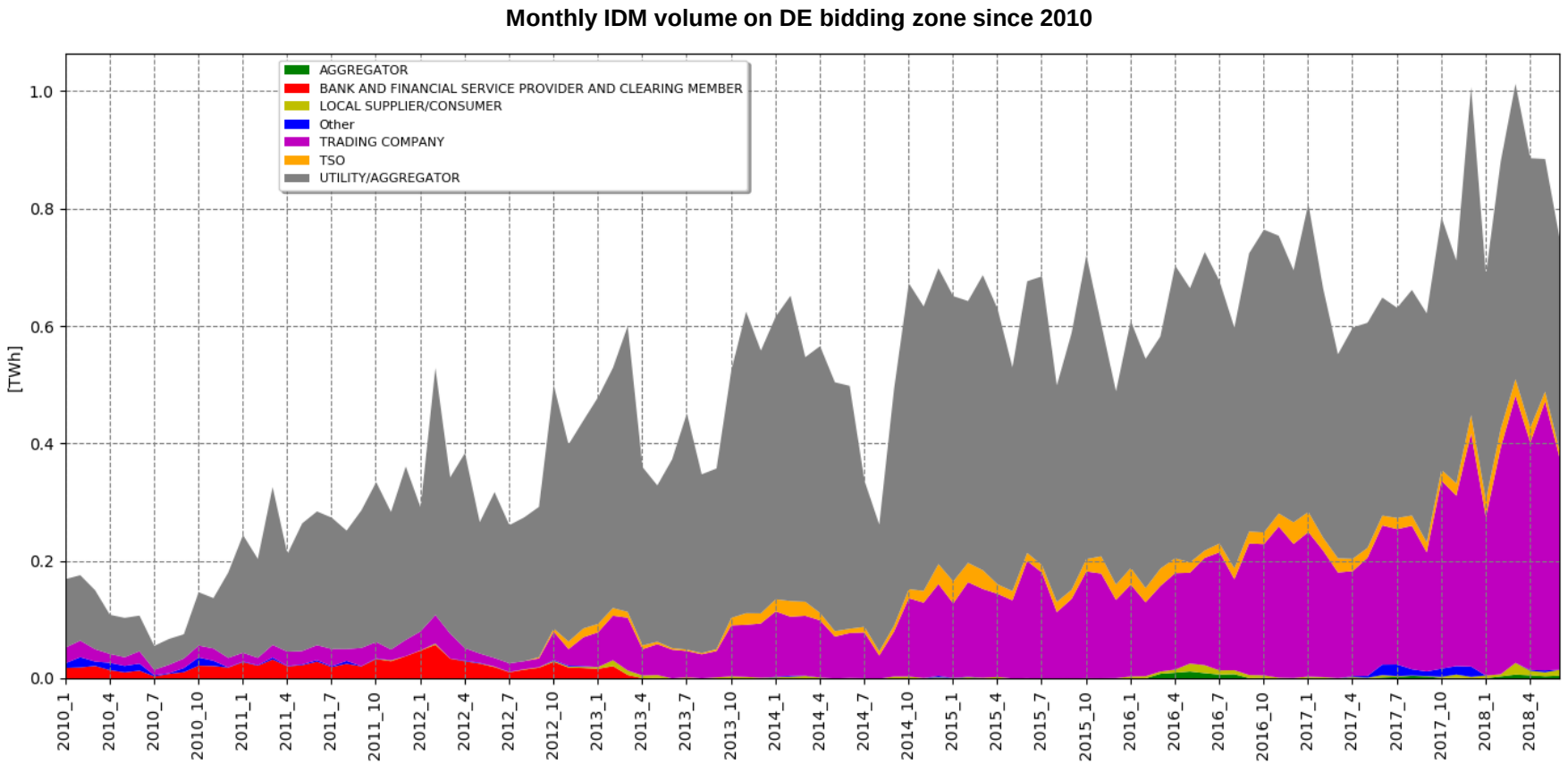
DAM FR volumes - Two sided Local volumes



IDM DE volumes - Two sided Local volumes

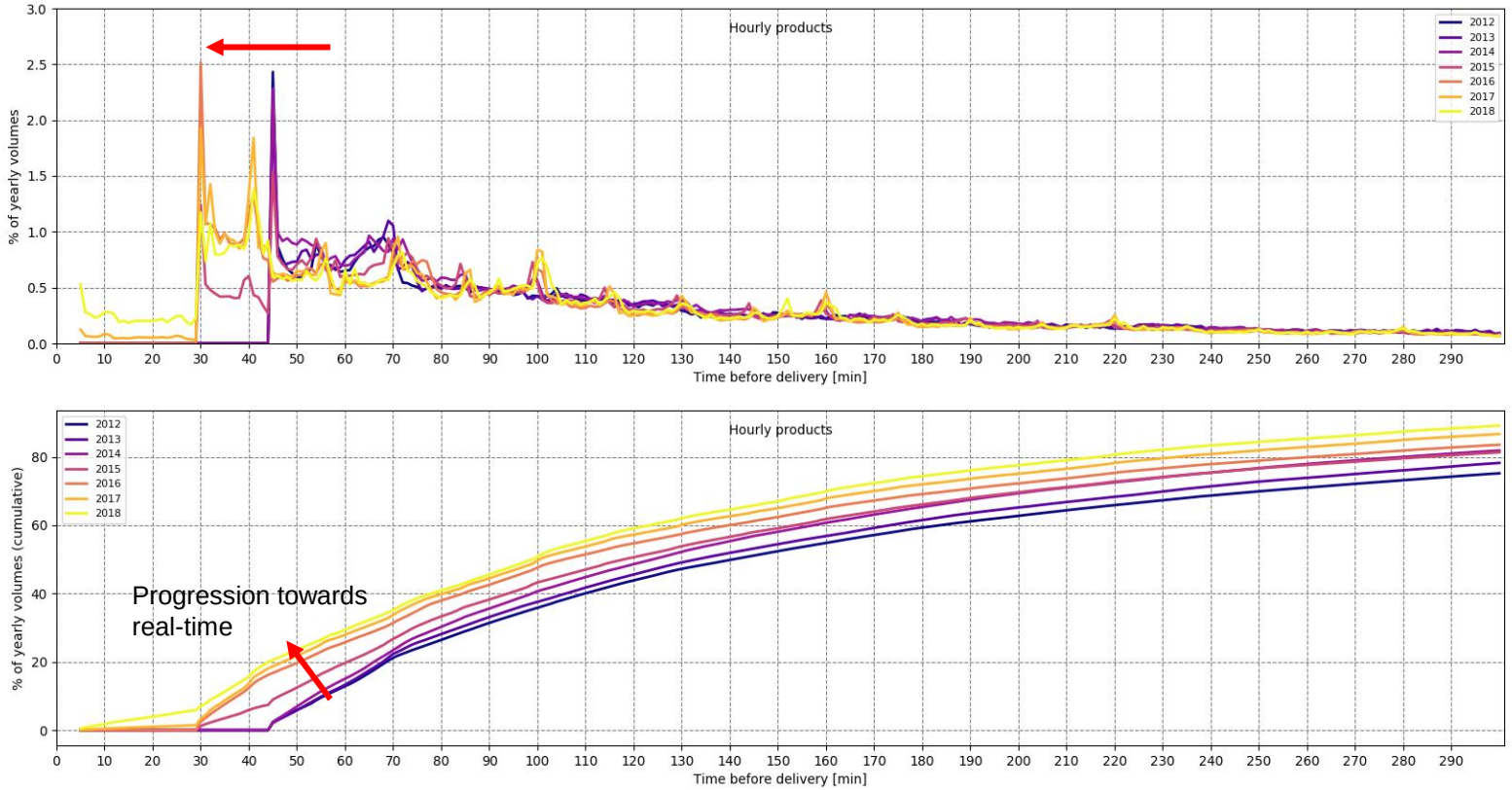


IDM FR volumes - Two sided Local volumes



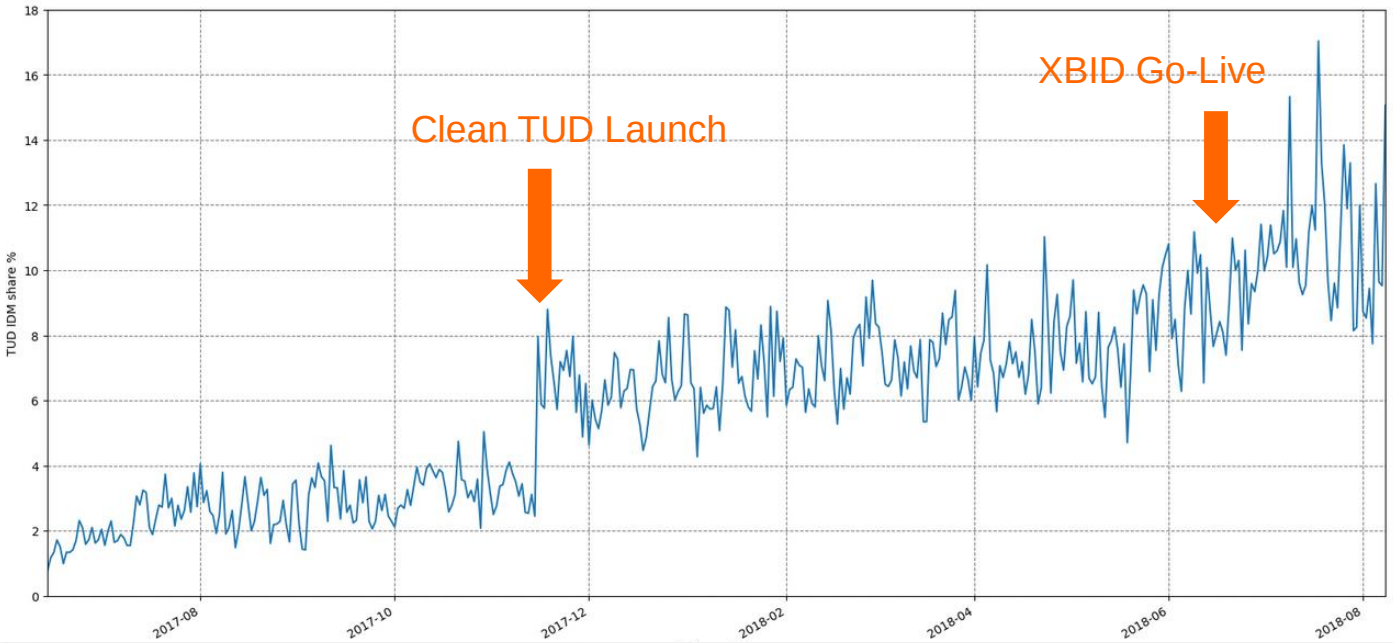
Bulk of volumes is traded closer to real-time

Lead time of all trades of 60-min products with at least 1 leg in DE



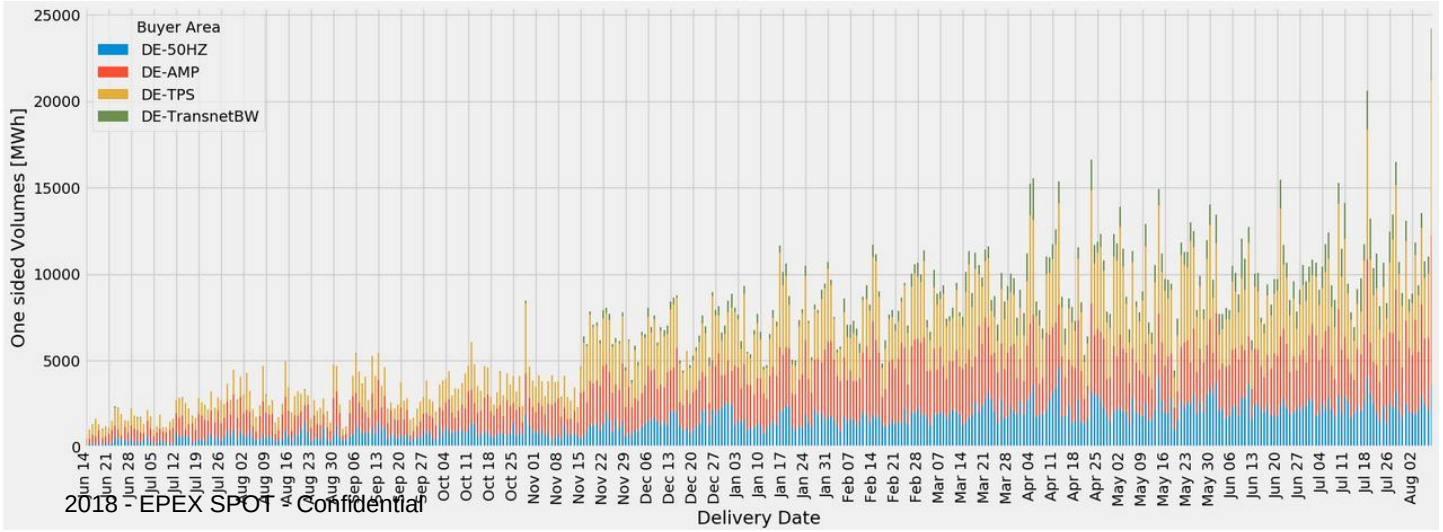
In 2018, 60% of total volumes have been traded between 0 and 120 minutes before physical delivery

Evolution of Trading Until Delivery (TUD) volumes



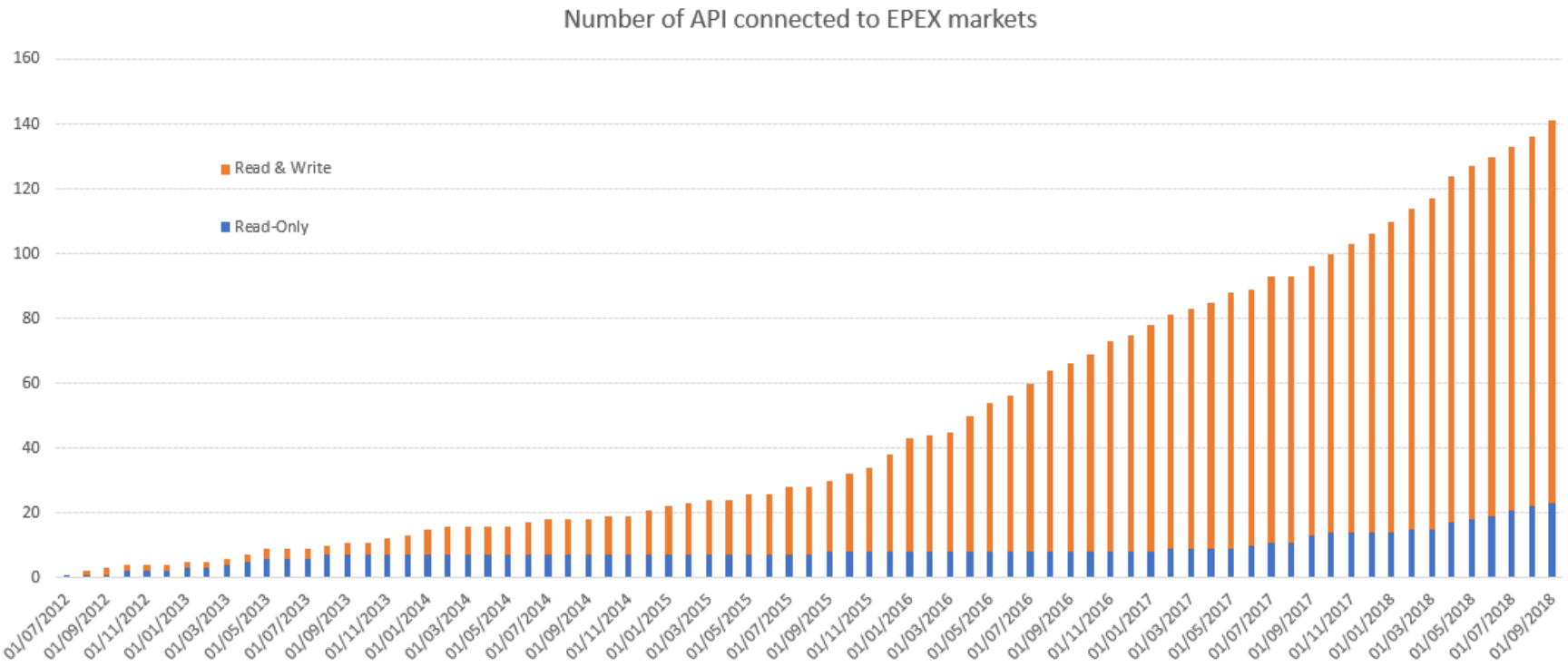
Average **TUD share** in the IDM DE volumes in **the two months before Xbid: 8%**

Average **TUD share** in the IDM DE volumes in the two months **after Xbid: 10,3%**



The share between the 4 German TSO control areas is roughly equal, except for TransnetBW where it is smaller

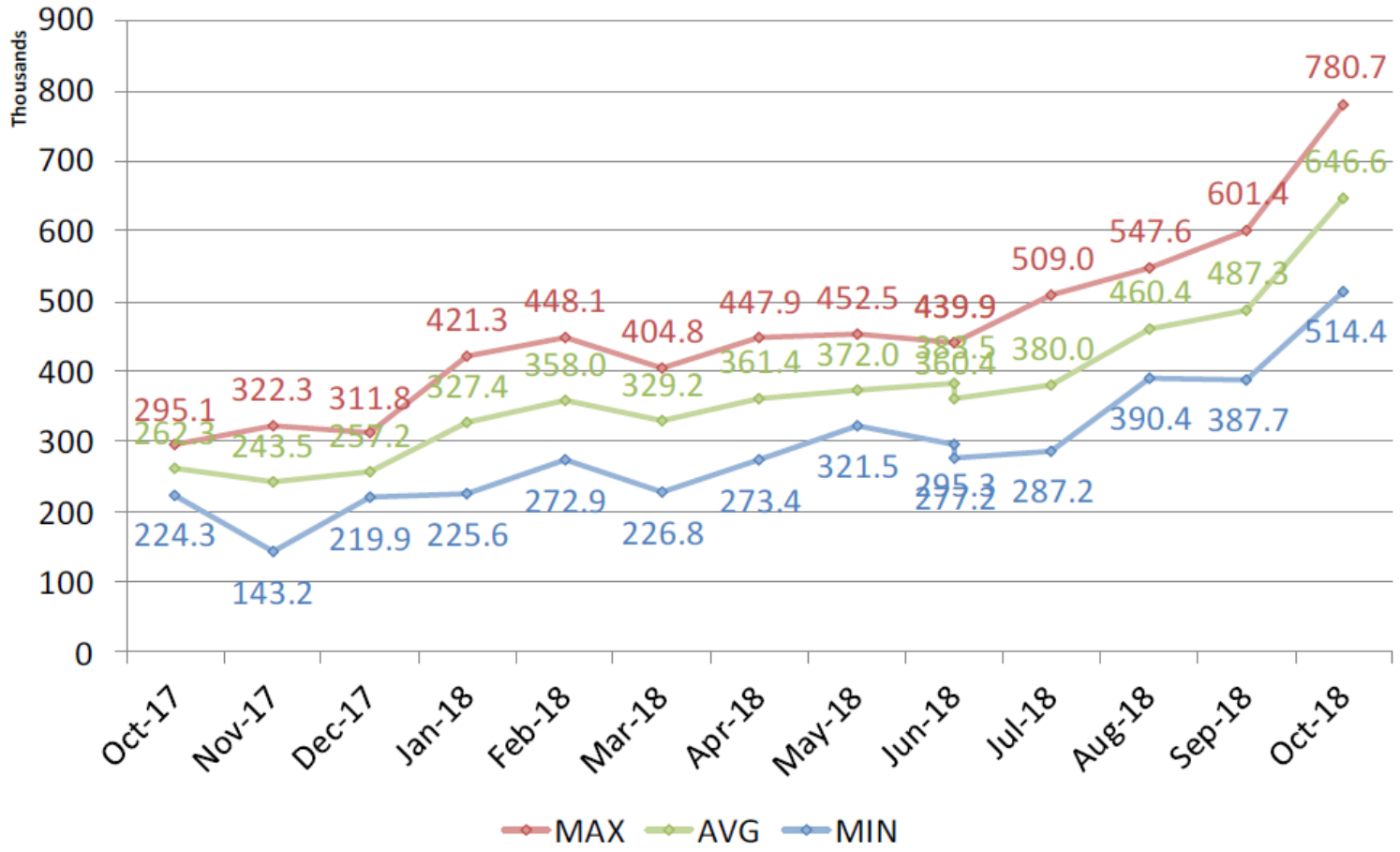
Robots/API developments



Source: M7 API_Invoicing ID Waitinglist Overview: API in production (Sept 18 update)

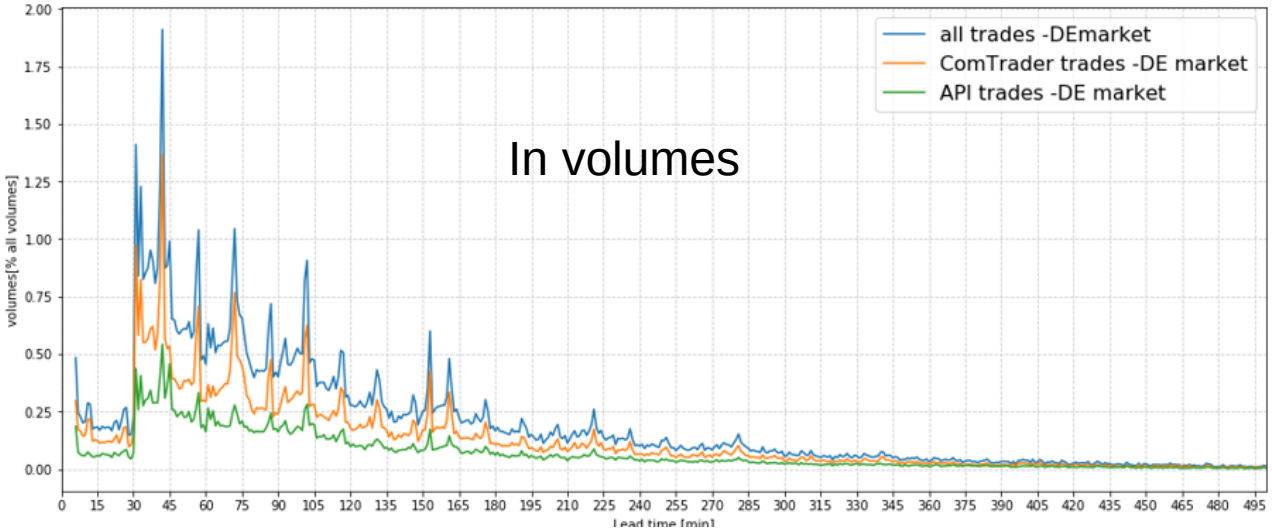
In 2018, 38% of APIs in production are developed by members themselves and 62% are provided by ISVs

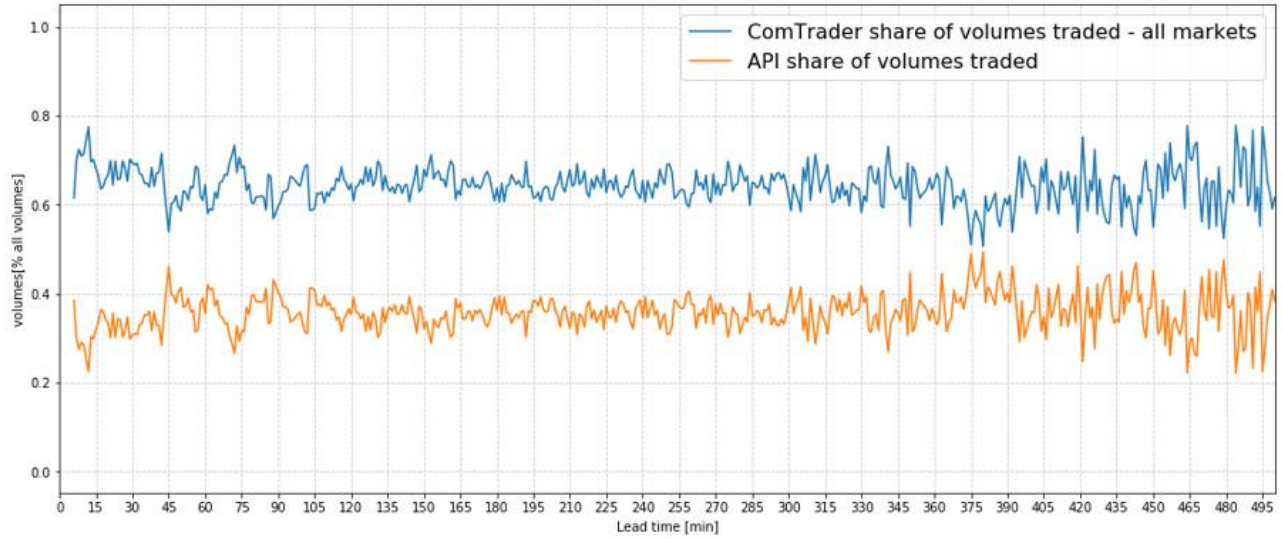
Increased performance of M7



The number of orders a day (both avg and max) has grown significantly from January 2018 on (~25 % for both)

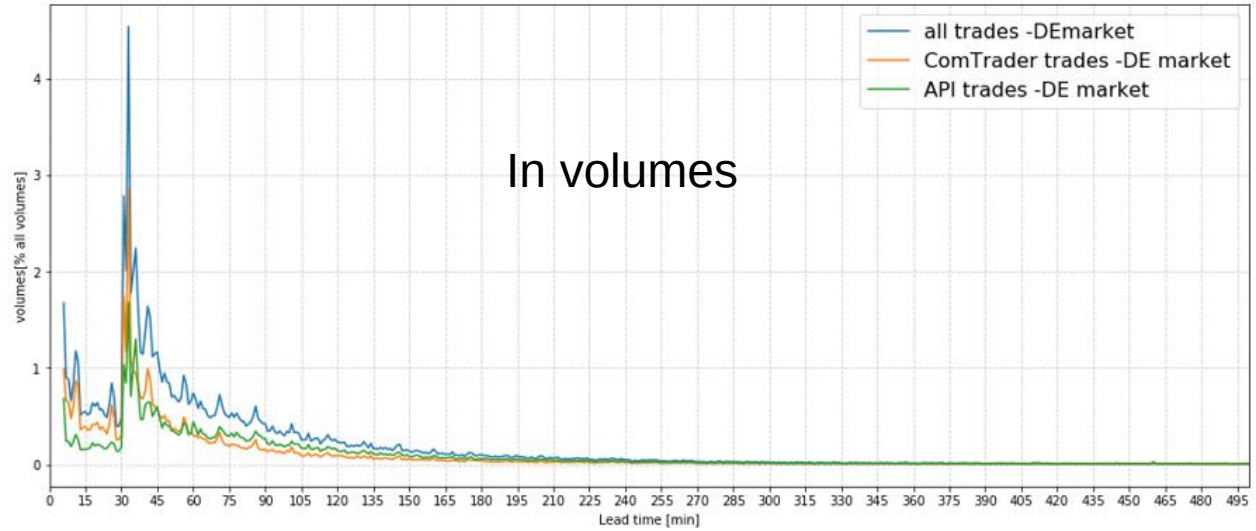
API Vs COMTRADER: Trades on M7 Hourly products – DE area

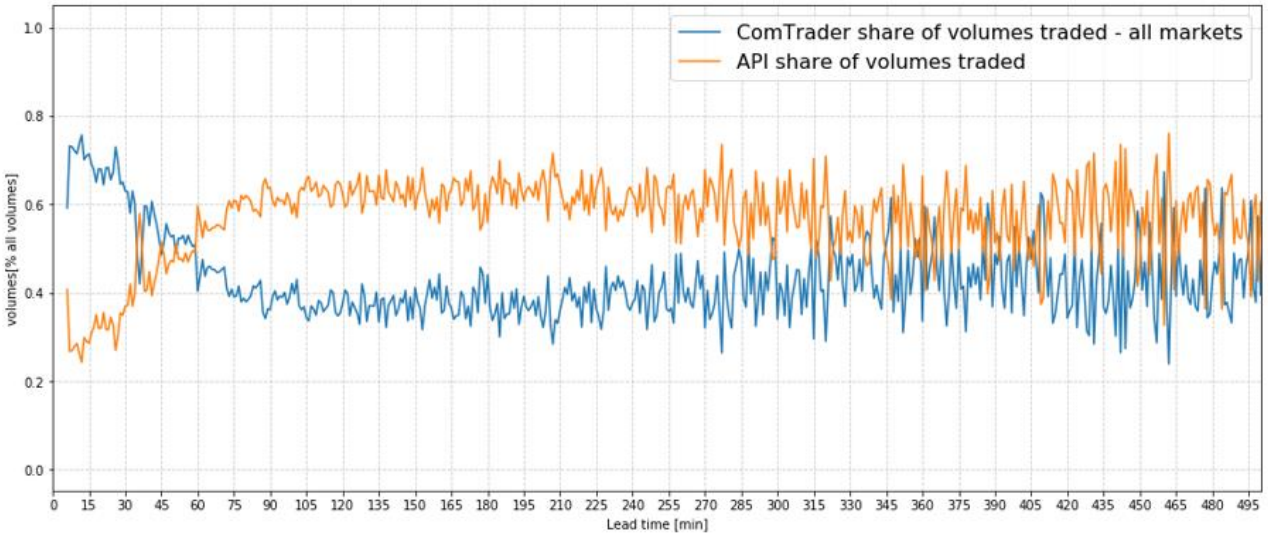




The market share of Comtrader vs APIs is rather stable throughout the session and even slightly increases during the TUD

API Vs COMTRADER: Trades on M7 Quarter-hourly products – DE area





The market share of Comtrader vs APIs is rather stable and Below APIs until 90 min before start of delivery. It is increasing closer to delivery and is above APIs from 60 min before start of delivery onwards.

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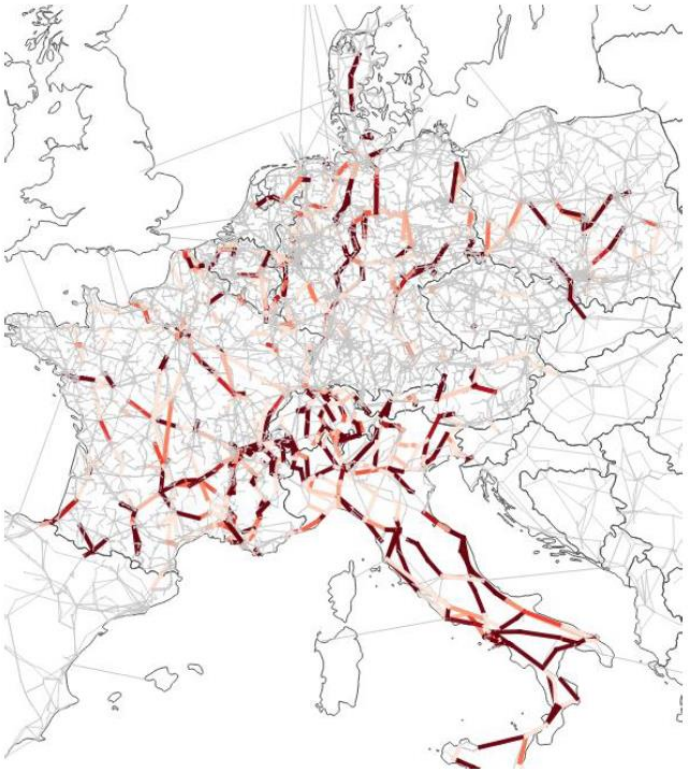
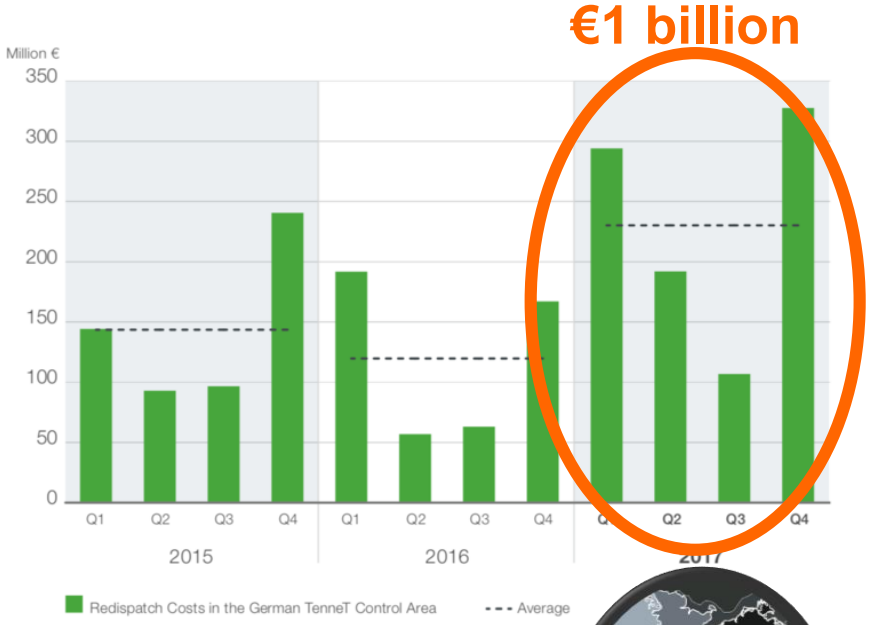
Congestions are slowly appearing in Europe

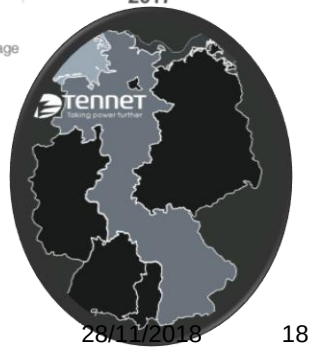
Study on congestion run by the RWTH Aachen University in 2018



Redispatch costs in the TenneT control area, spreading from the North-West to the South-East of Germany, between 2015 and 2017



Source: ENTSO-E Transparency platform



Extensive discussions at European and National levels on the bidding zone configuration

1. Bidding zones (re-)configuration

Bidding zones **are at the heart of the European power market** design:

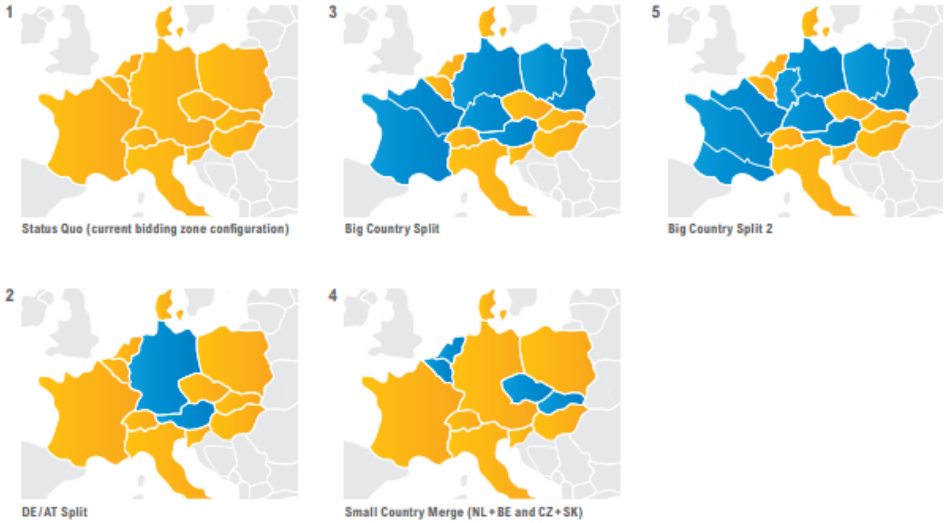
- Cross-border capacities are considered between the bidding zones
- Trading is unrestricted inside the zones

➔ **Their configuration is of the utmost importance for the efficiency of the power system but raises important questions.**

The current context is the following:

- Increasing occurrences of loop flows
- Limitation of cross-border capacities allocated in the DA market
- Increasing "intra-zonal" congestion issues in Germany and other countries
- Push from the European commission to increase the available cross-border capacity in the DA auction

Outcome: Risk for further splitting in coming years throughout Europe



Scenarios studied in the bidding zone review by ENTSOE (2018)

The results of this first Bidding Zone review were inconclusive as to which configuration should be the most efficient.

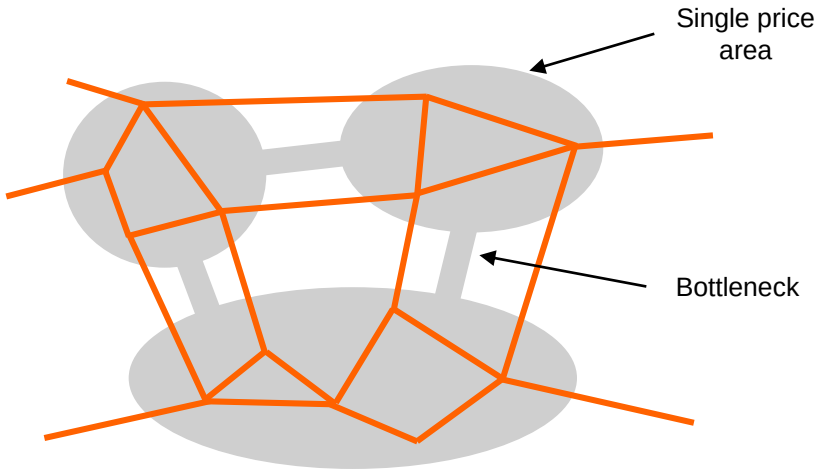
➔ This shows the complexity of these questions but more importantly shows the risks in case of bidding zone reconfiguration.

Source:
https://docstore.entsoe.eu/Documents/News/bz-review/2018-03_First_Edition_of_the_Bidding_Zone_Review.pdf

Zonal vs Nodal market designs

2. Nodal market design

The nodal market design relies on the concept of **Locational Marginal Pricing**. Each node of the transmission network is considered separately and in relation with the available transmission capacities. An optimal dispatch of the power plants is then calculated, based on marginal costs of production, load and other technical parameters.



	Nodal market	Zonal market
Short-term efficiency	• Maximization of the economic welfare by calculating the optimal dispatch at a nodal level	• Approximation of the optimal dispatch when the bidding zones follow congestions • Handling of congestions through redispatch • Potential impact on available cross-border capacity (uncertainty and security margins)
Long-term efficiency	• Locational signal for long-term investments • No cost associated with congestions	• No locational signal to orientate investments
Bidding	• Centrally dispatched unit bidding • Bidding based on technical constraint of the assets	• Portfolio bidding • Free bidding based on marginal costs
Liquidity and market power	• Increased transparency on grid needs • Market power can be concentrated on some nodes of the system	• Very good liquidity pool created by the large bidding zone for both long-term and spot markets
Complexity	• Very complex on many aspects: technical, political, economic	• Complex for TSOs to calculate available cross-border capacities and to monitor and organize their redispatch

Zonal vs Nodal market designs in the European context

- Nodal: best theoretical solution for price signal and resources allocation of short-term dispatch.

Can nodal system be extended to optimize distribution networks? ➔ Not sure

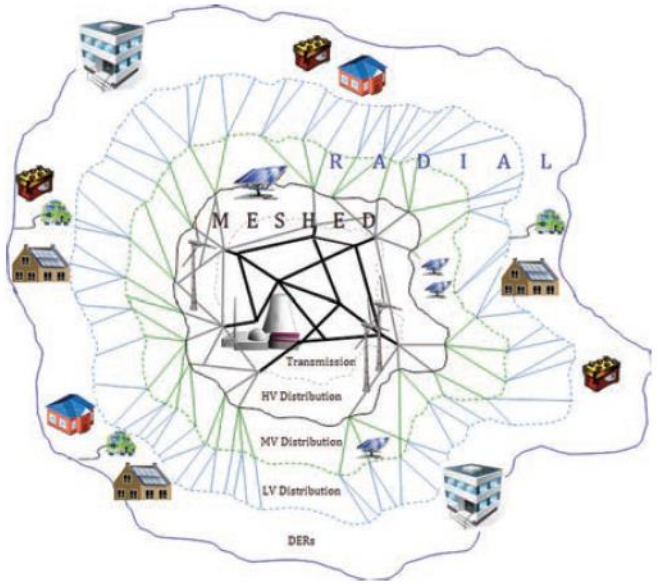
- **Congestions not proportional to nodal issues**: big bang or nothing, Sub-optimal to make nodal / zonal coexist (renders system sub-optimal)
- **Implementation complexity**

➔ Technical complexity: Probably manageable (working solutions exist, e.g. US) but a lot of work…
➔ Regulatory complexity (CACM): Need to change CACM and completely and rethink the European model
➔ Political complexity (national willingness not to split)

- **Redistribution effect** (a lot of sunk investments questioned)

➔ Financial compensation schemes needed.
But for how long? Transition schemes? A “badly located asset” is doomed forever. Is a transition scheme enough in this case?

- Mechanical algorithm vs market
- Long-term markets are jeopardized



Local Flexibility Markets: High-level perspective

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 by Entso-e)

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, smart metering, etc.) and **new flexibility sources (EVs, demand response, storage, 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

The traffic light concept: a helpful concept to understand interactions between market & grid

- The traffic light system is an indication of the actual status of grid and market interaction. Market information of the actual usage of flexibility through DSOs. The traffic light system is not an indication of the actual grid condition/available grid capacity nor Info on actual grid stability and security of supply.

- The traffic light concept raises a model for discussion as to how market participants and network operators can interact with one another in future. Using the logic of a traffic light, between the green market phase, in which the power grid functions for the marketplace without restrictions and the red phase in which the system stability is jeopardized.

Optimize grid operation especially within areas of high iRE4S share to solve grid bottlenecks

Design grid - market interactions within the Orange regime.

Develop and use flexibility for the distribution grid to minimize grid expansions

The traffic light concept

Flexibility is controlled by TSO/**DSO** without contractual basis to **preserve** a **secure network operation**

Flexibility is requested by TSO/**DSO** on a contractual basis to **avoid economic inefficient network expansion**

Flexibility is offered by **aggregators** for market and system oriented **portfolio optimization** and for **balancing**

- **Goals of the traffic light system**
  - Open up flexibility
  - Solve grid congestions
  - Expand energy grids in the long term
  - Enhance interaction of grid & market

The main 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 transparent market mechanism

- **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

Key design elements

The experience from many workshops and discussions around the topic of Local Flexibility markets helped us to understand the following key aspects:

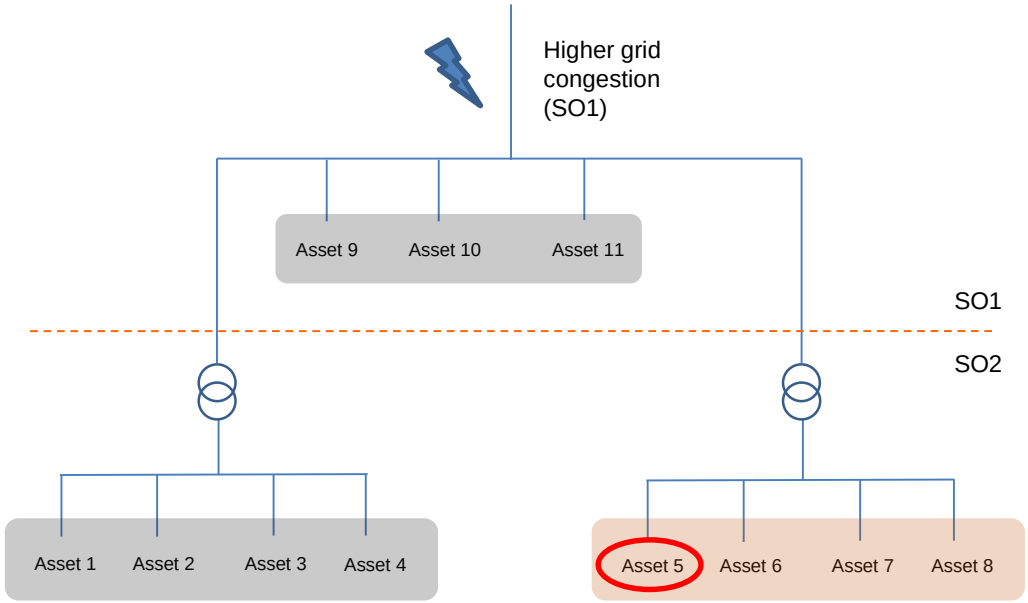
- **Clear definition of roles and responsibilities:** TSOs – DSOs – Market Operator – Flexibility Providers
- **2 C's rule - Congestion & Competition:** there is a need to have a problem to solve (Congestion) and sufficient amount of Competition for a market-based solution to be efficient.
- **Certification:** the assets that can bid in the locational order books are assets that have been certified by a System Operator.
- **Physical impact need and verification:** when a flexibility is activated in the Local Flex Market, it must deliver **a physical impact at a given point of the grid**. This impact can be verified by a System Operator ex-post.
- **Who can trade?**
  - Step 1: Trades possible only between System operators and Flexibility Providers
  - Step 2 (to be assessed): Secondary market with trades possible between Flex Providers
- **How to maintain global control area balance?**
  - Option A: the flexibility provider to rebalance its perimeter on its own
  - Option B: the System Operator needs to balance the second leg
  - Option C: quote spread products directly between different locations in the grid

Coordination between System Operators: challenges

System operators can have access to the same flexible resources to solve their congestions. **How to make the dispatch of resources efficient and reliable?**

Coordination between different System Operators (consider the verticality of the grid, different grid levels):

- Need to avoid conflicting / inefficient activations
- Aggregate willingness-to-pay from different system operators



If SO1 wants to activate Asset 5 to lift the higher grid congestion:

➔ Does it create a new congestion for SO2?

➔ Maybe SO2 also needs this activation. Cost sharing? Priorities?

Market power is a serious question that can be tackled through various measures

Voluntary mechanism for DSOs and flex providers

- complementarity with existing mechanism in the red traffic light
- long-term view is that the market becomes efficient when new investments are made if absence of competition or fundamentals

Regulated mechanisms (capped prices, limits market power)

- cannot foster development of flexibility (economic space not existent to foster investment)
- Transparency of price, volume, location

2C: competition and congestion

- Not adapted everywhere anyway: need for an “adequate” amount of competition

Complementarity with grid investments

Long-term contracting to mitigate price / market power

- Ensure short-term liquidity at reasonable price thanks to long-term contracting
  - Long-term planning should be part of a wider planning process that brings coherence with grid reinforcements

Regulation and surveillance

- All the data is available ➔ regulation and surveillance by the joint work of Market Operator, Regulators and System Operators should enforce strong market rules that can lead to hefty penalties/fines.
- Inc/dec

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Presentation of the enera project

The challenge

- **The increasing share of installed renewable capacity is creating new challenges for system operators to manage the grid efficiently and economically**

The enera Project

- **The German ministry of Economic Affairs and Energy is funding the enera project to explore new smart market mechanism to allow for more renewable energies in the future**
- **The 3 pillars of the project are: Network, Market and Data**

A project to experiment a new kind of market to solve growing grid congestions, as a complement to grid reinforcements (software and hardware)

Flexibility supply

Flexibility providers:

- Power plants
- Aggregators
- VPPs
- Storage
- Renewables

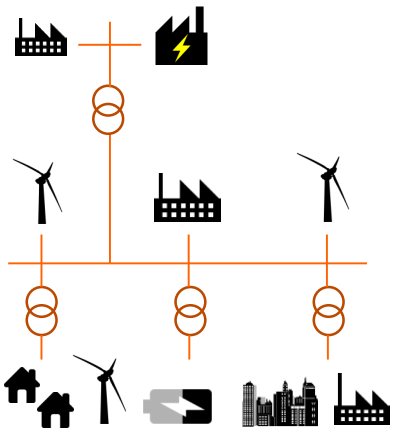
Flexibility market platform

epexspot

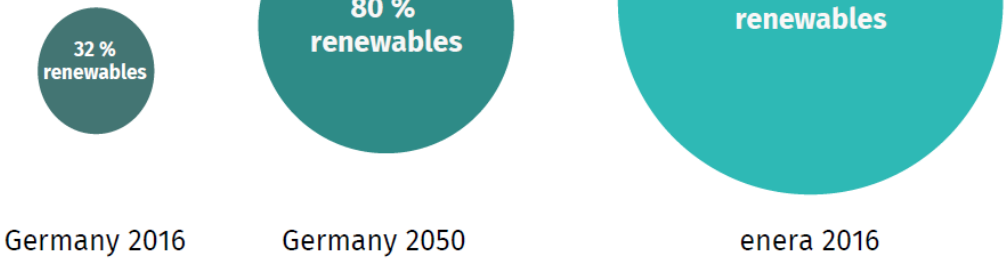
Market-based congestion management

Trading systems
Standards
Transparency
Coordination
Neutrality

Flexibility demand from system operators



ENERA Region: A significant wind production



ENERA partners: Consortium

POLITICAL PARTNERS

Niedersächsisches Ministerium für Umwelt, Energie und Klimaschutz

Niedersächsisches Ministerium für Wirtschaft, Arbeit und Verkehr

- Landkreis Aurich
- Stadt Aurich
- Gemeinde Bockhorn
- Samtgemeinde Brookmerland
- Gemeinde Dornum
- Stadt Emden
- Samtgemeinde Esens
- Gemeinde Friedeburg
- Gemeinde Großefehn
- Landkreis Friesland
- Gemeinde Großheide
- Samtgemeinde Hage
- Gemeinde Hinte
- Samtgemeinde Holtriem
- Gemeinde Ihlow
- Stadt Jever
- Gemeinde Krummhörn
- Stadt Lingen
- Landkreis Wittmund
- Stadt Norden
- Gemeinde Sande
- Stadt Schortens
- Gemeinde Südbrookmerland
- Stadt Varel
- Gemeinde Wangerland
- Stadt Wiesmoor
- Stadt Wittmund
- Gemeinde Zetel

CONSORTIUM

EWE, software AG, energy & meteo, TU Clausthal, ProSyst, devolo, EWE netz, FGH, Jacobs University, Schulz, RWTH Aachen University, SAP, TU Clausthal, 3M, Landkreis Aurich, BTC, Siemens, PPC, the peak lab., TenneT, Enercon, IABG, avacon, Phoenix Contact, DLR Deutsches Zentrum für Luft- und Raumfahrt, Stadtwerke Lingen, Bilfinger, Viessmann, Likron, Hochschule Fresenius, theben, NEXT ENERGY, OFFIS, Younicos an aggreko company

enera

Local order book system

A global market…

EU XBID | EPEX	Bid		Ask	
Product	**Qty**	**Price**	**Price**	**Qty**
DE 03:00	10	*32*	*33*	25
DE 03:00	3	*31*	*34*	5
DE 03:00	8	*30*	*35*	1
DE 03:00	7	*29*	*38*	4

In parallel with…

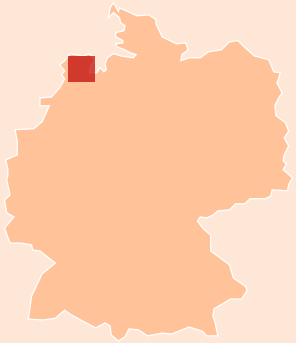
Local Market 4 | Bid | Ask

Local Market 3 | Bid | Ask

Local Market 2 | Bid | Ask

Local Market 1 | Bid | Ask

Product	Qty	Price	Price	Qty
DE 03:00 Local 2	10	*32*	*33*	25
DE 03:00 Local 1	3	*31*	*34*	5
DE 03:00 Local 1	8	*30*	*35*	1
DE 03:00 Local 1	7	*29*	*38*	4
DE 03:00 Local 1	7	*21*	*58*	4



“On-demand” local markets

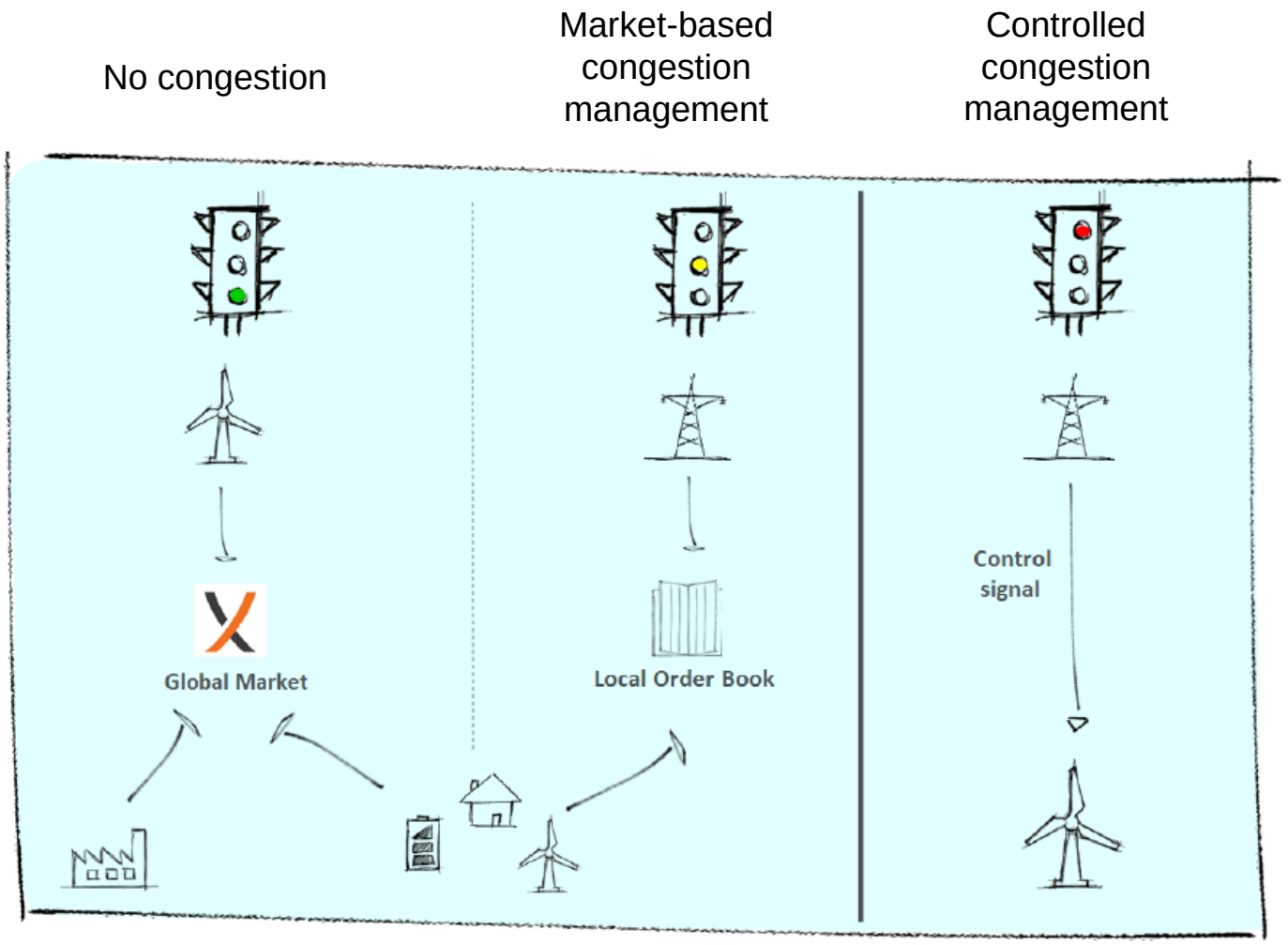
Main principle:

➔ Opening of “on-demand” locational order books in the intraday timeframe to solve congestion issues

Important elements

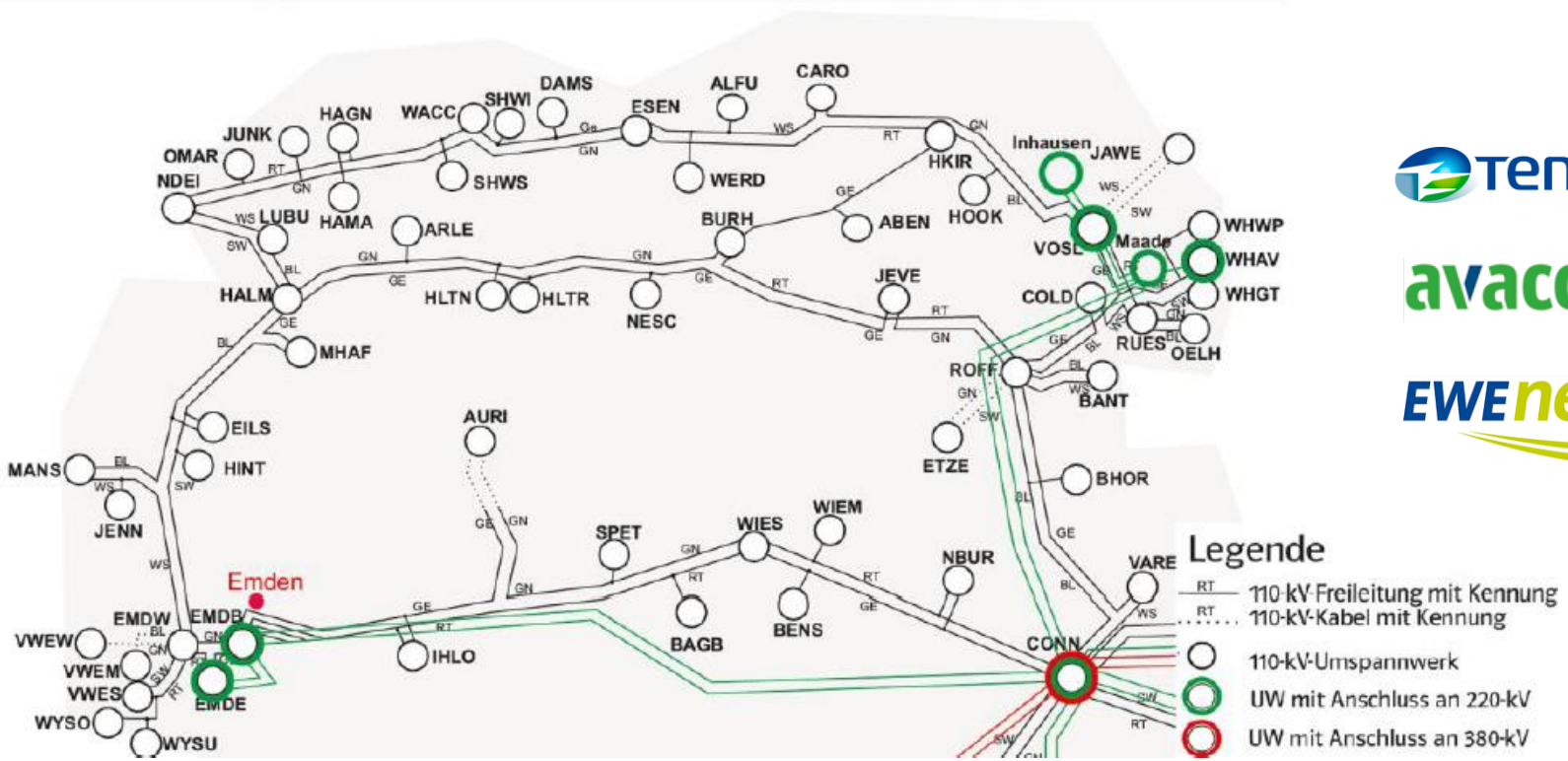
- ✓ *Local trading certifications delivered by System Operators to market participants*
- ✓ *“2 C’s rule” ➔ need of Congestion AND Competition to open a locational order book*
- ✓ *Strict compliance rules for local trading*
- ✓ *Cooperation between transmission and distribution over locational trading*

The process



Source: enera

Physical grid bottlenecks appear in the region on three SO grids

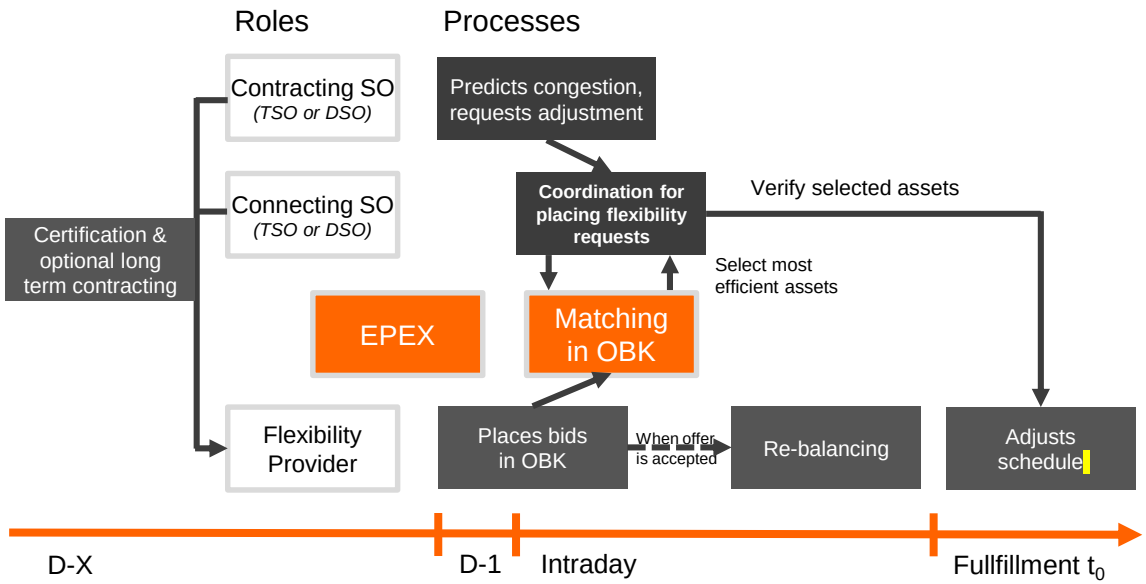


A complementary marketplace to alleviate congestions and value flexibility

The Flexibility Providers can bid the same asset on both the zonal Intraday market and a locational order book (when certified by the relevant SO for this local market area).

The Local Flexibility Market (LFM) is complementary to the zonal Intraday and the balancing markets.

New Local Flexibility Markets (congestion management)

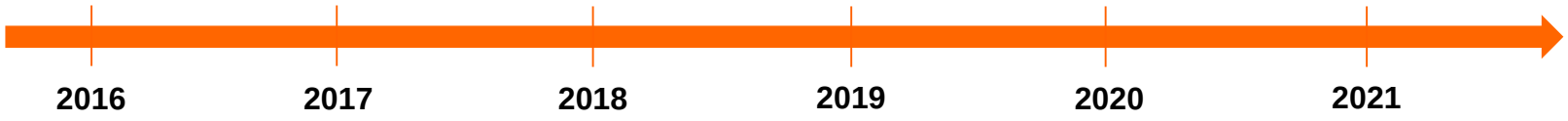


Existing markets (Intraday and balancing)

Balancing market

Continuous IDM

EPEX SPOT in project mode



Enera — Design Phase | Implementation | Demonstration

Other initatives — Other projects initiated

EPEX SPOT is designing the solutions to **address power system challenges** by:

- congestion management;
- enhancing the current design of liquid and large bidding zones.

This will create **new opportunities** for:

- the members to value their flexibility;
- for system operators to defer / complement costly grid expansion.

➔ The design can serve as a **blueprint for a much larger implementation.**