

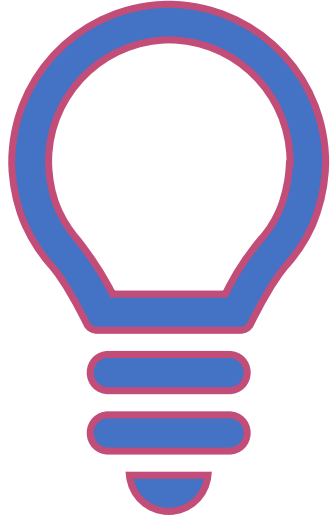
Electricity markets I.



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M U N I
F S S

Lecture outline

1. Introduction to electricity and energy systems
2. Introduction to electricity markets
3. EU legislative framework
4. Market design

Electricity as a commodity

Electricity is a specific type of commodity:

- It cannot be stored in large quantities in an economically efficient manner.
- It flows through the path of least-resistance in line within the laws of physics.
- Each unit is qualitatively identical (irrespective of the source).
- Its transport is dependent on a fixed network.
- It is an essential service for the society.
- It is vulnerable.

Unique characteristics of the whole energy system

- High capital cost
- Long payback period
- Economies of scale
- Necessity of long-term planning
- The bigger the system, the more robust and resilient it is
- Highly regulated sector

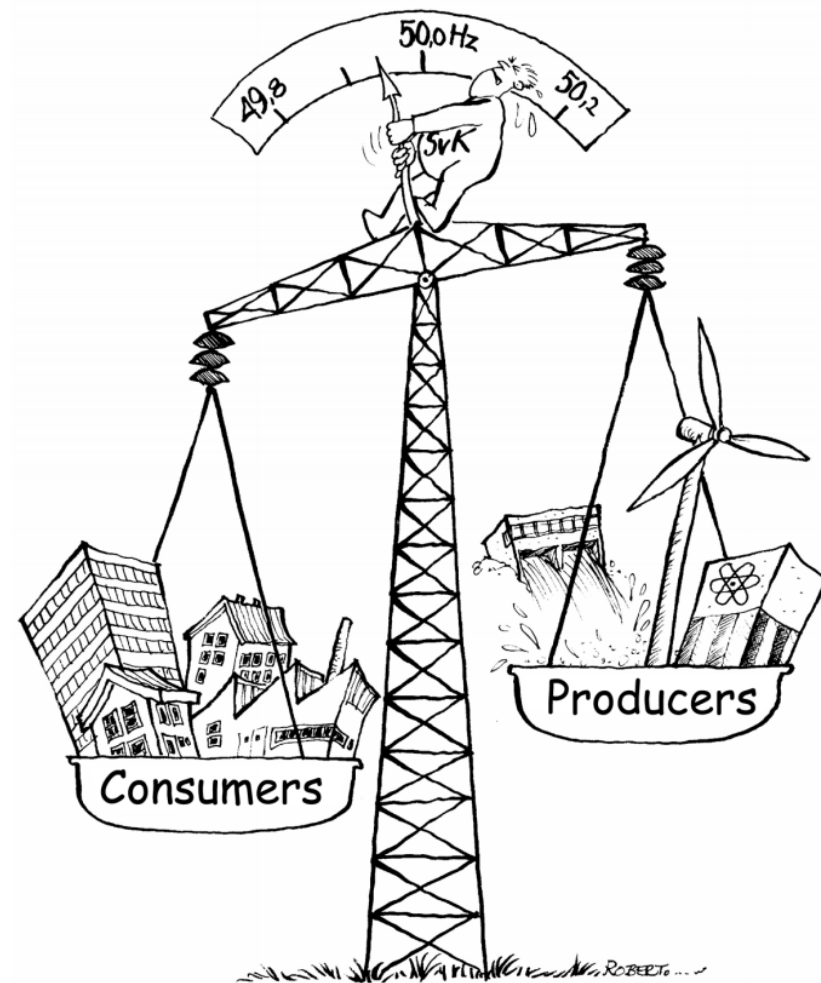
All these characteristics of electricity and energy systems have implications for the way electricity is traded as well as the whole electricity market's design.

What is the rationale behind the electricity market?

RELIABLE ELECTRICITY AT LEAST COST TO CONSUMERS

BALANCED SYSTEM AND WELL-DESIGNED ELECTRICITY MARKET

- ✓ Electricity must be generated at the same time as it is consumed
- ✓ Supply must meet demand



Source:
https://inis.iaea.org/collection/NCLCollectionStore/_Public/42/022/42022239.pdf

Demand side and supply side

- **Demand** is determined by consumers' behavior

BUT

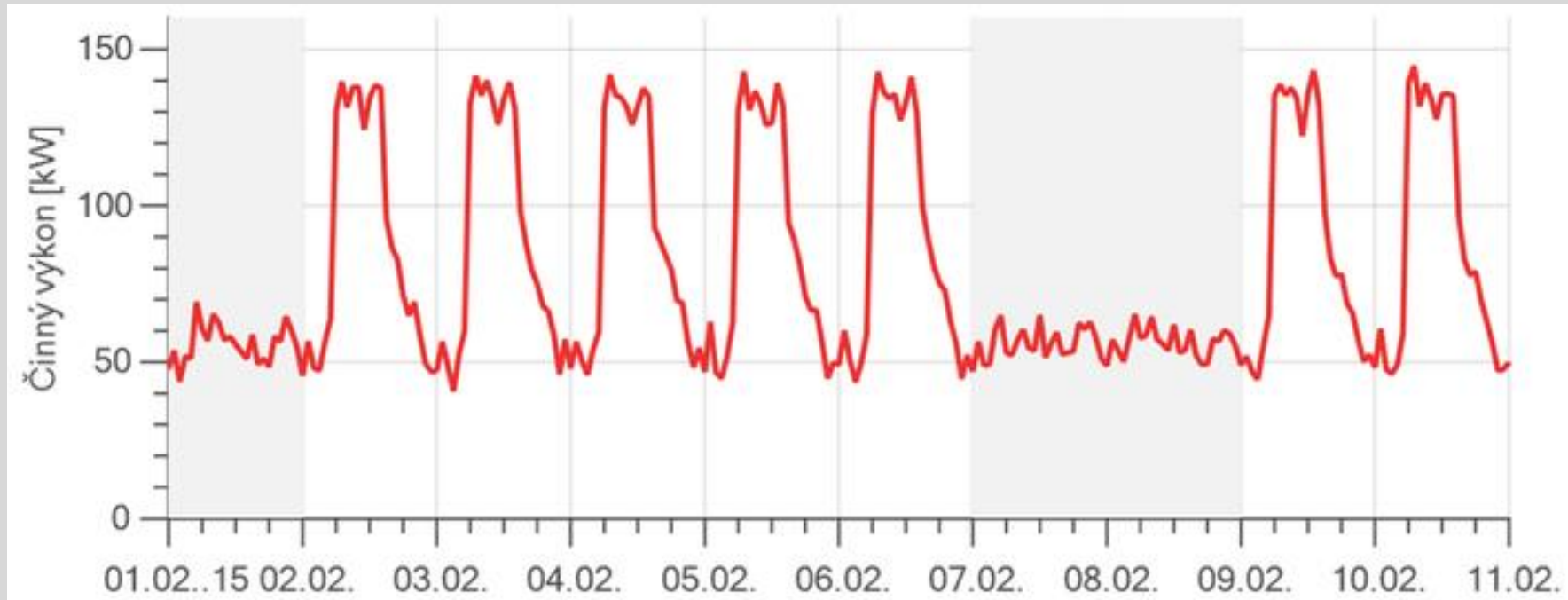
- There are certain patterns to it.

What are they?

- Peak hours x off-peak hours
- Week x weekend
- Holidays
- Type of production

- On **supply** side there are various power generators
- Balanced mix of power sources
- System services
- Ancillary services
- Base load x Peak load
- Fixed x variable cost

Transmission System Operator (TSO)



Source: <https://oze.tzb-info.cz/akumulace-elektriny/19222-micropt-design-optimalni-dimenzovani-hybridnich-energetickych-systemu-s-bateriovym-ulozistem>

Demand side and supply side

- **Demand** is determined by consumers' behavior

BUT

- There are certain patterns to it.

What could it be?

- Peak hours x off-peak hours
- Week x weekend
- Holidays
- Type of production
- Season

- On **supply** side there are various power generators
- Balanced mix of power sources
- System services
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Transmission System Operator (TSO)



INTERESTING FACT

Power blackouts in the EU



Power blackout or power outage is the **loss of the electrical power network supply to an end-user.**



There are **many causes of power failures** in an electricity network.

- faults at power stations,
- damage to electric transmission lines, substations or other parts of the distribution system,
- a short circuit,
- cascading failure, etc.



Depending on its magnitude a power outage could have **serious consequences**

- grid,
- safety of people,
- key infrastructure.



Extremely costly

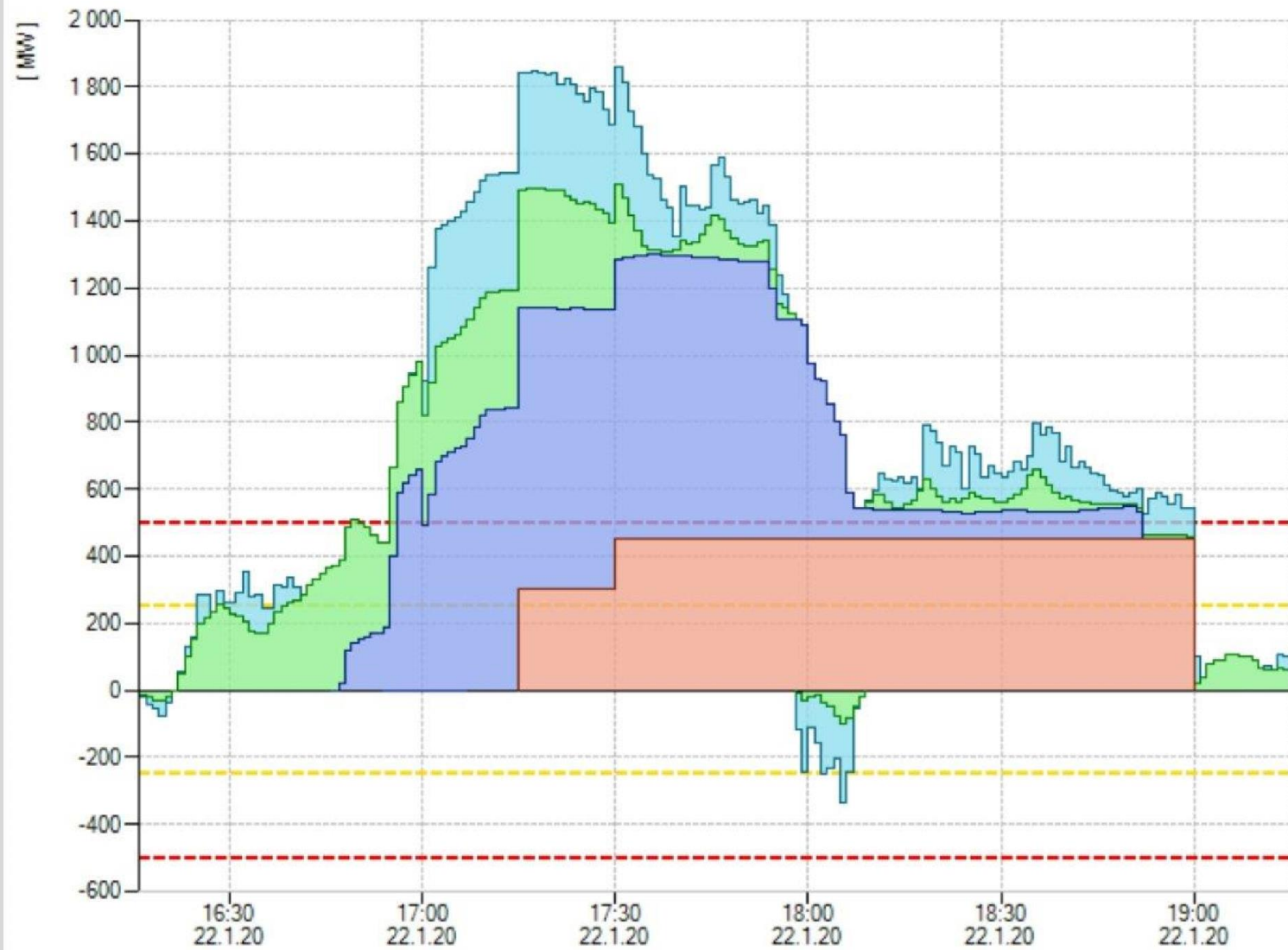


<https://www.blackout-simulator.com/>

ITALY BLACKOUT 2003



- One tree
- Cascading effect
- Impacting 56 million people
- Causing around €1.2 billion worth of damage



Obnovovat (T - 29s)

Graf

Aktivace – Saldo SVR

- poslední 3 hodiny
- celý den

Aktivace – Složky SVR

- poslední 3 hodiny
- celý den

Nákup SVR

- celý den

Legenda

Barva Řada

- RR
- Zahraničí – HV
- Manuální aktivace
- aFRR
- IGCC
- e-GCC

What is the difference between the wholesale and retail market?

RETAIL MARKET

- supply to the end-users
- regulated prices
 - consisting of several tariff elements besides the actual cost of electricity – e.g. market operator, system services, renewables, and cogeneration, distribution and transmission
- the role of a buyer and a seller usually does not change

WHOLESALE MARKET

- Business to Business (B2B)
 - end-users usually do not directly operate on this type of market
- wholesale prices are not regulated
 - energy-only prices reflecting short-run marginal costs of generation as well as actual demand and supply.
- take or pay principle
- the role of a buyer and a seller could change

Trading models

When?

- long-term vs. short term (day-ahead, intraday, balancing)

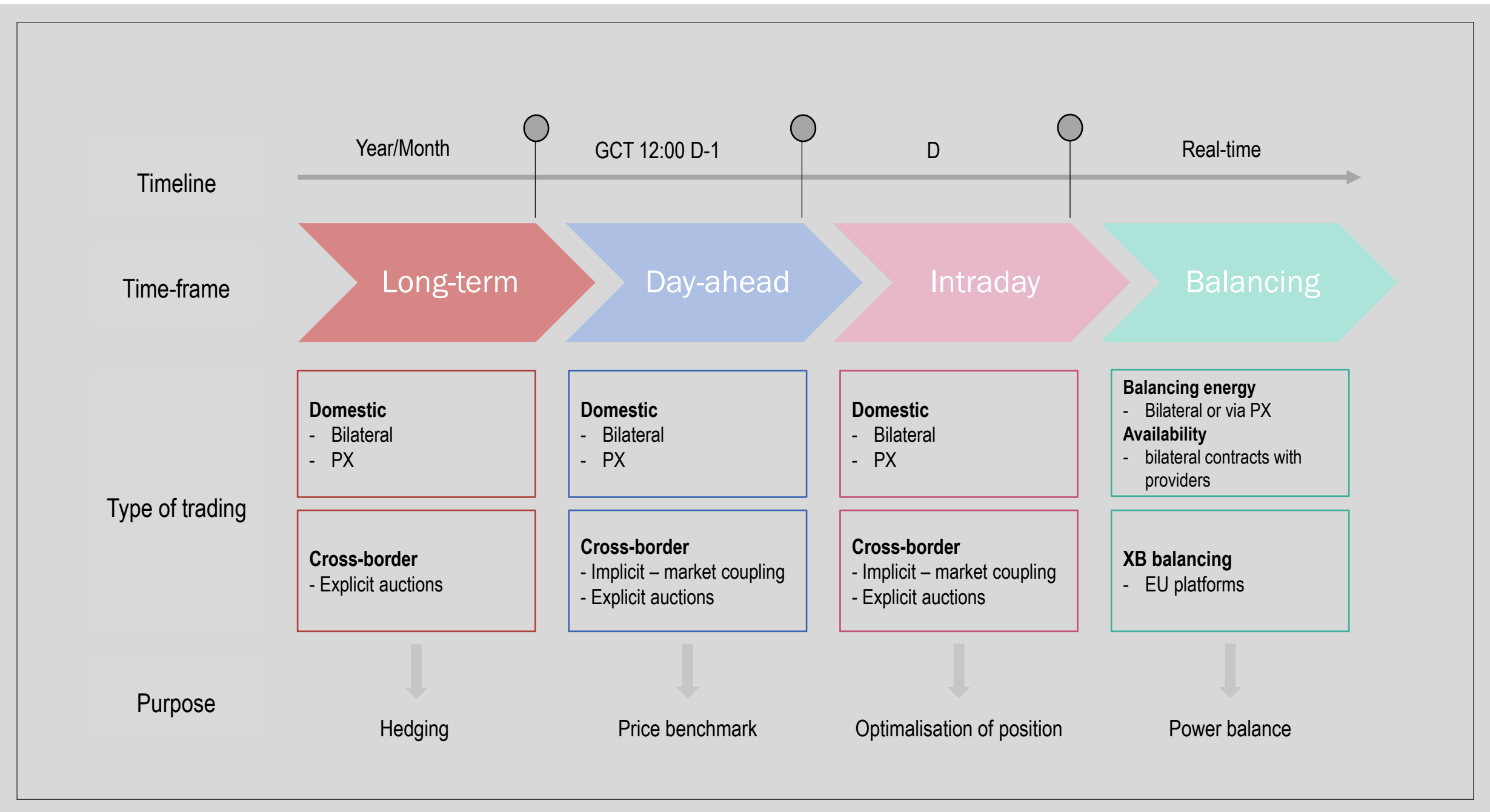
Where?

- domestic vs. cross-border (XB) trading
- XB can be based on implicit vs. explicit allocation of capacity

How?

- organized (power exchange)
 - auction
 - continuous trading
- bilateral (OTC, broker)

- *Based on the specific trading model and corresponding timeframe – different types of products



Market actors

Different roles – same vision

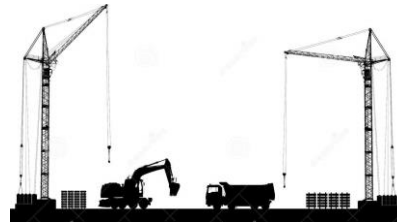
Architects of the market

- EU Institutions
- Member States
- ACER
- National regulatory authorities (NRAs)



Builders and managers

- TSOs, DSOs
- ENTSO-E
- NEMOs
- NEMO Committee
- Common governance structures



Players a.k.a Market participants

- Individual generators/large consumers
- Traders and suppliers
- Unions and associations





INTERESTING FACT

A Day in the Life of an International Trader

- **6:50** Start of trading on OTC platforms TFS, GFI, 42Fin
- **7:30** Start of trading at TGE
- **8:00** Start of entering daily trades on OTE and OKTE
- **8:30** Publication of daily CBC at CAO
- **9:00** End of entering CBC daily orders with CAO
- **9:00** Start of trading on PXE, EEX
- **9:30** Publication of results of daily CBC auctions at CAO
- **10:30** Publication of the results of daily trades on TGE
- **11:00** End of day trading on OTE, PXE and OKTE
- **11:40** Publication of daily trading results on OTE and OKTE
- **13:30** Completion in IS TSO
- **13:40** Publication of whether the nomination for cross-border scheduling was successful
- **14:30** Completion of corrections of nominations in IS TSO in case of discrepancy of nominations for cross-border transmissions
- **15:30** Start of intraday trading. A specific hour of intraday trading can be closed 2 hours before the start of the given trading hour
- **16:00** End of trading on PSE
- **16:30** Termination of trading at TGE
- **17:00** End of trading on OTC (brokerage) platforms TFS, GFI, 42Fin
- **17:30** End of trading on EEX

EU legislative framework



First legislative package 1996



Second legislative package 2003



Third legislative package 2009



Fourth legislative package 2016 → Clean Energy Package for all Europeans



Network codes

EU legislative framework



First legislative package 1996



Second legislative package 2003



Third legislative package 2009



Fourth legislative package 2016 → Clean Energy Package for all Europeans



Network codes

Clean Energy Package for all Europeans

- Regulation (EU) 2019/943 on the internal market for electricity
 - It revises the rules and principles of the internal EU electricity market to ensure it is well-functioning, competitive, and undistorted.
 - It also supports the decarbonisation of the EU's energy sector and the removal of barriers to cross-border trade in electricity.
 - Mainly contains rules on the **wholesale market** and network operation
- Directive (EU) 2019/944 on common rules for the internal market for electricity
 - It outlines rules for the generation, transmission, distribution, supply, and storage of electricity, together with consumer protection aspects, aiming to create integrated competitive, consumer-centred, flexible, fair, and transparent electricity markets in the EU.
 - Among other things, it contains rules on **retail markets** for electricity
- Market model:
 - Market based prices of electricity
 - Inclusion of new technologies
 - Stronger position of a consumer, definition of an active consumer

EU legislative framework



First legislative package 1996



Second legislative package 2003



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Fourth legislative package 2016 → Clean Energy Package for all Europeans



Network codes

Network Codes

Network codes are a set of rules drafted by ENTSO-E, with guidance from the Agency for the Cooperation of Energy Regulators (ACER), to facilitate the harmonisation, integration and efficiency of the European electricity market.

- Network codes/guidelines cover three areas of the electric power sector:
 - Grid and demand connection
 - System operation
 - **Market and trading**
- Market and trading Network Codes
 - Commission Regulation (EU) 2015/1222 establishing a guideline on capacity allocation and congestion management (CACM) - effective from 14 August 2015
 - Commission Regulation (EU) 2016/1719 establishing a guideline on forward capacity allocation (FCA) - effective from 17 October 2016
 - Commission Regulation (EU) 2017/2195 establishing a guideline on electricity balancing (GLEB) - effective from 18 December 2017
 - 22.2.2021 - Regulation amending the Electricity Guidelines

Electricity market design

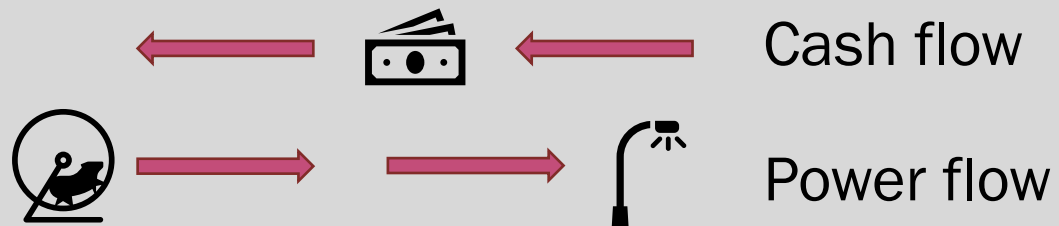
- Electricity markets are **designed markets**
 - Designed in a regulatory process
- Began as a monopoly utility → shifted to a power pool → final step spot markets
- **Good electricity market design is important** → improvement over time



How has electricity trading changed?

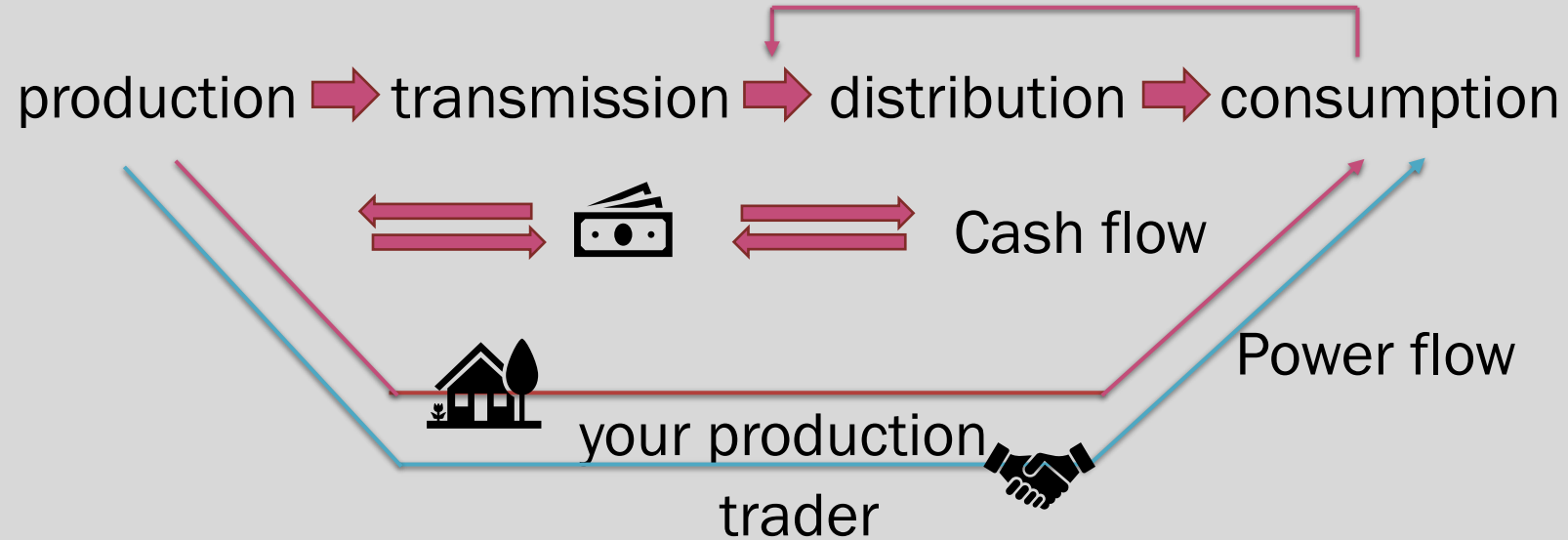
Centralized generation of electricity

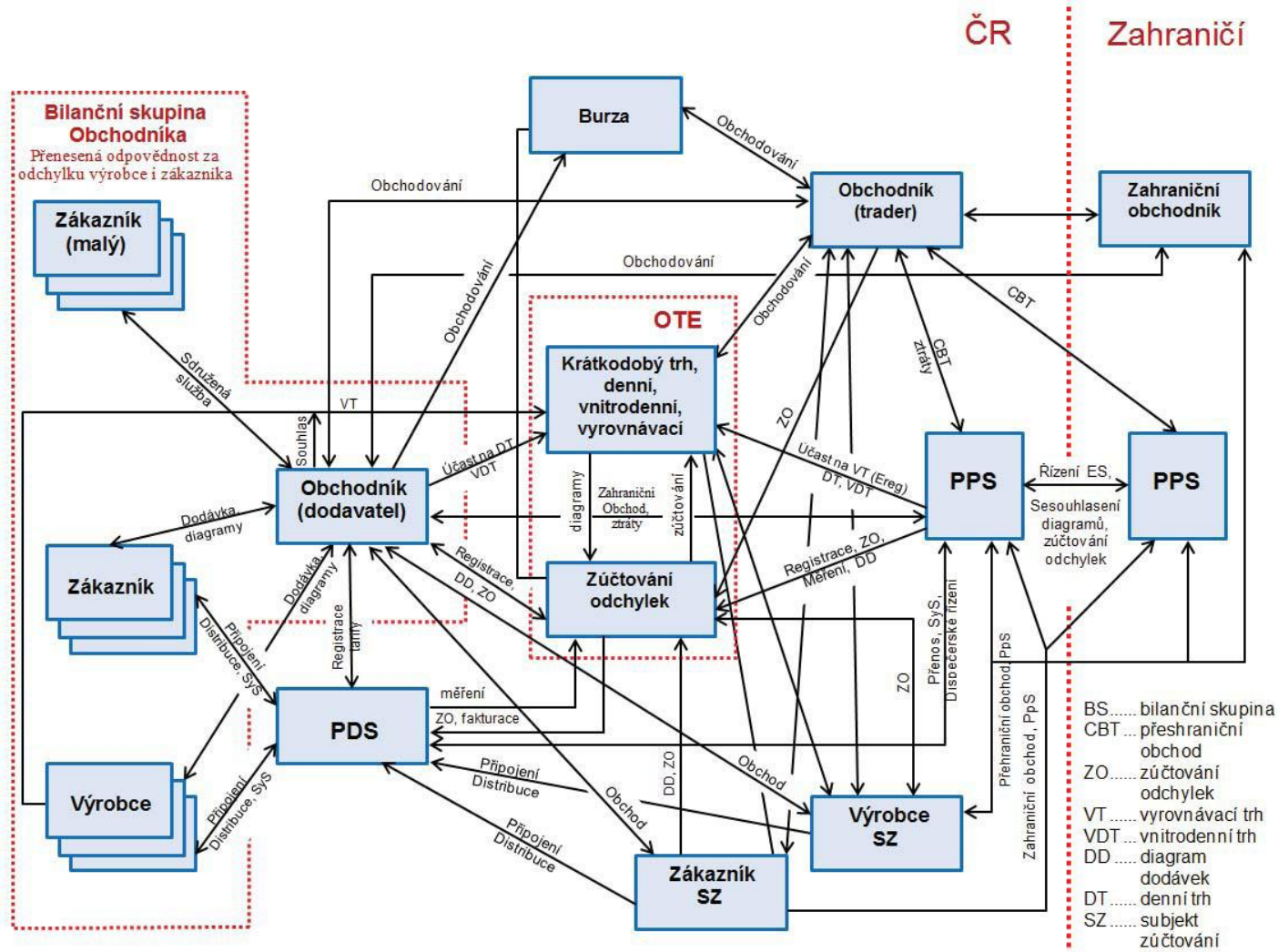
production → transmission → distribution → consumption



How has electricity trading changed?

Liberalized electricity sector





AND WHAT
WOULD IT
LOOKS LIKE
IF IT WAS
NOT
SIMPLIFIED?

Electricity market design



- Electricity markets are **designed markets**
 - Designed in a regulatory process
- Began as a monopoly utility → shifted to a power pool → final step spot markets
- **Good electricity market design is important** → improvement over time
- Still, electricity market design is far from static as the **ongoing transformation of the electricity industry** brings new challenges:
 - Expansion of RES
 - Demand response
 - Distributed generation
 - Smart homes
 - Battery storage

New "Market Design" and retail markets allows:



Better integration of renewables in markets



Better wholesale market arrangements



Facilitate demand response



Ensure adequacy of systems (including capacity)



Closer cooperation of TSOs



Increased level of governance (ENTSOs)

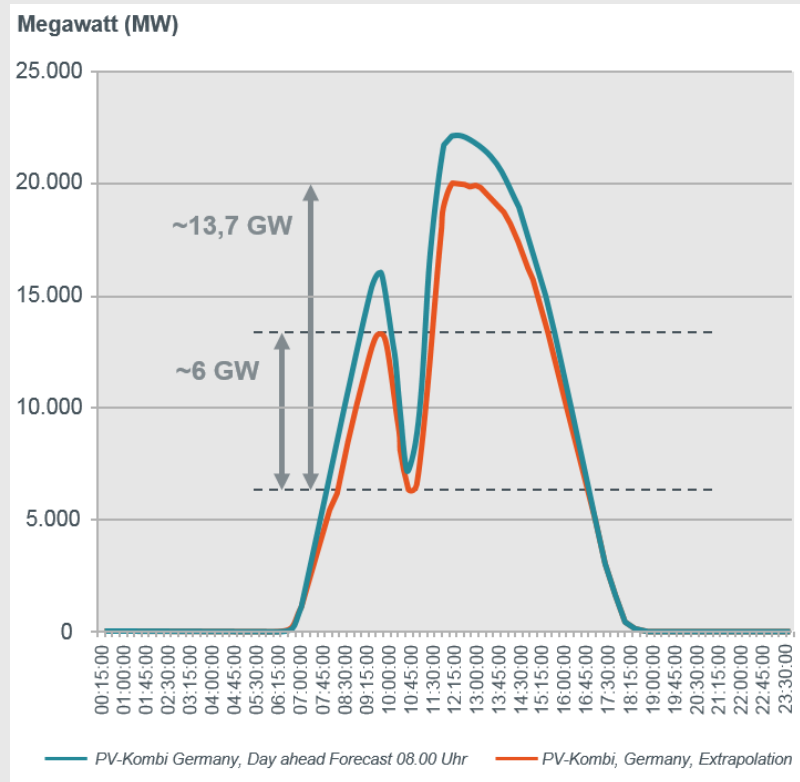


Increased regulatory powers (ACER)



INTERESTING FACT

Solar power and the impact of a solar eclipse on the electricity markets in Germany



- Date - 20.3.2015, sunny day
 - The installed capacity of photovoltaics in Germany - 39 000 MW
 - Last solar eclipse like that - 1999
 - In 75 minutes the power decreased by 50 %
 - 2 674 MW fall and 4 111 MW rise in solar PV
- Four biggest German TSOs made a capacity reserve of 3 800 MW.
- According to 50Hertz, the total cost was around 3,5 million euros and the preparation for this moment took them almost a year.

REShaping Europe's electricity market design

- Major question?

How to adjust to a large share of variable renewable energy sources?

- And many others...

Where to get the flexibility from?

How to modify regulations so the system is fair?

How to adjust the market design?

What do you think?

QUESTIONS

?

Thank you for your attention

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Sources:

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