Organized electricity markets in different timeframes

Regional Training – EU4E

27 July 2023, Batumi, Georgia

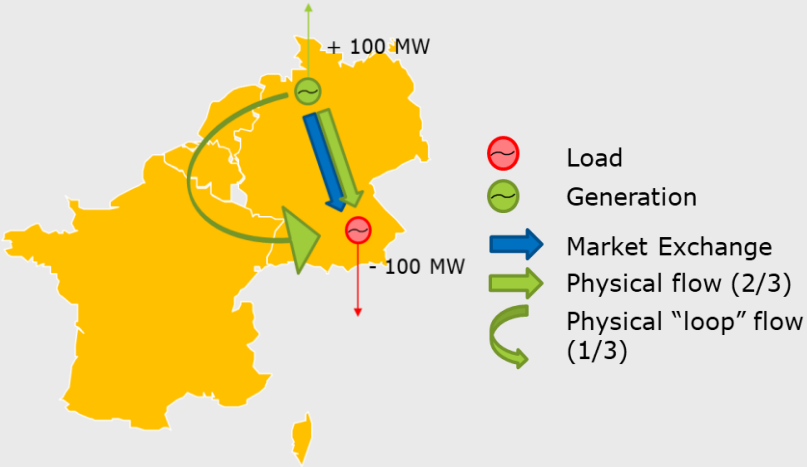
Agenda

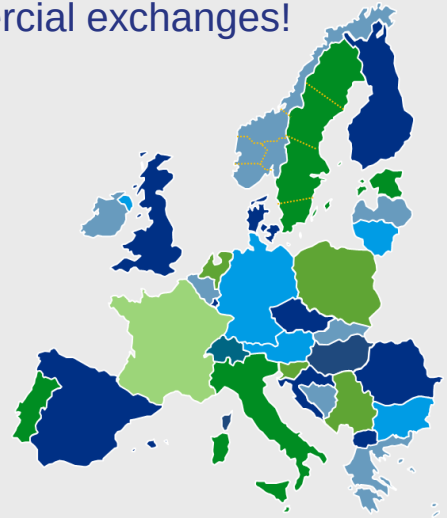
- ✓ **Introduction to electricity markets**
- ✓ **Different market segments and timeframes**
  - Forward market
  - Short-term markets (day-ahead and intraday)
  - Balancing market
- ✓ **Market coupling – SDAC and SIDC**
  - Legal framework
  - Nominated Electricity Market Operators (NEMOs)
  - SDAC and SIDC functioning

Introduction to electricity markets

Zonal model of the European electricity market

- Electricity markets in Europe rely on **bidding zones (zonal model)** which are assumed as ‘copper plates’ without structural congestion.
- Bidding zones are therefore defined as the largest geographical area within market patriciates are able to trade freely and without capacity allocation.
- Zonal model leads to differences between physical and commercial exchanges!





Source: TENNET

Physical limitations of the grid

Maximum electricity per cable

- Electricity is carried by cables, made of copper
- Cables can only contain up to a certain amount of electricity - physical capacity [MW]

Ability to withstand an outage

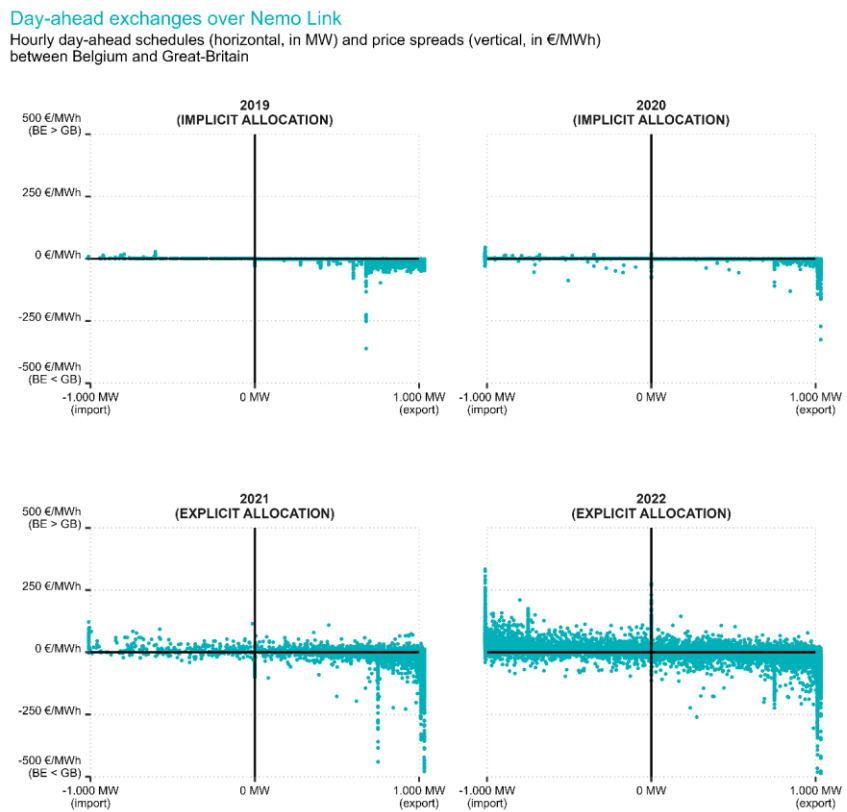
- In case a line is out of service, will be transfer to remaining lines.
- The grid must be able to sustain an outage. TSOs apply the “N-1 criterion”

Congestion management

Congestion: If volume of electricity that traders want to transport exceeds capacity that TSOs can make available

→ **capacity calculation and allocation between bidding zones**

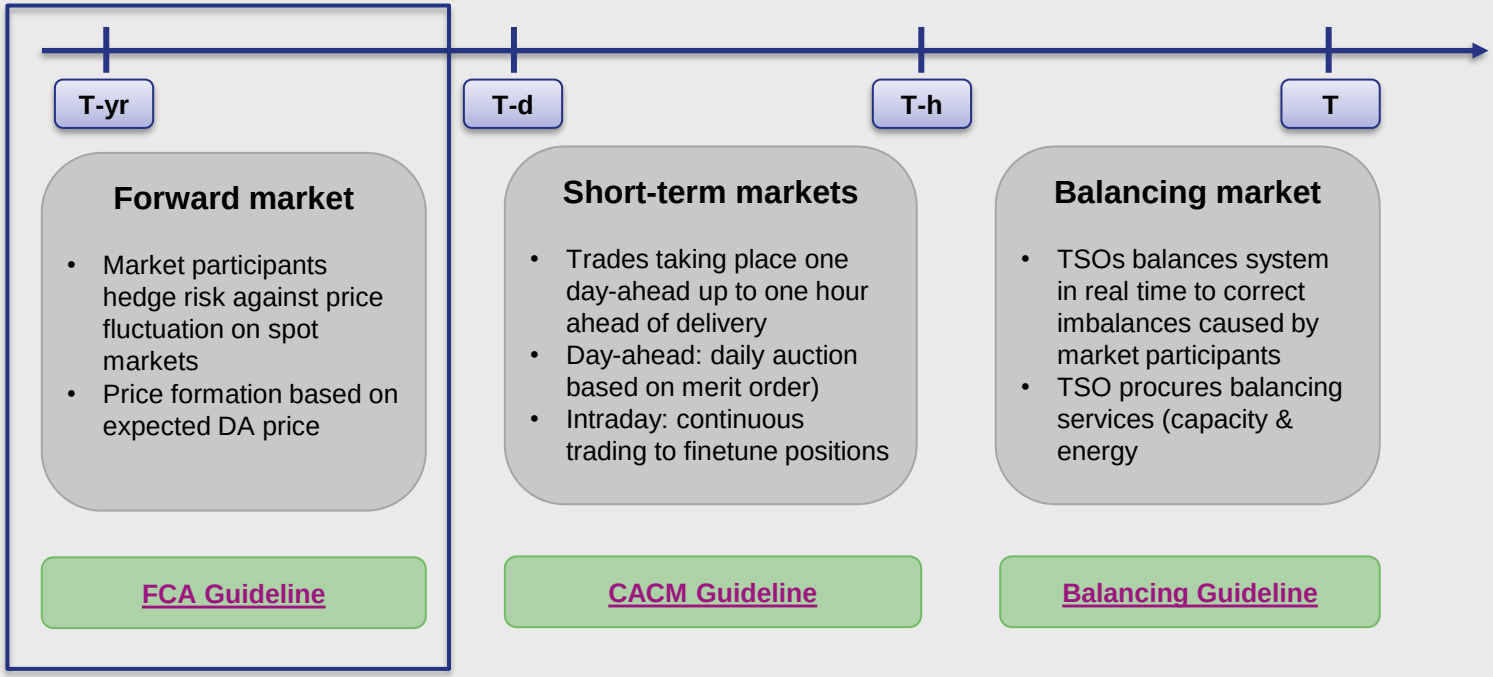
- Explicit: transmission capacity is auctioned separately from the marketplaces where energy/electricity is auctioned
- Implicit: allocation of capacity is performed together with the purchase of electricity (no need to engage in any capacity auctions for market participants)



Source: Study CREG

Different market segments and timeframes

Market segments – Forward market

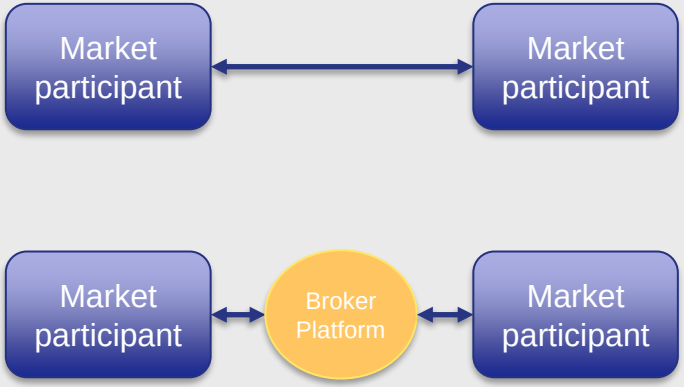


Forward markets

- Trade of electricity takes place Over-the-Counter (OTC) and at power exchanges.
- TSO organize auctions (on joint platforms) to issue long-term transmission rights (LTTRs) in monthly and yearly auctions
- LTTRs are mostly financial transmission right (FTR) which entitle their holder to receive the price spread (difference) of the two bidding zones linked to that product (in case of positive spread)
- Physical transmission rights (PTRs) allowing for a physical allocation of capacity under the Use-it or Sell-it (UIOSI) principle are allowed.
- The TSOs with the collected congestion income, will pay the FTR holders.

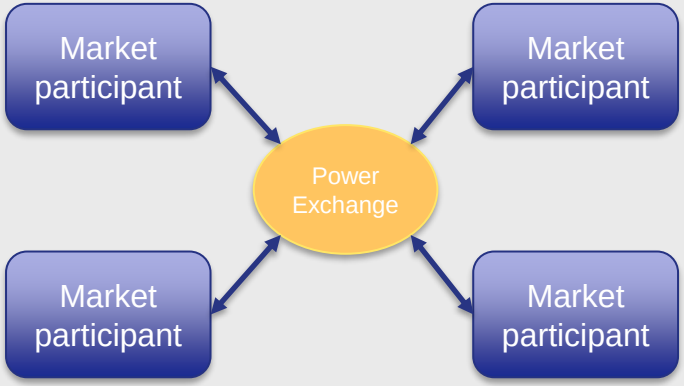
OTC vs. Power Exchange

OTC Trading



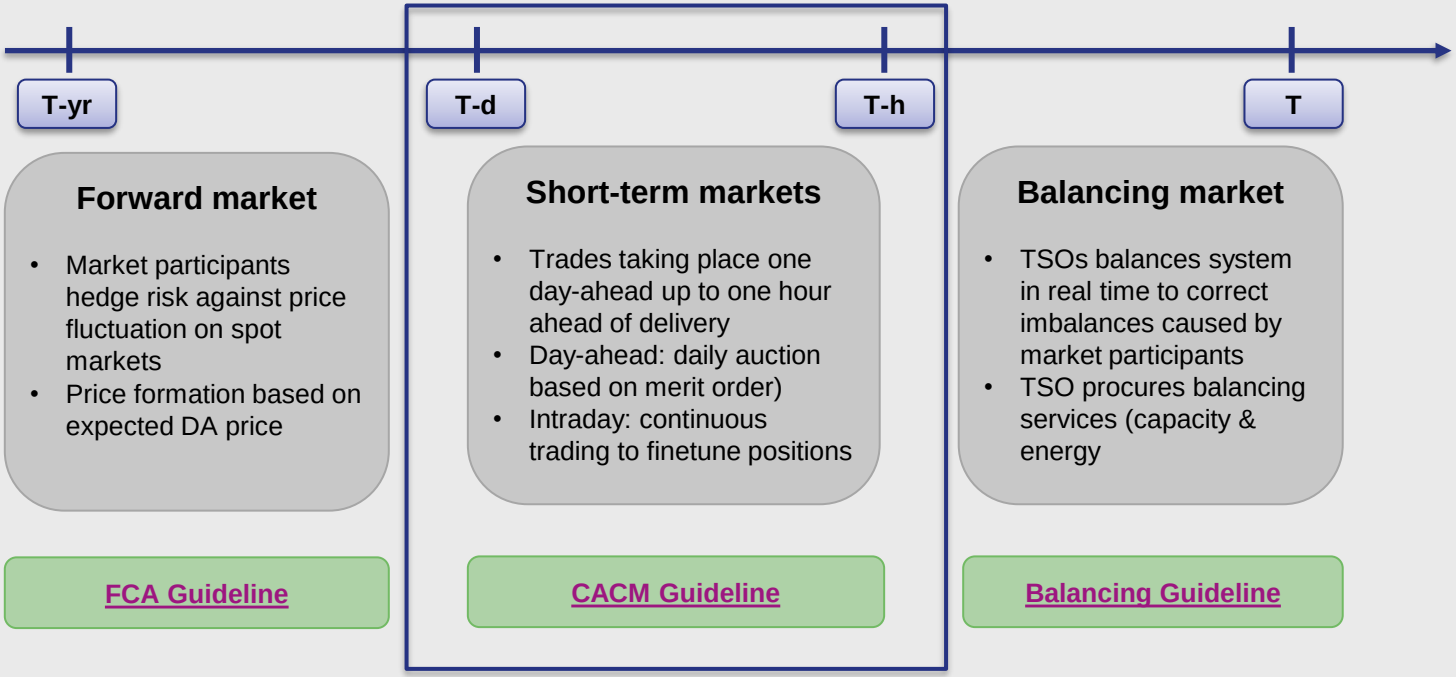
- Counterparties know each other and reach their own agreements
- Low or no fees for brokerage

PX Trading



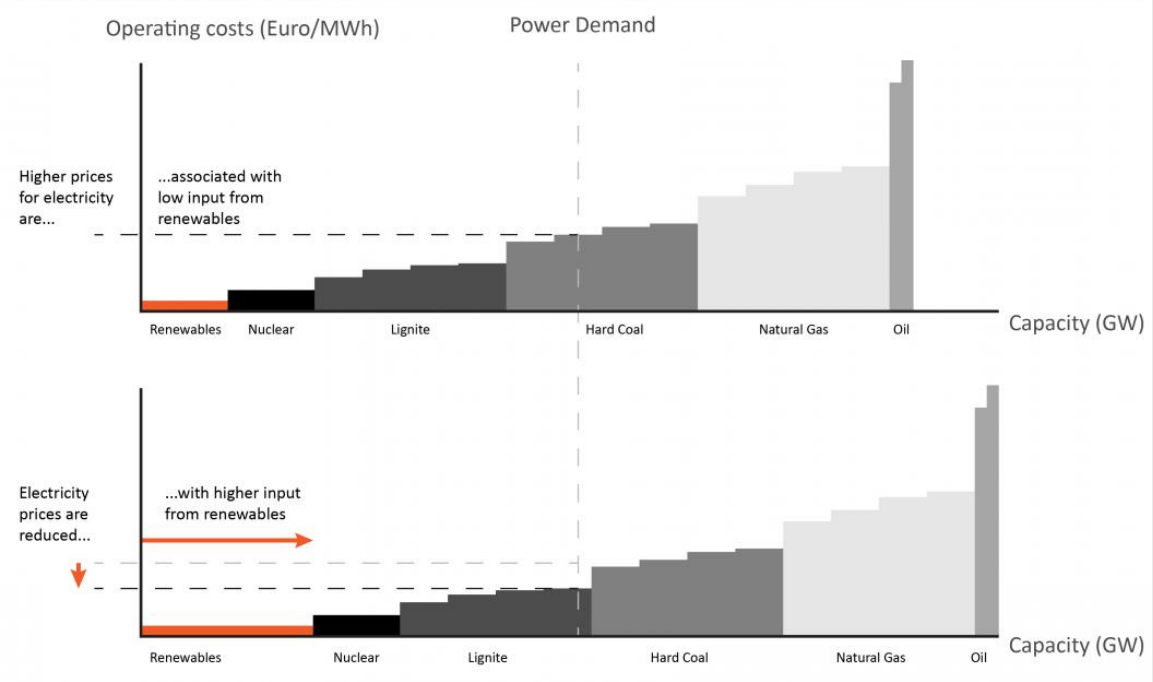
- PX acts as central counter party for all market participants and for all settlement (anonymous)
- Fees for power exchanges

Market segments – Short-term markets



Day-ahead market – Merit order principle

- DA auction at around noon the day before delivery for every market time unit of the following day
- **Marginal pricing**: electricity prices set by variable cost of marginal plant (most expensive needed to cover demand)
- **Clearing price**: all generators receive and all consumers pay the same (uniform) price

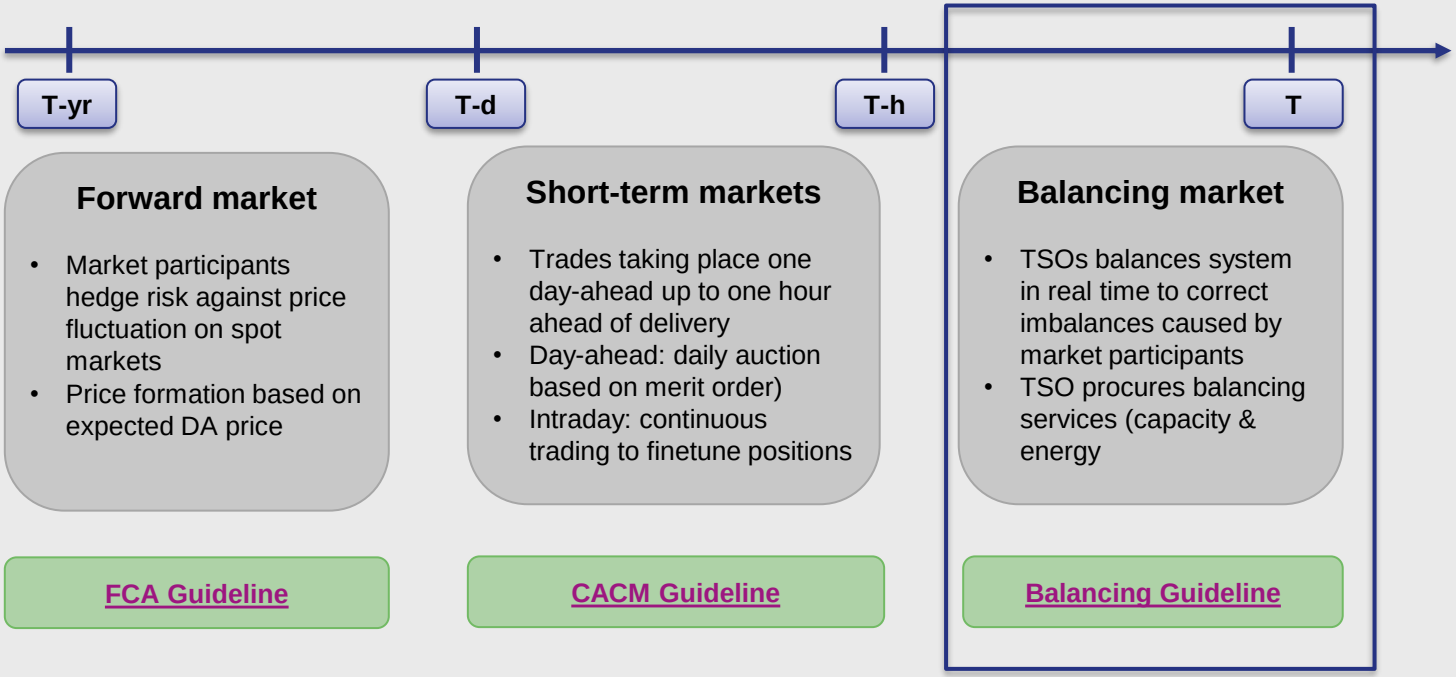


Source: Clean Energy Wire

Intraday market – Continuous trading

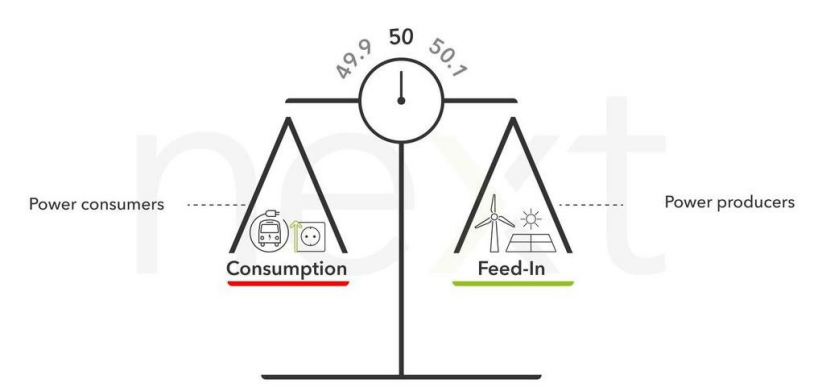
- Continuous buying and selling of electricity at a power exchange at the same day of delivery (up to one hour or even some minutes before delivery)
- Main difference to day-ahead is the pricing principle = pay-as-bid
- As soon as buy and sell orders match, a trade is executed at the agreed price.
- Trade is done on a first-come first-served principle where the highest buy price and the lowest sell price get served first.
- ID markets are getting more and more important as RES production increases and thereby the need to balance positions closer to real time.

Market segments – Balancing market



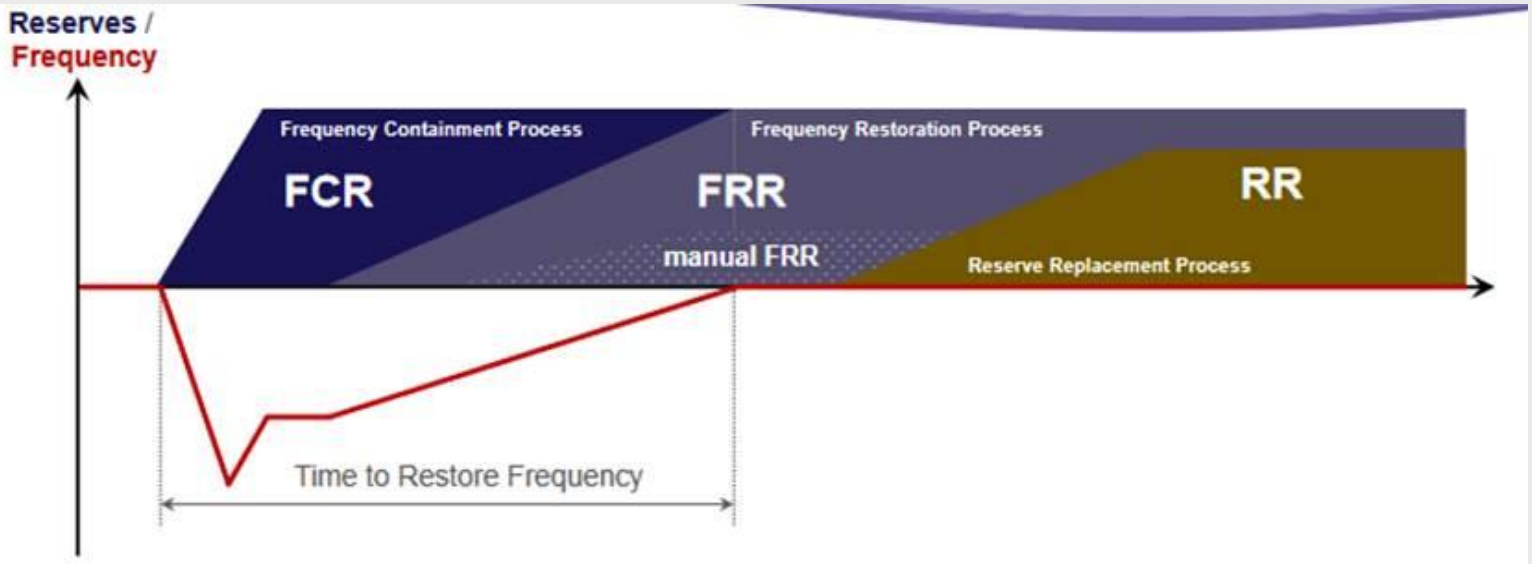
Balancing markets

- TSOs procure balancing services from Balancing Service Providers (BSPs) to level out frequency deviations and keep stable frequency of 50Hz
- Balancing services are one out of many ancillary services and include
  - **Balancing capacity:** flexible capacity which the provider has agreed to keep available for a certain period in order to provide balancing energy
  - **Balancing energy:** energy which is used by system operators to perform the maintenance of the frequency



Source: https://www.next-kraftwerke.com/

Balancing services – different types



- Frequency Containment Process → Stabilization
- Frequency Restoration Process → Regulate to Set-Point Value
- Reserve Replacement Process → Restore FRR

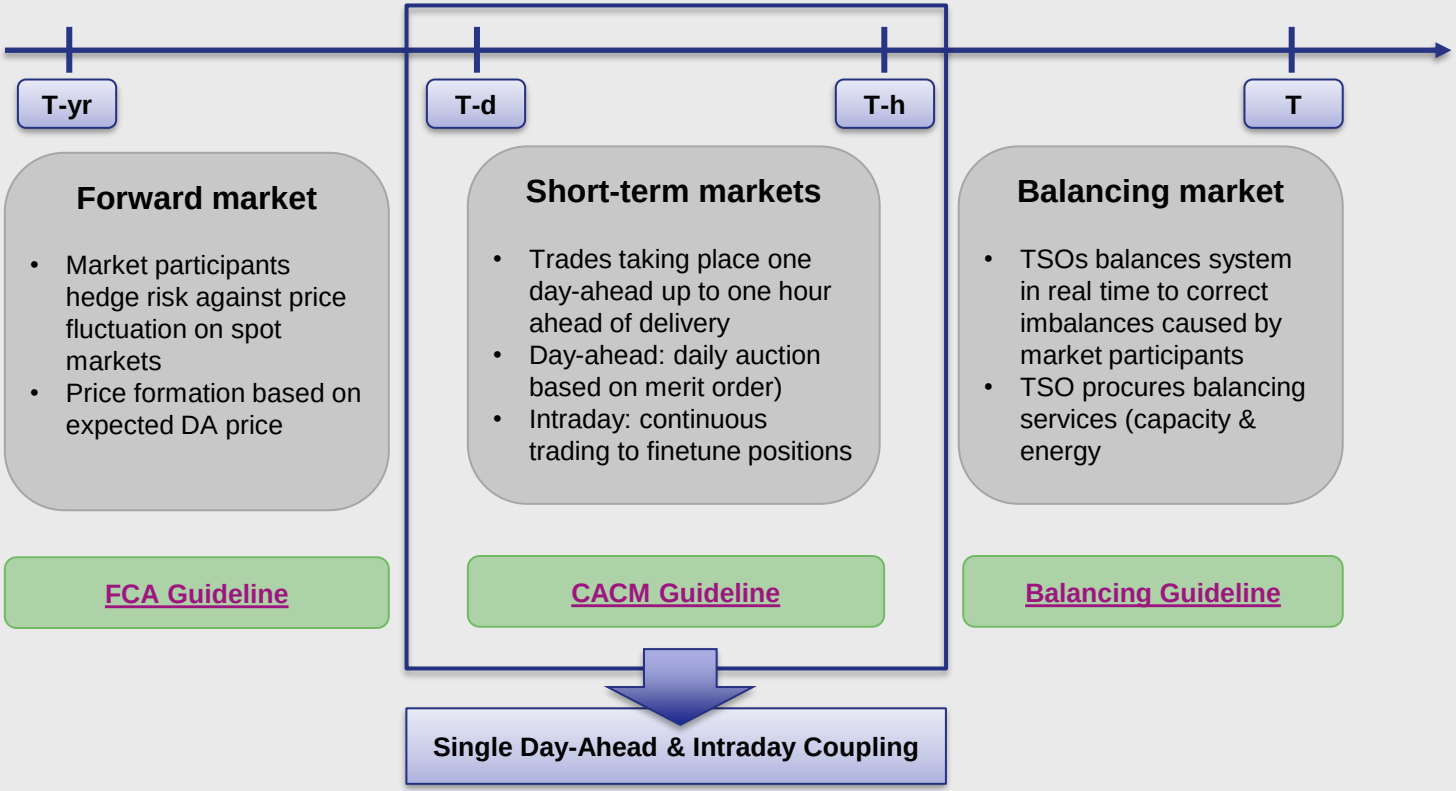
Source: ENTSO-E

Market Coupling

EU's Internal Energy Market – Target Model

- **Electricity Target Model** foresees the coupling of the different national markets into one European electricity market ensuring optimal use of cross-border transmission capacity.
- The integration of electricity markets across Europe aims at
  - cost-effective way to ensure secure, sustainable and affordable energy supplies
  - markets ready to integrate RES and attract investment in RES to achieve decarbonization of the energy system
- Through common energy market rules and cross-border infrastructure, energy can be produced in one EU country and delivered to consumers in another.

Market segments – Short-term market



Legal Framework for Market Coupling

- Two legal acts define requirements for the SDAC and SIDC
  - **Regulation (EU) 2019/943** on the internal market for electricity
    - setting **fundamental principles** for well-functioning, integrated electricity markets and
    - defining **basic requirements for DA and ID markets**
  - **Regulation 2015/1222** on establishing a guideline on capacity allocation and congestion management (CACM Guideline)
    - governing **single day-ahead and intraday coupling** (SDAC and SIDC) and
    - defining **role of NEMOs** as well as **NEMOs' and TSOs' specific tasks** in SDAC and SIDC
- CACM Regulation acknowledged already existing solutions and introduced power exchanges in the legal framework

Market Coupling – what does it mean?

- National electricity markets are coupled, pooling demand and supply across Europe, simultaneously taking into account cross-border transmission constraints.
- SDAC and SIDC are based on implicit capacity allocation i.e. scarce cross-border capacities are allocated in the most efficient way through a common algorithm.
- Within the coupling, cross-border capacity is used more efficiently and price differences between bidding zones can be reduced.
- Thereby, SDAC and SIDC opt at maximising social welfare.

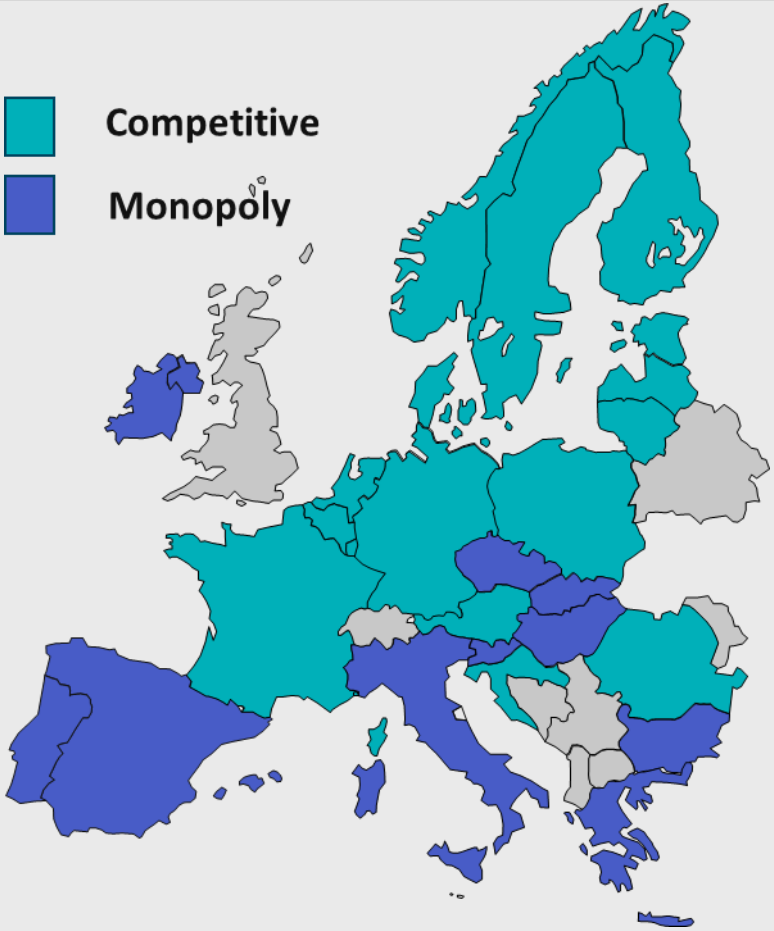
Market Operator and NEMO

‘market operator’ means an entity that provides a service whereby the offers to sell electricity are matched with bids to buy electricity

‘nominated electricity market operator (NEMO)’ means an entity designated by the competent authority to perform tasks related to single day-ahead or single intraday coupling

- NEMOs newly introduced to manage SDAC and SIDC
- Mostly power exchanges as tasks relate to this kind of business
- NRA is competent authority for designation, monitoring and if necessary, revoking designation (unless otherwise provided by MSs/CPs)

Overview of NEMOs in the EU



List of SDAC/SIDC NEMOs

CROPEX, epexspot, ETPA, EXAA, GME, HEnEx, hupx, IBEX, Nasdaq, NORD POOL, OKTE, omie, opcom, OTE, semopx, SOUTH POOL, TGE

Source: All NEMO Committee

NEMO Designation *Art. 4 CACM*

- Each CP shall ensure that at least one NEMO is designated by 15 June 2023
- Initial designation term of 4 years (further cycles not defined)
- Applicants can be either domestic or non-domestic
- CACM defines designation criteria (continuous compliance required)
- NEMO designated in one MS/CP has the right to offer DA and ID trading activities with delivery in another MS/CP by notification (‘passporting’)
- MSs/CPs can refuse passporting in case
  - applicant NEMO is a monopoly NEMO or
  - national market is operated by a monopoly NEMO

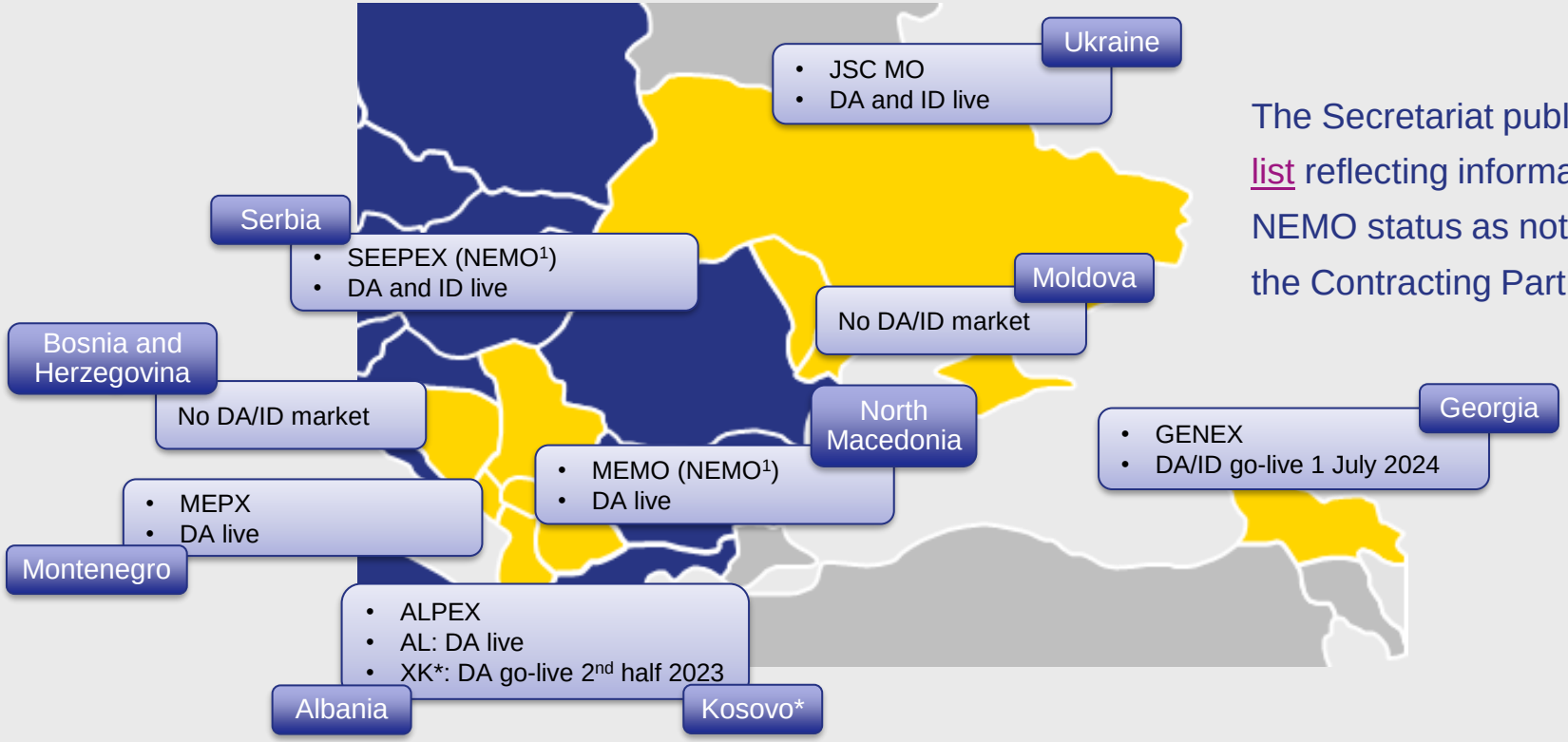
NEMO as National Legal Monopoly *Art. 5 CACM*

- National legal monopoly is deemed to exist where national law expressly provides that no more than one entity can carry out DA and ID trading services
- If at time of entry into force of CACM a national legal monopoly exists, CP was required to notify the Secretariat by 15 Feb 2023 and may refuse designation of more NEMOs
- If there are several applicants, the applicant which best meets designation criteria shall be designated
- NRA shall fix and approve NEMO fees for trading in DA and ID markets, sufficiently in advance of their entry into force, or specify methodology

NEMO Designation Criteria *Art. 6 CACM*

- Sufficient resources for operation of market coupling in DA and ID
- Non-discriminatory treatment of market participants and access to information regarding NEMOs' tasks and
- Cost-efficiency with separate accounts for market coupling operator function
- Adequate level of business separation from other market participants
- Monopoly NEMOs shall not use fees to finance other tasks/markets
- Appropriate market surveillance, transparency and confidentiality arrangement
- Provision of clearing and settlement services
- Necessary communication systems for coordinating with TSOs

DA and ID markets - Status-quo in Contracting Parties



The Secretariat published a list reflecting information on NEMO status as notified by the Contracting Parties.

[1] *These entities were designated as NEMOs prior to the MC Decision in the respective CPs.*

NEMO's Tasks Art. 7(1) CACM

'NEMOs shall act as market operators in national or regional markets to perform in cooperation with TSOs single day-ahead and intraday coupling.'

***'market coupling operator (MCO) function'** means the task of matching orders from DAM and IDM for different bidding zones and simultaneously allocating cross-zonal capacities;*

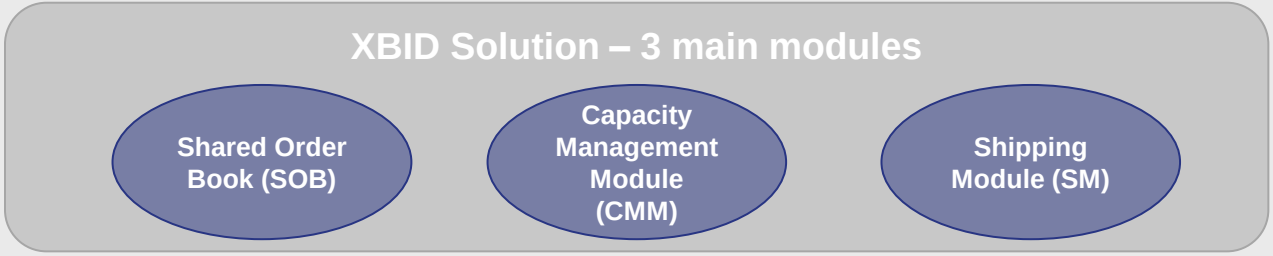
Individual NEMO/power exchange	MCO function
Tasks performed individually, relating to market participants (if applicable as competitive entity)	**Tasks implemented jointly with other NEMOs**

SDAC algorithm - EUPHEMIA

- The SDAC makes use of a common price coupling algorithm, called EUPHEMIA, to calculate electricity prices across Europe and to implicitly allocate auction-based cross-border capacity.
- EUPHEMIA matches energy demand and supply for 24 hours simultaneously (combinatorial optimization process).
- PCR, a cooperation of a sub-set of NEMOs owns and operates the algorithm.
- This process maximizes social welfare (consumer surplus, supplier surplus and congestion rent) and takes into account price limits of orders and network constraints.

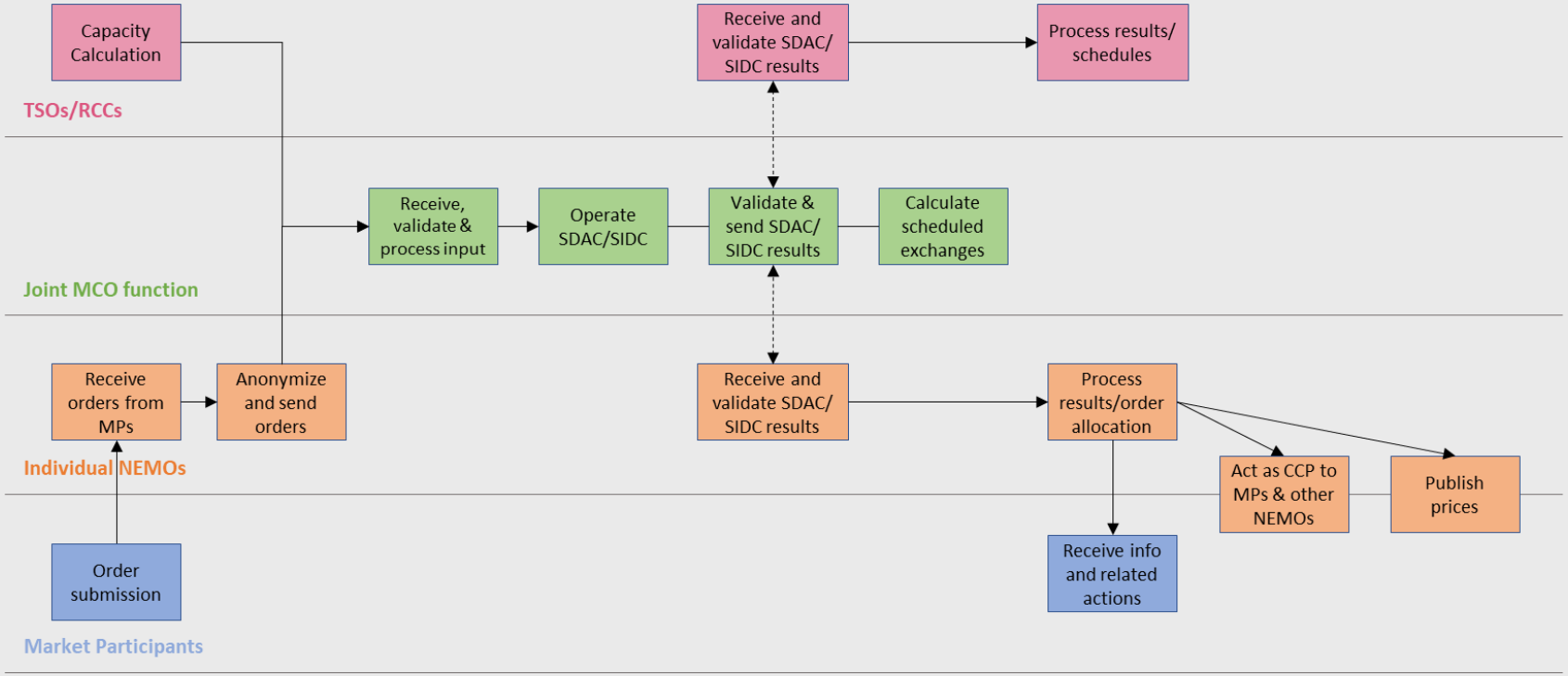
SIDC solution - XBID

- The XBID (cross-border intraday) solution is based on a common IT system with three main modules.
- It allows for orders entered by market participants for continuous matching in one bidding zone to be matched by orders similarly submitted by market participants in any other bidding zone - as long as there is enough capacity available.



Source: SIDC Info Package

Market coupling and related tasks



Disclaimer: This is a schematic overview of the most important tasks focusing on NEMOs and MCO.

Thank you for your attention!

https://www.energy-community.org

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