



**POLITECNICO**  
MILANO 1863

DIPARTIMENTO  
DI INGEGNERIA GESTIONALE

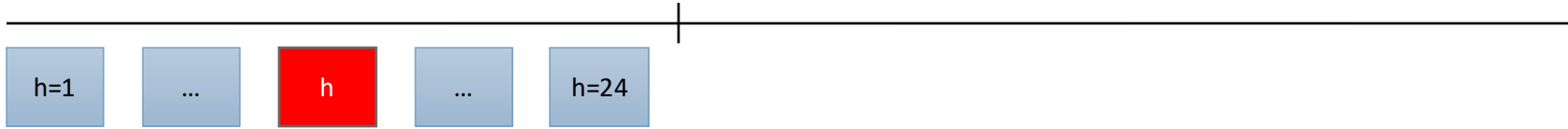
# Explaining the evolution of Italian electricity prices

27.09.2024 | Giovanni Bonaccorsi (DIG) – Guillaume Koechlin (DMAT)

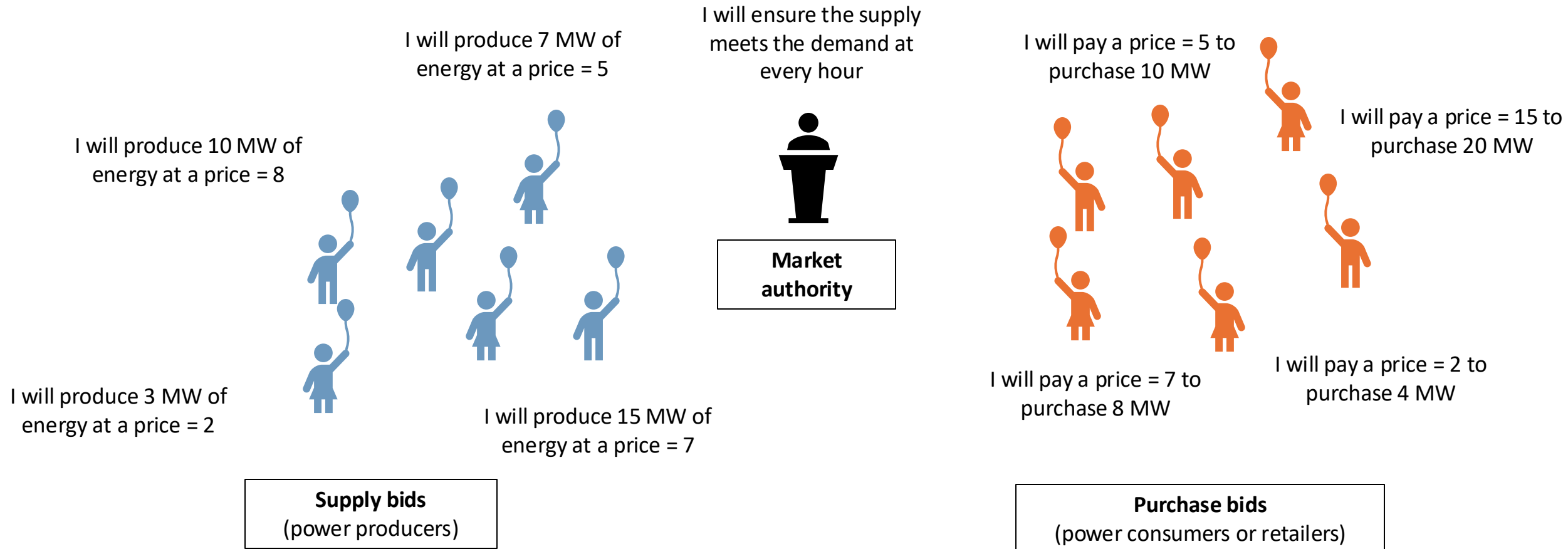
# The context: how electricity prices are born?

The day ahead

Today



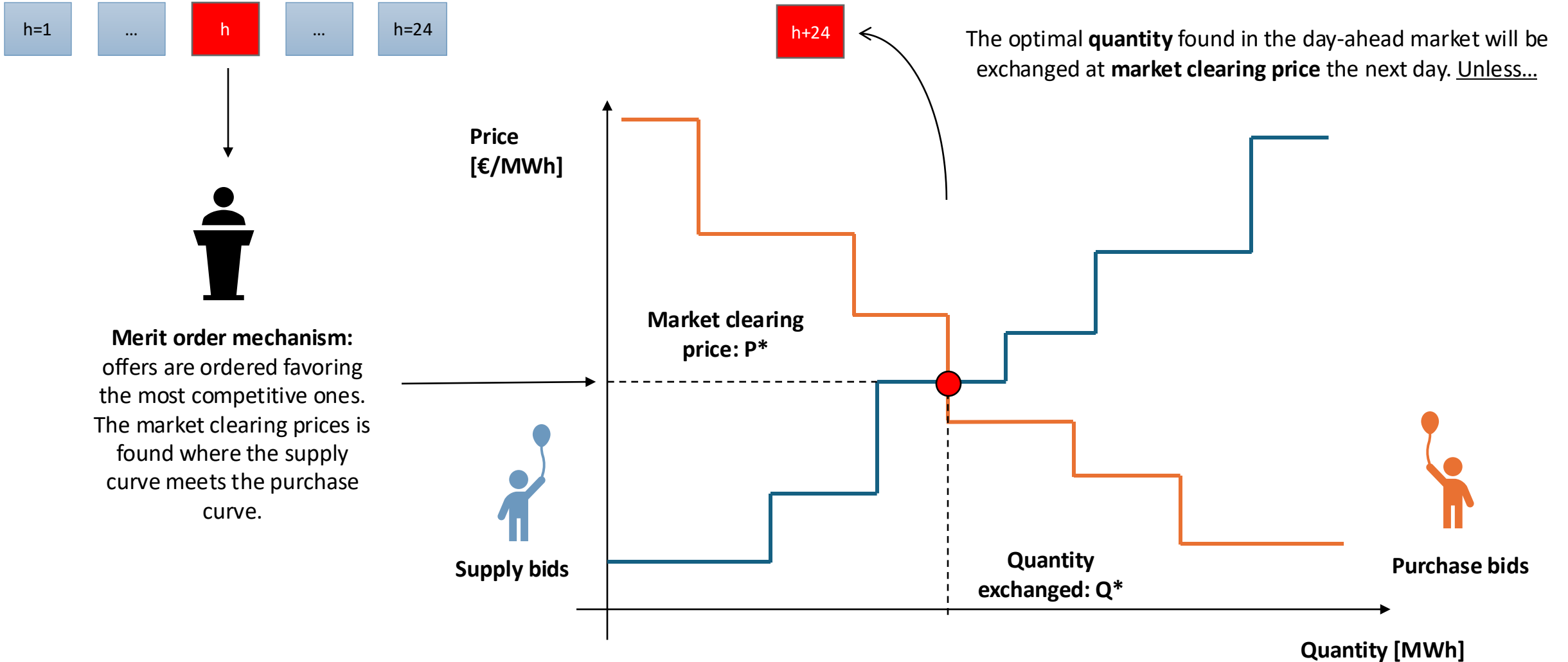
Tomorrow at h time...



# The context: how electricity prices are born?

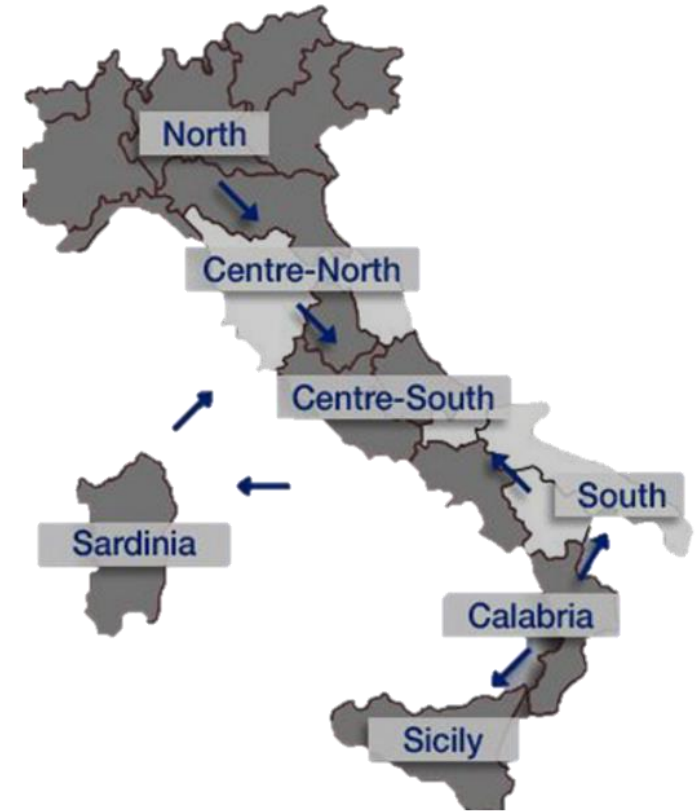
The day ahead

Today



## Decoupling

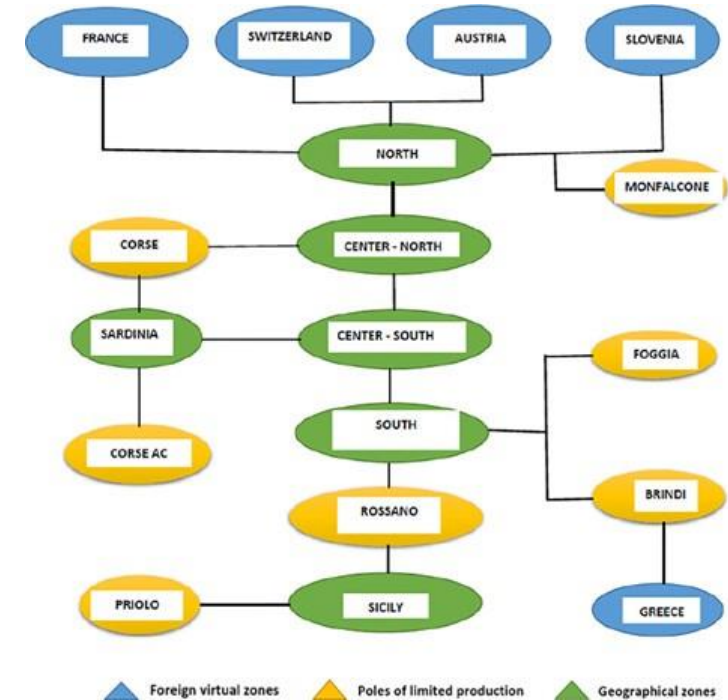
- Unless... there is **decoupling**, i.e., multiple market clearing prices. Why this happens?
- **Zonal Pricing Mechanism:** Italy uses a zonal pricing mechanism, meaning the country is divided into bidding zones. Electricity prices in each zone are determined by market clearing, where supply meets demand.
- Each zone may experience **different price dynamics** due to:
  - **Supply-demand balance:** consumption patterns may differ between zones.
  - **Transmission constraints:** Limited capacity in transmission lines between zones leads to price variations.
  - **Renewable energy:** Higher penetration of renewables like wind and solar in certain zones can lead to lower prices during high generation periods.
- **Congestion Management:** When transmission lines between zones become congested, prices increase in zones where demand exceeds supply. The grid operator manages congestion by adjusting prices to reflect local conditions, ensuring grid stability.
- **Key Bidding Zones in Italy:** Northern, Central-Northern, Central-Southern, Southern, Sardinia, and Sicily.



From: Ahelegbey, Daniel Felix, et al.  
"Structural changes in contagion channels: the impact of COVID-19 on the Italian electricity market." Annals of Operations Research (2024): 1-26.

# Decoupling

- Unless... there is **decoupling** , i.e., multiple market clearing prices. Why this happens?
- Zonal Pricing Mechanism:** Italy uses a zonal pricing mechanism, meaning the country is divided into bidding zones. Electricity prices in each zone are determined by market clearing, where supply meets demand.
- Each zone may experience **different price dynamics** due to:
  - Supply-demand balance:** consumption patterns may differ between zones.
  - Transmission constraints:** Limited capacity in transmission lines between zones leads to price variations.
  - Renewable energy:** Higher penetration of renewables like wind and solar in certain zones can lead to lower prices during high generation periods.
- Congestion Management:** When transmission lines between zones become congested, prices increase in zones where demand exceeds supply. The grid operator manages congestion by adjusting prices to reflect local conditions, ensuring grid stability.
- Key Bidding Zones in Italy:** Northern, Central-Northern, Central-Southern, Southern, Sardinia, and Sicily.
- Foreign Exchange Influence:** Scheduled cross-border energy exchanges, mainly with France, Switzerland, and other neighbors, impact local prices through imports and exports, further influencing zonal disparities.



From: Fianu, Emmanuel Senyo, Daniel Felix Ahelegbey, and Luigi Grossi. "Modeling risk contagion in the Italian zonal electricity market." European Journal of Operational Research 298.2 (2022): 656-679. .



The data

Variable	Description	Geograph ical level	Time granul arity	Source
The market clearing price(s)	The price(s) obtained in the day-ahead market: 1.The « <b>unique</b> » <b>national price</b> ( <i>prezzo unico nazionale</i> , <b>PUN</b> ) 2.The <b>other zonal prices</b> : if at least one of these other prices is different from the PUN we observe a <b>decoupling</b>	bidding zone level	daily	<a href="http://www.mercatoelettrico.org">www.mercatoelettrico.org</a>
Load Forecast	This variable represents the <b>predicted electricity demand</b> for the upcoming day in a specific <b>bidding zone</b> . The forecast is based on historical data, weather conditions, and anticipated electricity consumption patterns	bidding zone level	daily	ENTSOE
Wind and solar forecast	This variable provides a <b>day-ahead forecast of electricity generation from renewable energy sources</b> , specifically <b>wind and solar</b> , in a particular <b>bidding zone</b> . The forecast is based on weather predictions (e.g., wind speed, sunlight) and generation capacity in each zone.	bidding zone level	daily	ENTSOE
Scheduled foreign exchange	This variable represents the <b>Net Transfer Capacity (NTC)</b> , which is the <b>forecasted electricity exchange capacity</b> between different bidding zones or across country borders for the following day. It shows the maximum amount of electricity that can be transferred between regions without causing congestion on the grid.	bidding zone level	daily	ENTSOE
Gas price	This variable represents the futures price of natural gas, specifically the Title Transfer Facility (TTF), which is a virtual trading point for natural gas in the Netherlands. It reflects the expected price of gas for the next month at a national level.	National level	monthl y	

## Research objectives

The project aims at explaining the **dynamics of electricity prices**.

In particular, the following approaches may be followed:

- Develop a model to analyze how renewable generation, gas prices, and foreign exchanges **impact electricity prices** across bidding zones.
- Apply a statistical model to **forecast day-ahead electricity prices**, accounting for time-varying effects of load, renewable generation, decoupling across bidding zones and gas prices.
- Investigate **the factors behind decoupling** between bidding zones exploiting the information from demand and renewable production forecasts, gas prices and foreign exchanges.
- Develop **a spatial model to predict electricity prices in bidding zones** based on the geographical proximity of regions, load forecasts, and renewable generation.
- Investigate **how the variance of day-ahead electricity prices changes** depending on the proportion of renewable energy (wind and solar) in the forecast and how volatility in gas prices contributes to price instability.



**POLITECNICO**  
MILANO 1863

DIPARTIMENTO  
DI INGEGNERIA GESTIONALE

# Contatti

Giovanni Bonaccorsi - [giovanni.Bonaccorsi@polimi.it](mailto:giovanni.Bonaccorsi@polimi.it)

Guillaume Koechlin - [guillaume.koechlin@polimi.it](mailto:guillaume.koechlin@polimi.it)





**Grazie per l'attenzione**