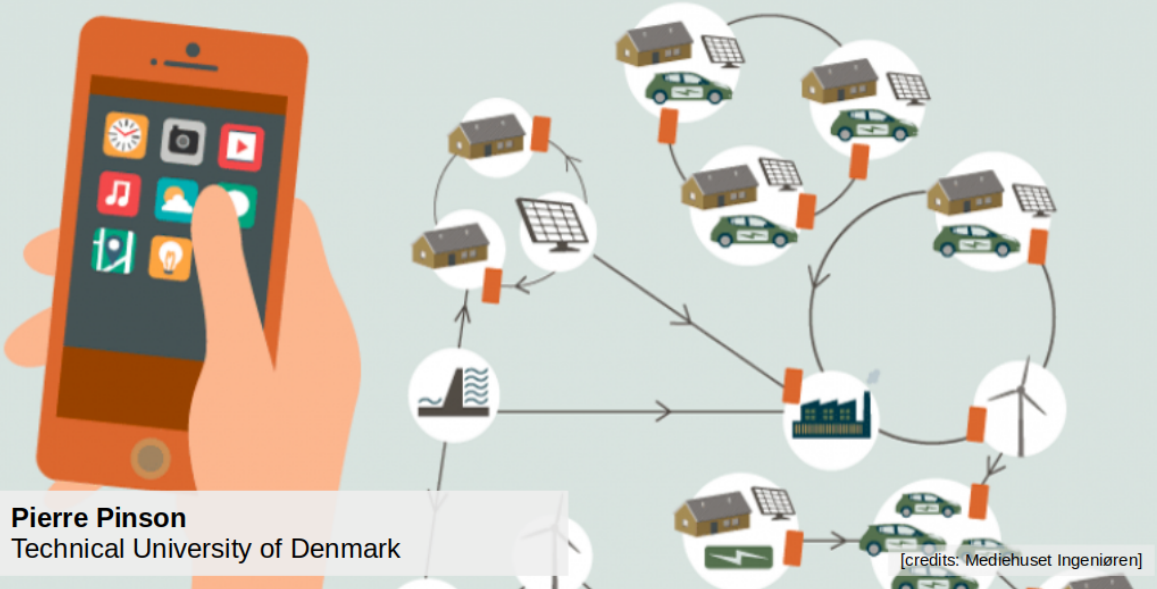
Module 1 – Fundamentals of Electricity Markets

1.3 The various markets and their purpose



Pierre Pinson
Technical University of Denmark

[credits: Mediehuset Ingeniøren]

Electricity as a “special” commodity

Why is electricity so special?

Electricity as a “special” commodity

Why is electricity so special?

1. There must always be a **balance between power generation and consumption**

Electricity as a "special" commodity

Why is electricity so special?

1. There must always be a **balance between power generation and consumption**
2. Transportation and distribution is performed on **a power network, with its specific physical rules**

Electricity as a "special" commodity

Why is electricity so special?

1. There must always be a **balance between power generation and consumption**
2. Transportation and distribution is performed on **a power network, with its specific physical rules**
3. **Storage is uneconomical** (as of today)

Electricity as a "special" commodity

Why is electricity so special?

1. There must always be a **balance between power generation and consumption**
2. Transportation and distribution is performed on **a power network, with its specific physical rules**
3. **Storage is uneconomical** (as of today)
4. A large part of the **electric demand is of must-serve nature** (residential, hospitals, etc.)

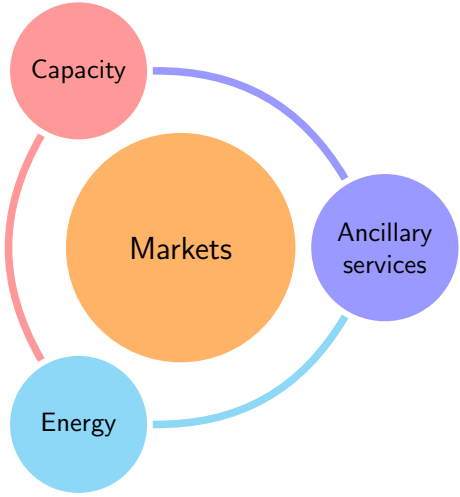
Electricity as a "special" commodity

DTU

Why is electricity so special?

1. There must always be a **balance between power generation and consumption**
2. Transportation and distribution is performed on **a power network, with its specific physical rules**
3. **Storage is uneconomical** (as of today)
4. A large part of the **electric demand is of must-serve nature** (residential, hospitals, etc.)
5. The final consumers cannot differentiate the origin of the product (as well as its quality and nature)

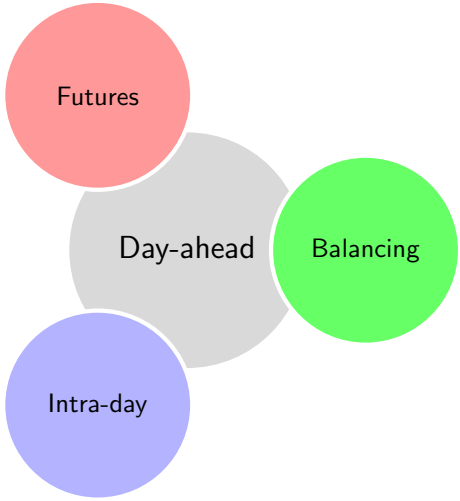
Different types of markets



- **Capacity**: for the system operator to ensure that sufficient generation capacity is present for reliable system operation in future years and at competitive prices
- **Energy**: central place for the optimal scheduling and settlement of energy exchanges
- **Ancillary service**: any type of service that supports power system operations, directly bought by the system operator, e.g.
  - Primary reserves
  - Secondary reserves
  - Tertiary reserves (also called manual)
  - Black-start capability, short-circuit power, reactive reserves and voltage control

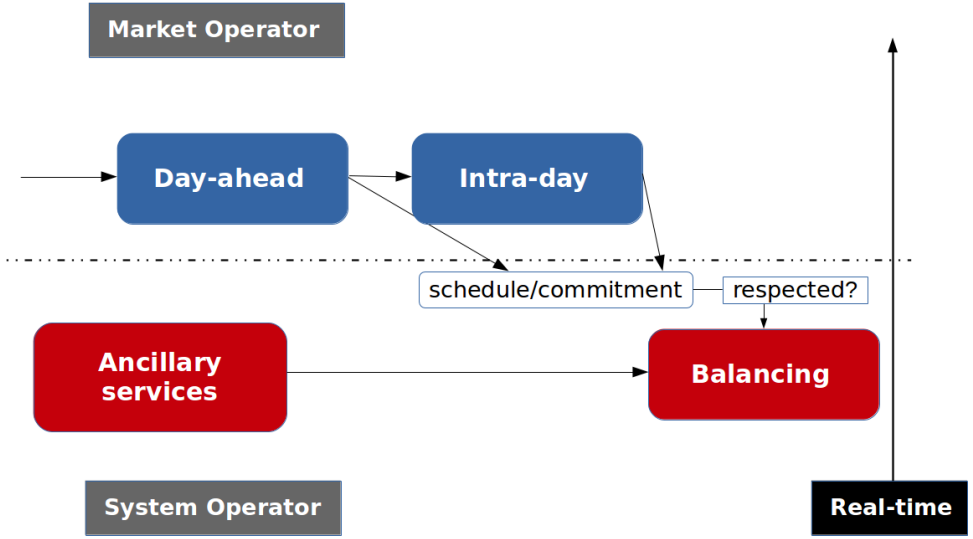
Our focus will be on **energy** and **ancillary services**

Electricity markets and their purpose

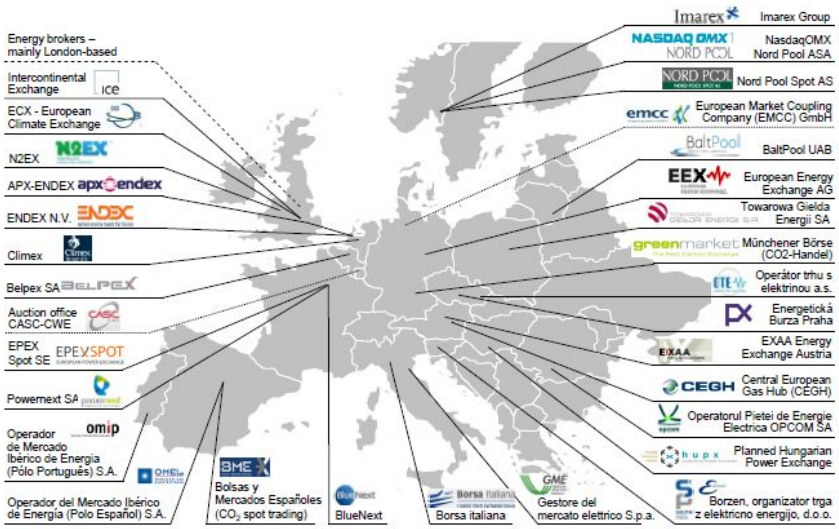


- **Futures** markets: financial contracts with time horizons up to six years - used for price hedging and risk management.
  Ex: *NASDAQ OMX Commodities for Scandinavia*
- **Day-ahead** (or spot): seen today as the central instrument for everyday matching of electricity supply and demand.
  Ex: *Nord Pool Elspot for Scandinavia*
- **Intra-day**: continuous trading platform, between day-ahead and balancing, allowing to correct original schedules (e.g., in case of plant outages or changes in wind power generation).
  Ex: *Nord Pool Elbas for Scandinavia*
- **Balancing**: close to real-time operation, for the system operator to ensure power system balance.
  Ex: *Energinet.dk in Denmark*

Parallel between electric energy and ancillary services



Looking at the bigger picture



[source: www.etrmsystems.com]

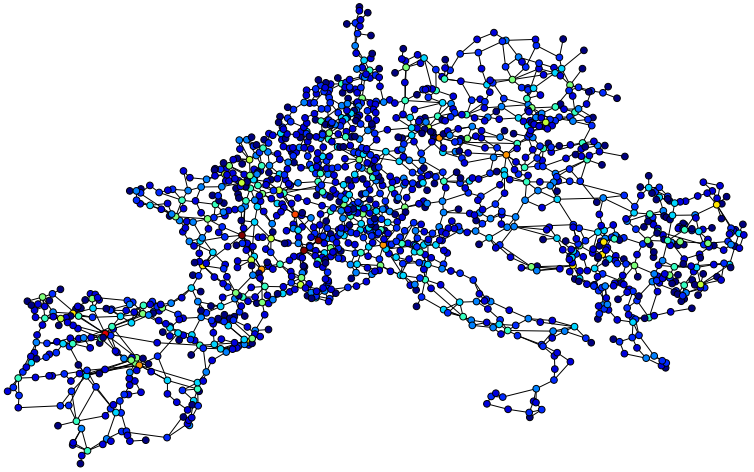
Exciting time: The "Internal Energy Market"

- Grid operators and power exchanges from 14 EU Member States plus Norway inaugurated on 4 February 2014 a pilot project for joint electricity trading, so-called *day-ahead market coupling*

- **Overall objectives:**
  - harmonize European electricity markets and strengthen competition
  - improve liquidity, transparency and efficiency in the power markets across Europe
  - social welfare optimization

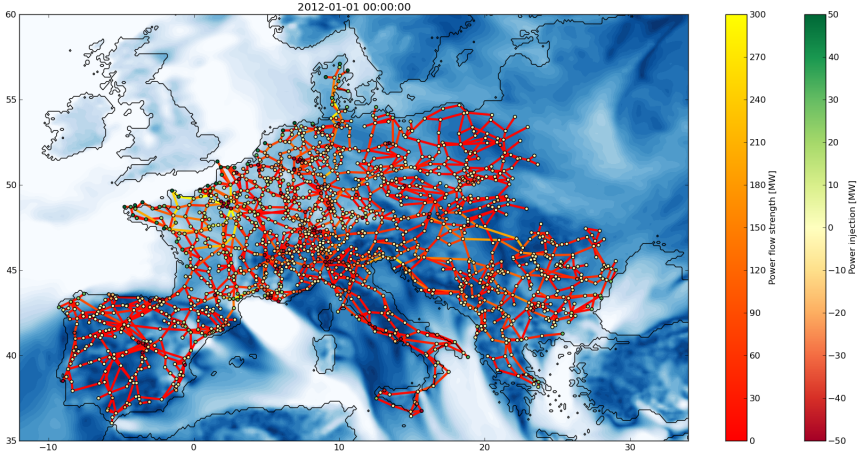
- **In practice:**
  - flow-based coupling of *day-ahead markets*
  - standardization of (also new) products for *intra-day markets* and new matching algorithms
  - target model for *balancing*? co-existence with new intra-day solutions?

The importance of the network



This is a simplified grid for the first synchronous zone of the European Transmission Network (app. 1500 lines only)... The real one has more than 32.000 lines!

The importance of FLOWS on the network



[courtesy of Tue V. Jensen, DTU Elektro]

The same grid with power flowing as a function of *renewable energy generation* and *electric power consumption*, in a future renewable-based power system....