Reconfiguration of Bidding Zones in Electricity Markets

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Outline

- ENTSO-E Bidding Zone Review
- Impacts of zonal, nodal and national systems
- Norwegian Electricity Market
- Swedish Electricity Market
- Italian Electricity Market
- Italian case as example for GB reform?

ENTSO-E Bidding Zone Review

- **Commission Regulation (EU) 2015/1222** (CACM) → bidding zones should enable effective congestion management while maximizing the overall efficiency of the market.
- Zone borders to be based on structural congestion.

ENTSO-E: **zone size affects market liquidity**

- Larger zones improve liquidity by *increasing number of participants and products*
- Smaller zones may reduce liquidity, widening bid/offer spreads, but can *internalize network constraints*

How many zones?

Country	Date	Peak Demand	Number of zones
Norway	2008 – ongoing	25.2 GW	5
Sweden	2011 – ongoing	25.2 GW	4
Italy	2004 – ongoing	49.6 GW	7
Denmark	2000 – ongoing	6.4 GW	2
Australia	1998 – ongoing	32.8 GW	5
California	1998 – 2009	43.9 GW	3
Texas	2002 – 2010	85.5 GW	5
Great Britain	*From 202X?*	*48 GW*	*7/12?*

Reconfiguration of Norwegian Bidding Zones

Zones evolve to manage congestion and reflect hydrological conditions.

Before 1991 deregulation
- National pricing system

After 1991 deregulation
- Flexible zones and borders

2008 – 2009
- **2 zones**
- Early 2009: added NO3
- March 2010: 4 zones (NO1-NO4)

Since September 2015
- **5 zones (NO1-NO5)**
- 2018 study: *proposals to* ***split NO4*** to better manage northern bottlenecks

Source: Statnett (2025)

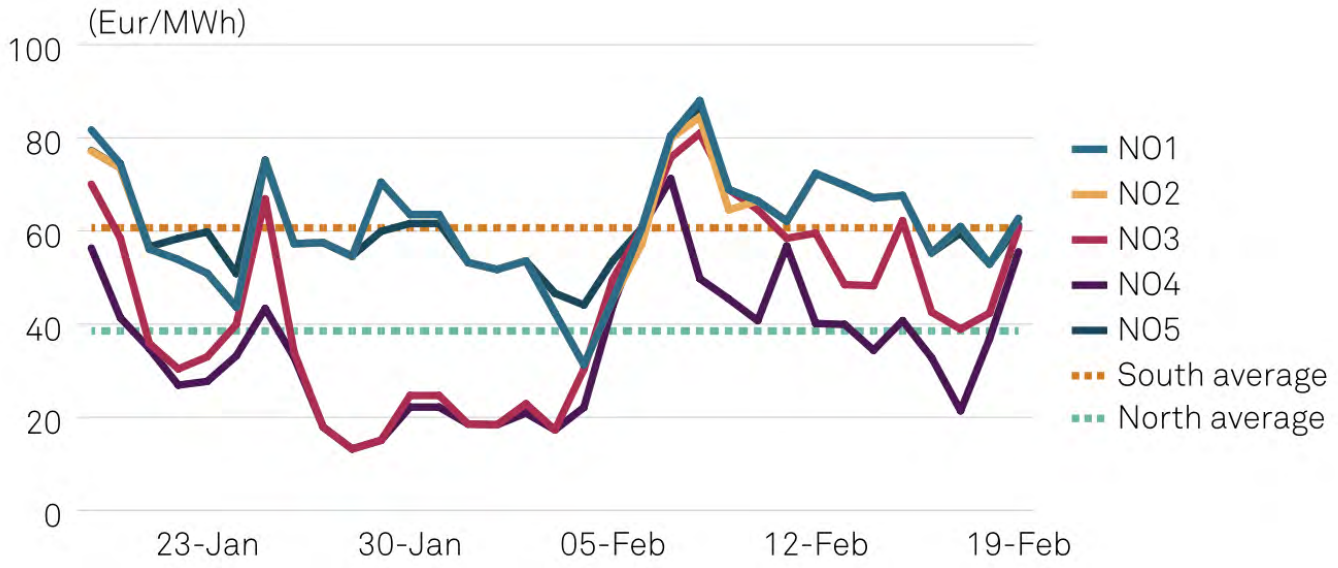
Norwegian Electricity Market

Norway: dominated by **hydropower** (93%), little wind (2019: 2.3%)

Zonal pricing

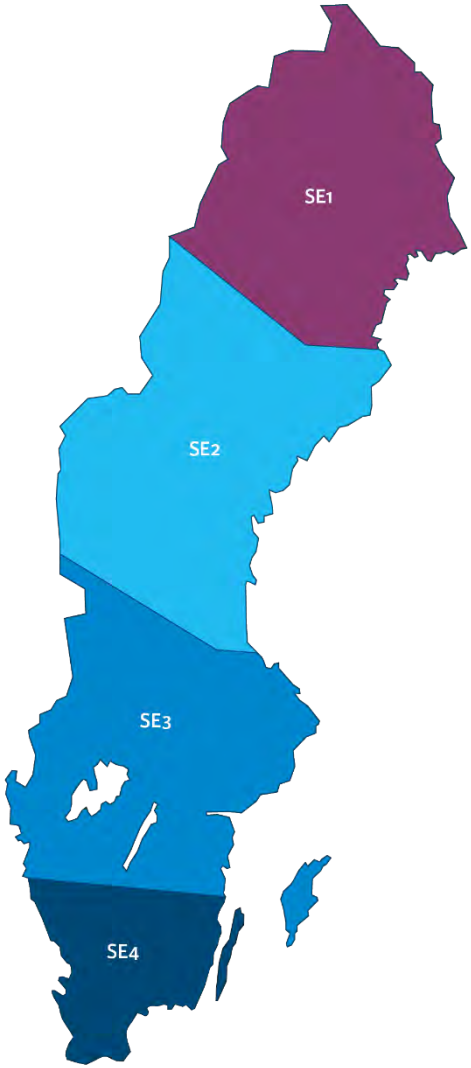
- Congestion frequent in all 5 zones → countertrading/redispatch.
- Zonal prices signals grid constraints from varying weather and reservoir levels
- Price spreads: mean absolute hourly difference **~ €9/MWh**; projected to €11 (2030) and **€15 (2040)**

Norwegian power price zones in January and February 2024



Projections source: Statnett (2024)
Graph source: Nord Pool (2024)

Swedish Electricity Market



Before November 1, 2011: single bidding zone

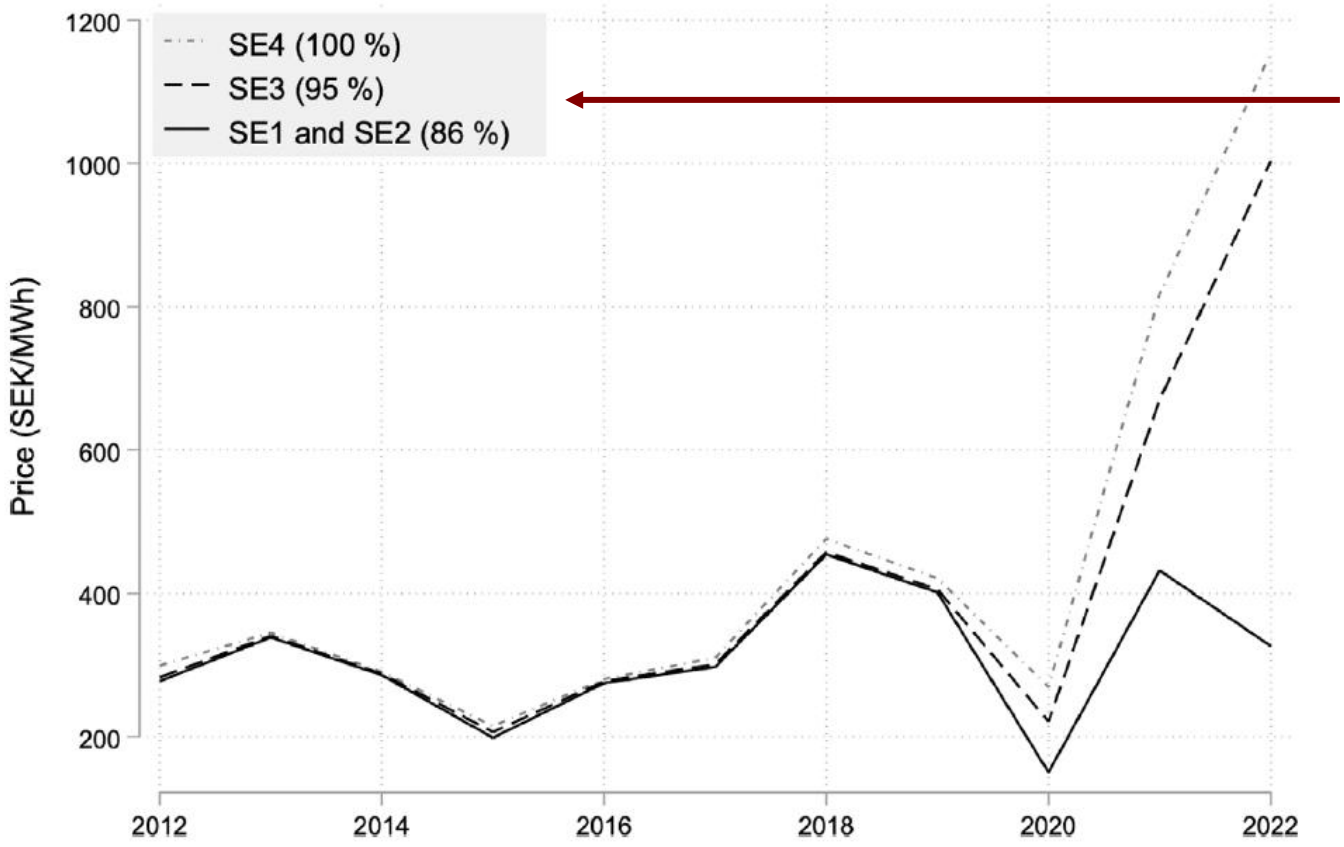
- most of the demand in South, generation in North
- Low prices from hydropower and nuclear
  → prices in Sweden lower than other zones
- Reduced exports to Denmark to avoid congestions
  → ***Violate EU competition rules***

2009: EC notes *introduction of bidding zones to* avoid price distortion, reflect real market conditions

2012: Introduction of zonal pricing

Source: Mjölby-Svartådalen Energi AB (2025)

Reconfiguration of Swedish Zonal Market



Zonal spot prices as % of SE4

Source: Lundin (2022)

Key Drivers of price divergence:

- High north hydro (SE1/SE2) → price suppression
- Nuclear phase-out (Dec 2019) in SE3 → upward pressure in SE3
- Elevated Baltic power prices → transmitted through southern interconnectors

Italian Electricity Market

Zonal Pricing Framework

- Hourly zonal prices: balance supply–demand s.t. transmission constraints
- Single National Price (**PUN**): consumption-weighted average of zonal prices as a reference for end-customers

Key Features & Drivers

- North–South divide:
  - North: high demand, strong interconnections → frequent imports
  - South & islands: high renewable generation (solar, wind) but limited export capacity → local price spikes

Historical Evolution of Zonal Design

Pre 1999: no market, large and small monopolies, bilateral contracts.

16 March 1999: Electricity Market established by **Legislative Decree.**

1st April 2004: IPEX (Italian Power Exchange) → zonal market.

1st January 2025: Market abandons PUN. Zonal consumer prices.

Low internal transfer capacity → zones.

- **Geographical zones**: bounded by physical transfer limits, inter-zone exchanges capped to preserve system security.
- **Virtual zones**: foreign interconnection point or with a limited production pole;
  - **Limited production poles**: production units with grid access < installed capacity.

Reconfiguration of Italian Bidding Zones

Before 2021

- 6 bidding zones
- 2019 limited-production poles in Brindisi, Foggia and Priolo were removed

From January 1, 2021

- Umbria reassigned from Centre-North to Centre-South
- Rossano pole replaced by new Calabria zone

Can the Italian case be important for GB reform?

- Italian electricity market - highly relevant case of zonal pricing
  - Evolving: 2021 structural reconfiguration
- One of Europe's most advanced frameworks
- Approach balances complexity and clarity, offering insights into:
  - Market efficiency
  - Managing congestion
  - Directing investment
  - Integrating RESs without compromising system stability

Key lessons for GB market reform

zonal splits improve price signals and
guide targeted infrastructure investments.

Impacts of zonal pricing

Do price zones provide more efficient congestion management than a single price regime? Yes

- Countries with zonal markets (Italy, Sweden and Norway) have significantly lower congestion management costs than the single zone national market in Germany

Does a zonal system lead to persistent price differences between zones? It depends

- Norwegian price differences have generally remained high between North and South.
- In Sweden, Northern zones have excess supply and lower prices while the South has excess demand and higher prices
- In Italy, price differences between zones have decreased over time

Are zonal prices more volatile than national prices? It depends

- In Sardinia, the 2011 connection to the Italian zonal market increased local day-ahead price volatility, while the other zonal prices remained unaffected. In a simulation of Germany's shift from a national regime to a zonal market, no significant change in price volatility is expected.

Does the zonal system promote societal welfare? This is disputed!

- Changes in locational pricing in various countries are illustrative.
- Most of the studies are based on projections and not real data analysis.
- Different studies give different results, sensitive to different policy measures

Thank you for your kind attention!

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German Electricity Market

Germany currently uses a **single national price zone**, neglecting regional supply-demand and grid constraints.

Key Features:

- North: abundant low-cost generation (wind, solar, nuclear, lignite)
- South: concentrated demand with higher generation costs (CCGT, transport premiums)
- Regular congestion requiring redispatch (costs rose from 25M in 2009 to 1.4B 2020)

Energiewende (Quitzow et al., 2016)**:**

11 March 2011 → Fukushima accident

June 2011 → Parliament voted to close eight oldest nuclear plants and to phase out the remaining nine by 2022 - removing roughly 8 GW of capacity in Southern Germany

Impacts (Centre for Public Impact, 2016):

- Over 146 million tons of CO2-equivalent emissions were offset by renewables in 2013
- Germany reduced its carbon emissions by 27% between 1990 and the end of 2014
- By 2014, more than 2 million solar thermal systems had been installed in Germany.

Debate on zonal pricing: the regional electricity supply imbalance is expected to grow. This has fuelled discussions on whether Germany should shift to a *split-zonal market*, with separate northern and southern price zones to better reflect regional supply and demand dynamics.

New Zealand Electricity Market

Before 1996 → New Zealand adopted a uniform-price spot market.
Since 1996 → New Zealand operates a **Full Nodal Pricing** (FNP) system with 253 nodes and prices calculated every 30 minutes, reflecting locational marginal costs and network constraints.

Key features:

- Generation mix: ~55-65% hydro, supplemented by geothermal, gas, coal, wind
- HVDC link transports energy from South Island hydro to North Island demand
- FNP provides granular price signals
- **Challenges**: price volatility, infrastructure complexity, risk of market power in sparsely served nodes

New Zealand's nodal system demonstrates the trade-offs between price granularity and operational complexity.

Source: Philpott et al. (2019)