Competition models for the electrical industry and electrical markets

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The monopoly: the old but still-used competition model

Generator → Wholesaler/transmitter → Distribution company → Customer

(a)   (b)

→ Energy sales
---▶ Energy flows within a company
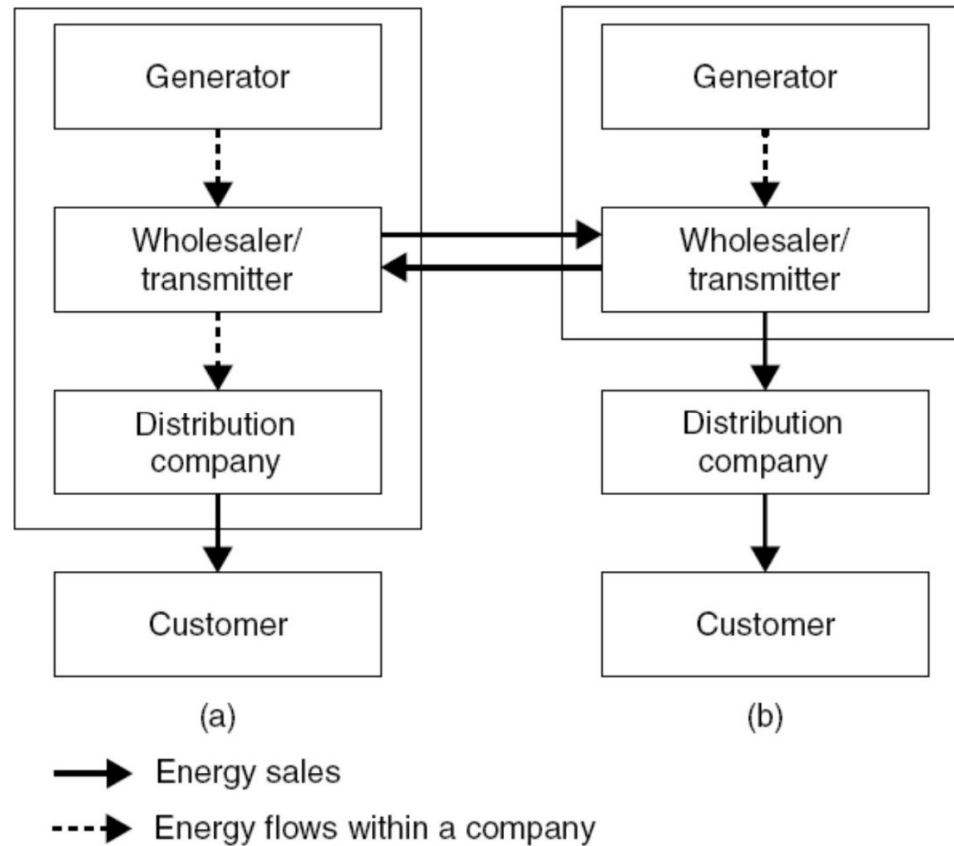
Vertically integrated structure (monopoly): The same company produces, transmits and distributes (directly or indirectly) the product to consumers at a single, imposed price.

Since the 1980s, it has been argued that this model was inefficient:

1] no incentive to operate efficiently and encourages unnecessary investment

2] politics interfering with good economics, etc.

Fully unbundled structure: The generation company and transportation company are different. The consumers choose the provider(s). Price components: product + transportation. Product and transportation are managed commercially by different companies. Product traded on specific market(s) according to transactions or contracts (buyer, seller, quantity, price, and time of delivery).

Shift in many countries from a vertically integrated to an unbundled structure. Unfortunately, electricity is **not a simple commodity.**

How to move towards an unbundled structure & competition?

Break up of large electrical generation companies (Genco) into smaller ones.

Allow the creation of new companies (for generation, retailing, etc.)

Create TSOs/DSOs to perform transmission/distribution in coordination with power plant operations (In the US: ISO).

Create appropriate trading infrastructures (marketplaces).

Determine the eligibility of the consumers for trading directly with in markets.

Install appropriate metering devices to monitor the transaction performance.

Create a regulating organism to ensure fair and efficient operations for electrical energy systems & markets.

Solve all the technical problems appearing with the unbundling of the original system.

Operation and development not carried out any more by one single organization. Is it possible to coordinate the different entities to achieve least-cost operation?
(e.g., maintenance of transmission system done jointly with the maintenance of operation line, coordination of long-term development in generation and in transmission, etc.)
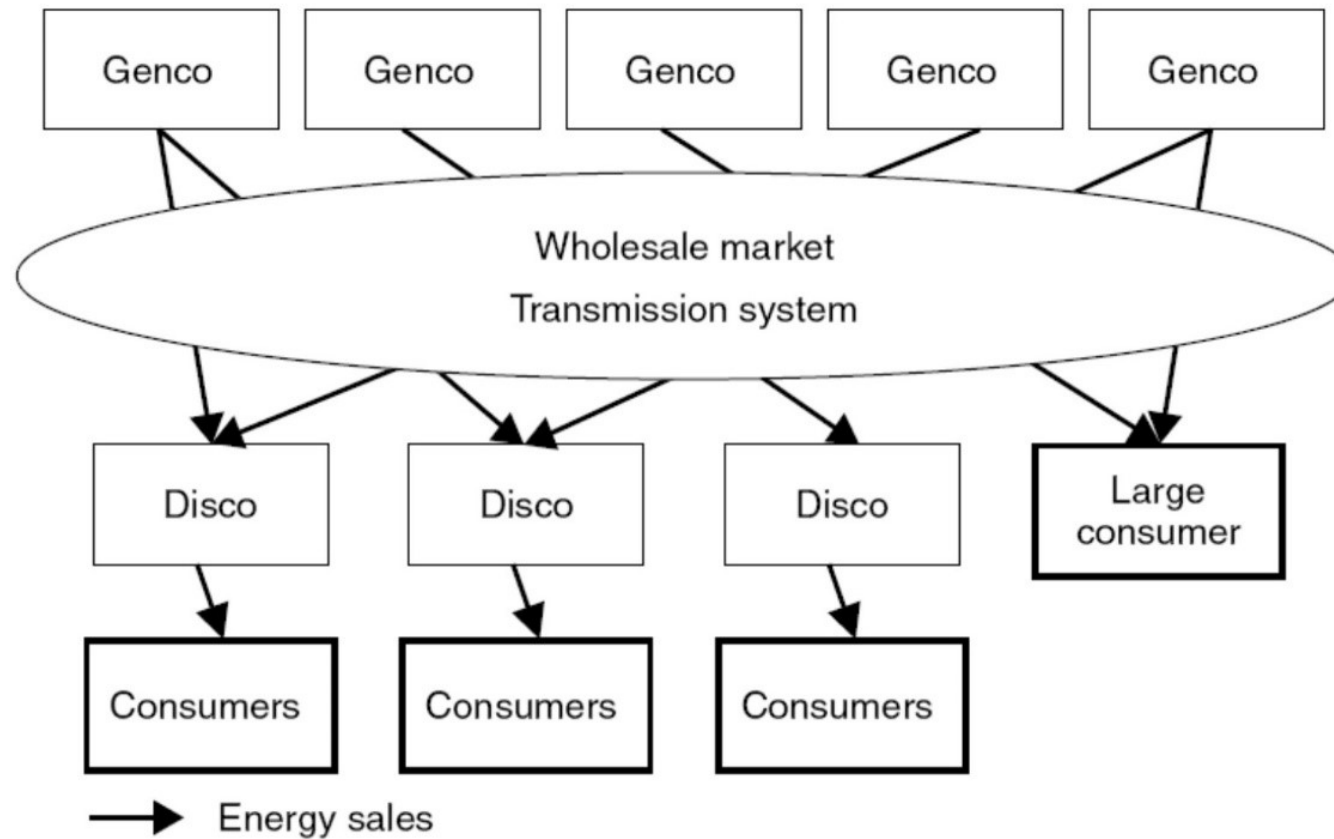
How to ensure that generation will always match demand in free markets ?
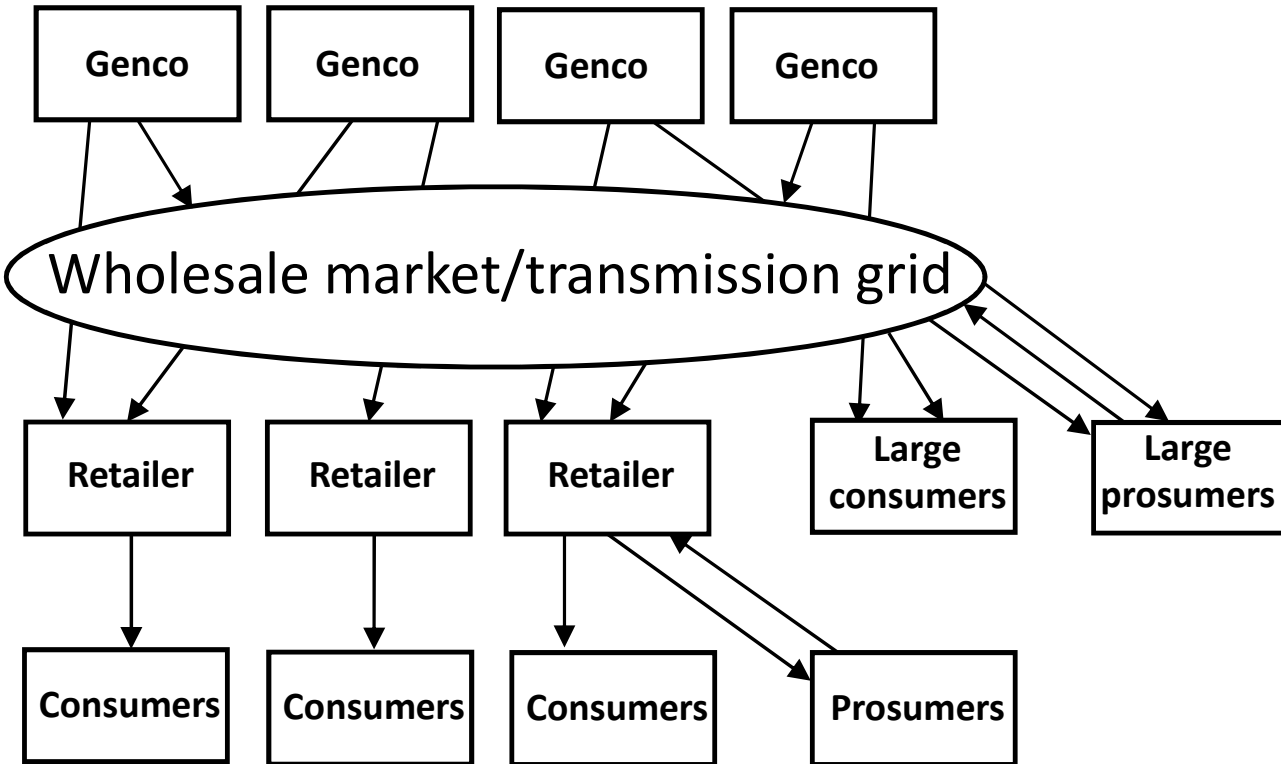
The purchasing agency model
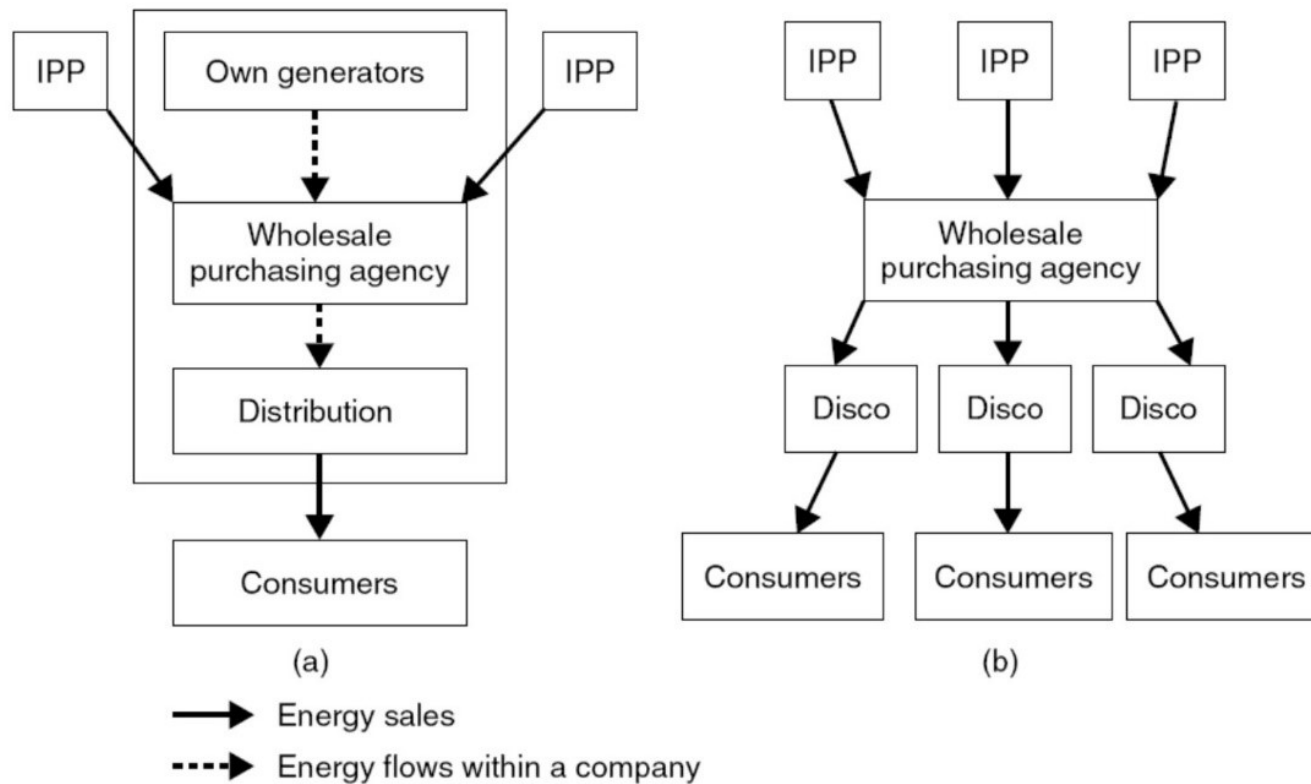
The Purchasing agency model with Independent Power Producers (IPPs) (a) integrated version (b) disaggregated version.

The wholesale competition model

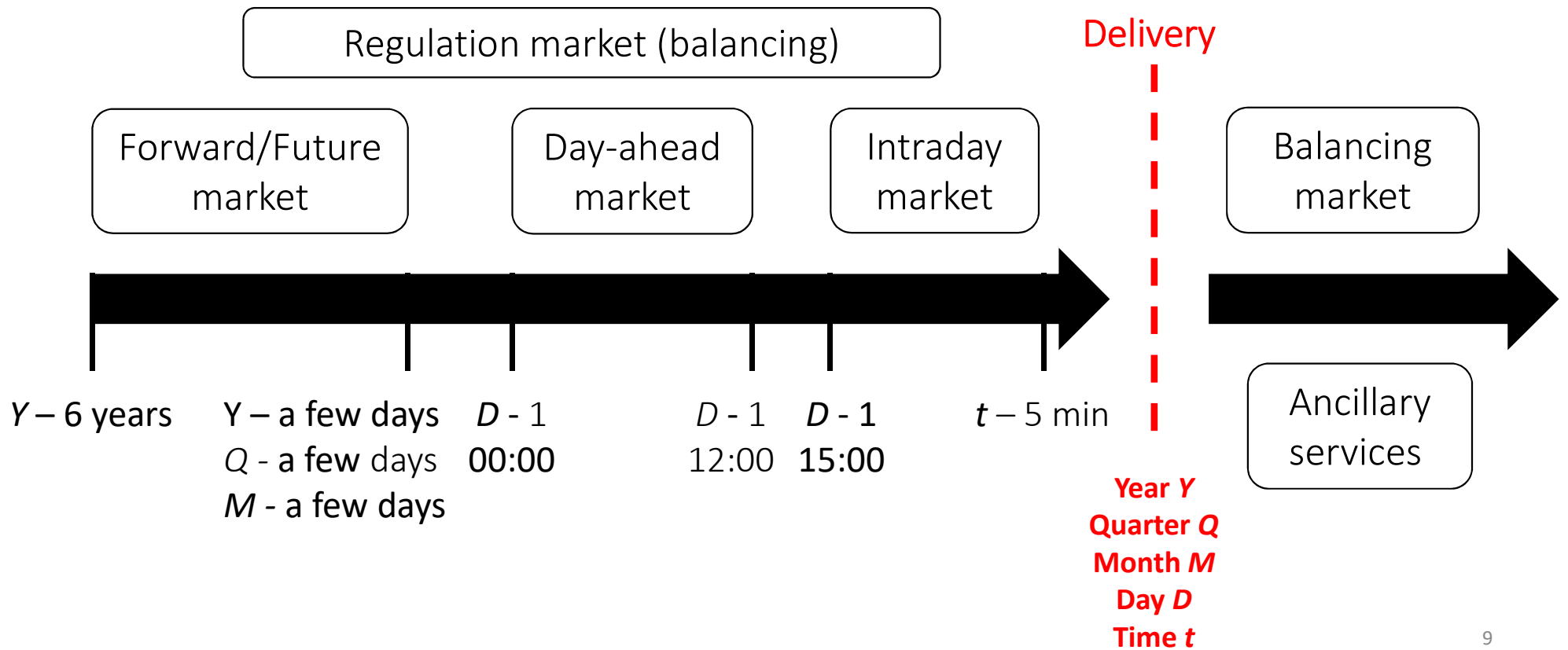# The retail competition model with prosumers

Dominant model in Europe for more than ten years.

Electricity sold on a quarter-by-quarter basis on energy markets.

Transitioning to this model made Haulogy successful.

Electricity markets – Overview

Regulation market (balancing)

Delivery

Forward/Future market

Day-ahead market

Intraday market

Balancing market

$Y - 6$ years

Y – a few days
Q - a few days
M - a few days

D - 1
00:00

D - 1
12:00

D - 1
15:00

$t - 5$ min

**Year Y
Quarter Q
Month M
Day D
Time t**

Ancillary services

Forward/Future market – Presentation

Electricity market based on **long-term bilateral financial contracts** between producers and consumers (generally retailers) of electricity.

Opportunity for the market participants to perform **price hedging and risk management**, to avoid any short-term higher price volatility.
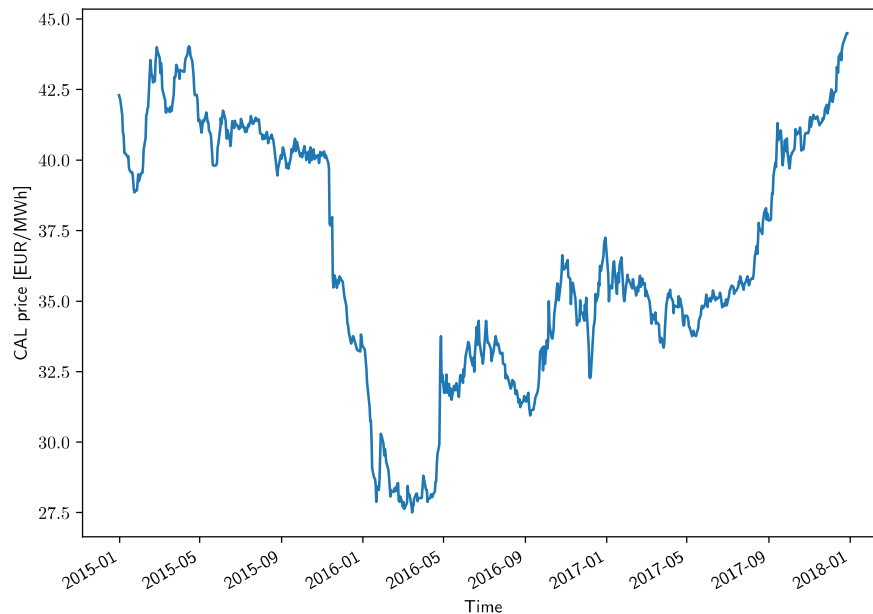
Diverse products available: yearly, quarterly or monthly base-load products.

Trading horizon from **six years up to a few days ahead** of the product's first delivery day.

The Forward/Future price represents the **expected price** to be observed on the day-ahead market for the time period considered.

Forward/Future market – Example

CAL 2018 product

Calendar (CAL) product:

- Yearly base-load product (delivery of constant electric power for the entire year).

- Starting three years ahead of the delivery year.

- Ending a few days before the first day of the delivery year.

Day-ahead market – Presentation

Also called the **electricity spot market**, the day-ahead market is the central electricity market for everyday matching of electricity supply and demand.

This electricity market is operated once a day for all hours of the following day through a **single blind auction** (hourly resolution).

The day-ahead market is organized as a **pool**:

- All **bids** (buying) and **asks** (selling) orders are considered simultaneously.
- The other market participants' orders are **unkown**.
- A unique price is determined by the **market clearing algorithm** for all participants.

Market operator: EPEX SPOT (originally Belpex).

Day-ahead market – Timeline
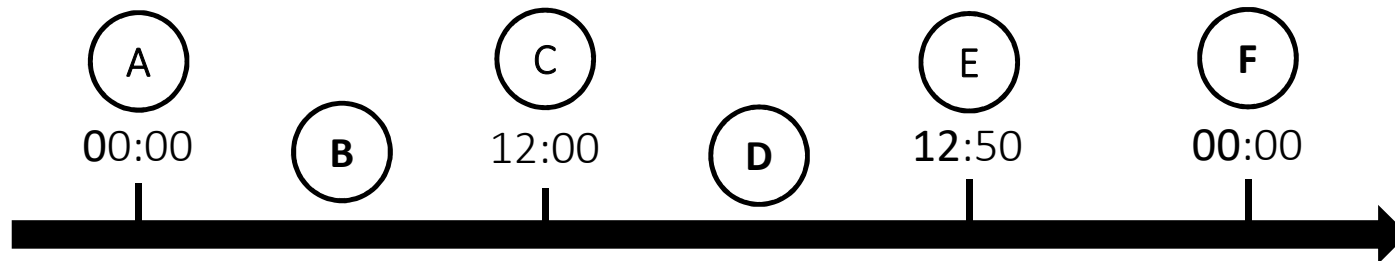
A. Opening of the day-ahead market for all hours of the following day.

B. Market participants submit their bids and asks to the order book (simple orders, block orders, exclusive orders, curtailable orders, ...).

C. Closing of the day-ahead market for all hours of the following day.

D. Execution of the market clearing algorithm.

E. Notification of the market participants and system operators about the market clearing outcomes.

F. Beginning of the delivery of electricity for the entire day.

Day-ahead market – Clearing algorithm

For each hour of the following day (simple explanation when no contraints exist):

1. Aggregation of the ask orders submitted to the order book into the **supply curve**.
2. Aggregation of the bid orders submitted to the order book into the **demand curve**.
3. Determination of the **equilibrium point** (intersection of both curves).
4. Notification of the resulting **clearing prices and volumes**.

This market clearing algorithm maximizes the **social welfare**.

https://www.epexspot.com/en
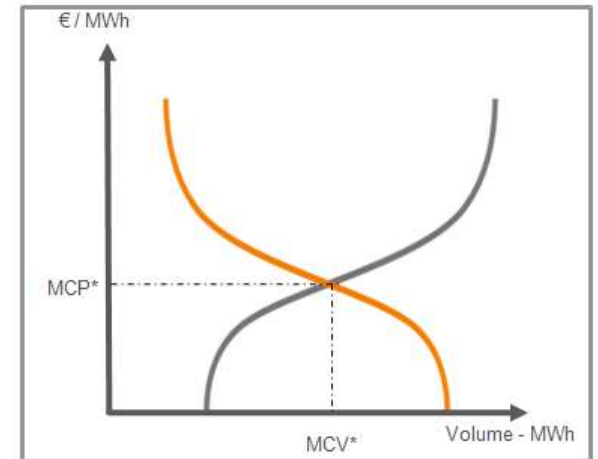
Day-ahead market – Potential problem

The clearing of the day-ahead market happens a **fairly long time** prior to the supply and consumption operations (between 12 and 36 hours).

The actual generation/consumption may **deviate from the original schedule** contracted (different weather forecasts, technical problems, etc.).

Three main solutions are offered to the market participants:
- **Compensate** with other generation/consumption assets within their portfolio.
- Adjust their positions through the **intraday market**.
- Do nothing and be exposed to the **balancing market**.
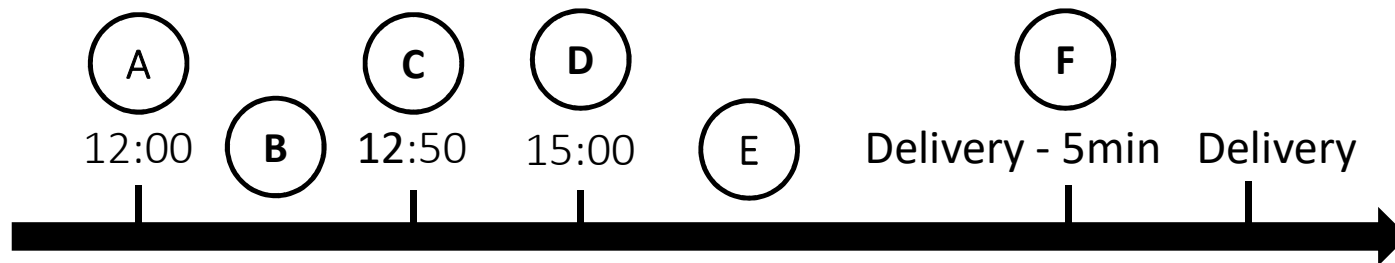
Intraday market – Presentation

The intraday market allows the market participants to **adjust their positions** through **bilateral contracts**. It is an opportunity for producers and consumers to make **last-minute adjustments** and balance their positions **closer to real time**.

This electricity market authorizes **continuous trading**, meaning that a trade is executed as soon as two orders match (different constraints have to be met depending on the orders types).

Multiple contracts are available: hourly, half-hourly and quarter-hourly.

Market operator: EPEX SPOT (originally Belpex).

Intraday market – Timeline

A. Closing of the day-ahead market for all hours of the following day.

B. Market clearing algorithm execution.

C. Notification of the market participants and system operators about the market clearing outcomes.

D. Opening of the intraday market for delivery on the following day.

E. Continuous trading on the intraday market.

F. Closing of the intraday market for the delivery period considered.

Intraday market – Fictive example (1)

Context: There is a last-minute update in the wind forecast, and the predicted wind power generation associated with the portfolio of a supplier is suddenly decreased by 50 MWh for the time period 10:00-11:00. This wind power generator intends to adapt its position on the intraday market, whose state is represented hereafter for that specific time period.

Question: Which actions could be performed by this supplier to avoid any imbalance?

ID	Side	Quantity (MWh)	Price (€/MWh)
G1	Sell	100	35
G2	Sell	80	40
G3	Sell	50	50
G4	Sell	20	65
C1	Buy	10	55
C2	Buy	20	60
C3	Buy	35	65
C4	Buy	110	70

Non-Curtailable orders
(All or None)

Intraday market – Fictive example (2)

1. A first possibility is to buy 50 MWh from G3 and pay 50 x 50 = 2500€.

2. A second possibility is to buy 80 MWh from G2 and sell 10 MWh and 20 MWh to C1 and C2, respectively, thus paying 80 x 40 − 10 x 55 − 20 x 60 = 1450€.

3. Other possibilities?

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Non-curtailable orders
(All or None)

Last words

Every time new ways for trading electricity emerge, new business opportunities appear for Haulogy.

Many new models will appear quite soon (Renewable Energy Communities, consumer-centric model from ELIA, etc.).

Think about the products that could be developed around autonomous EVs that could charge anywhere and discharge electricity into your home batteries.