



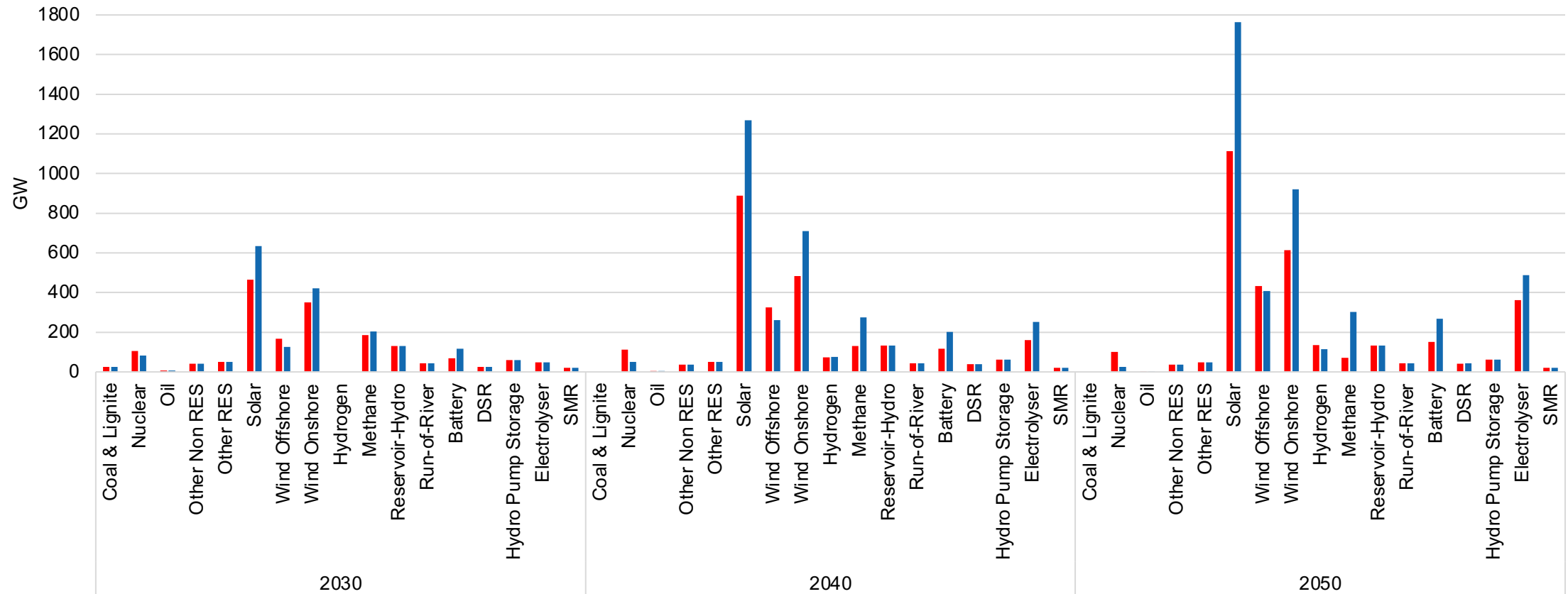
Impact of European renewable
proliferation and market integration
on the Swiss electricity market

Dr. Adamantios Marinakis
Principal Expert, FEN, ETHZ
11.09.2023, EPFL

Background

Massive proliferation of variable renewables in Europe (TYNDP2022)

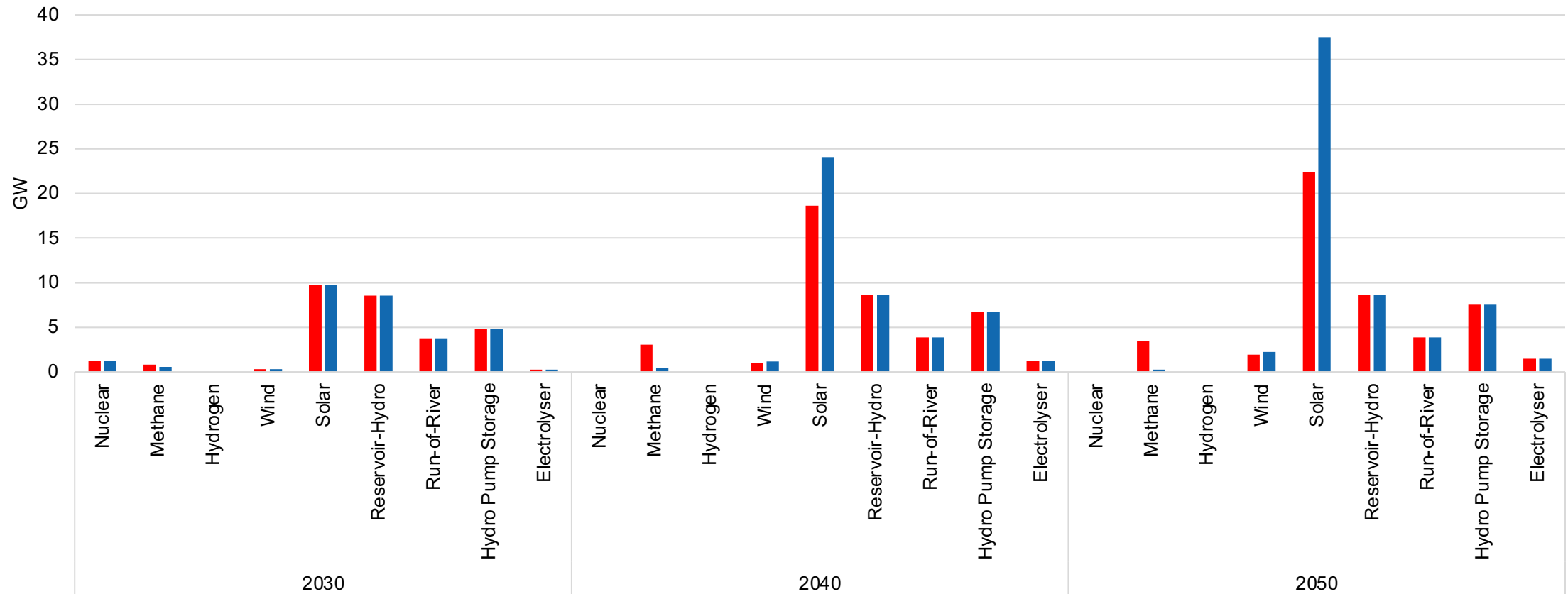
Installed capacities of power and hydrogen generation technologies
Global Ambition (red) and **Distributed Energy (blue)** scenarios



Background

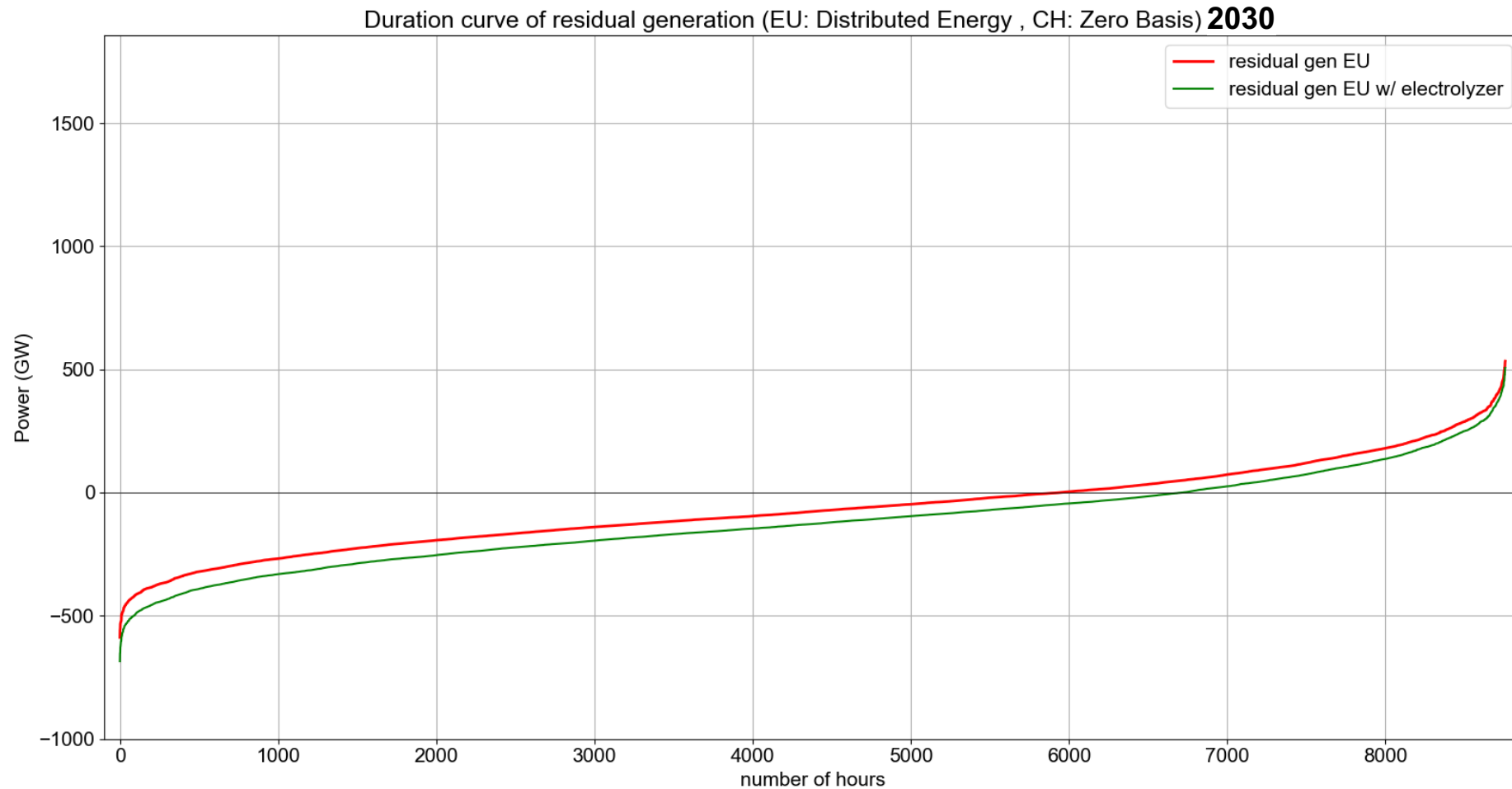
Massive proliferation of variable renewables in Switzerland (EP2050+)

Installed capacities of power and hydrogen generation technologies
Zero B (red) and Zero Basis (blue) scenarios



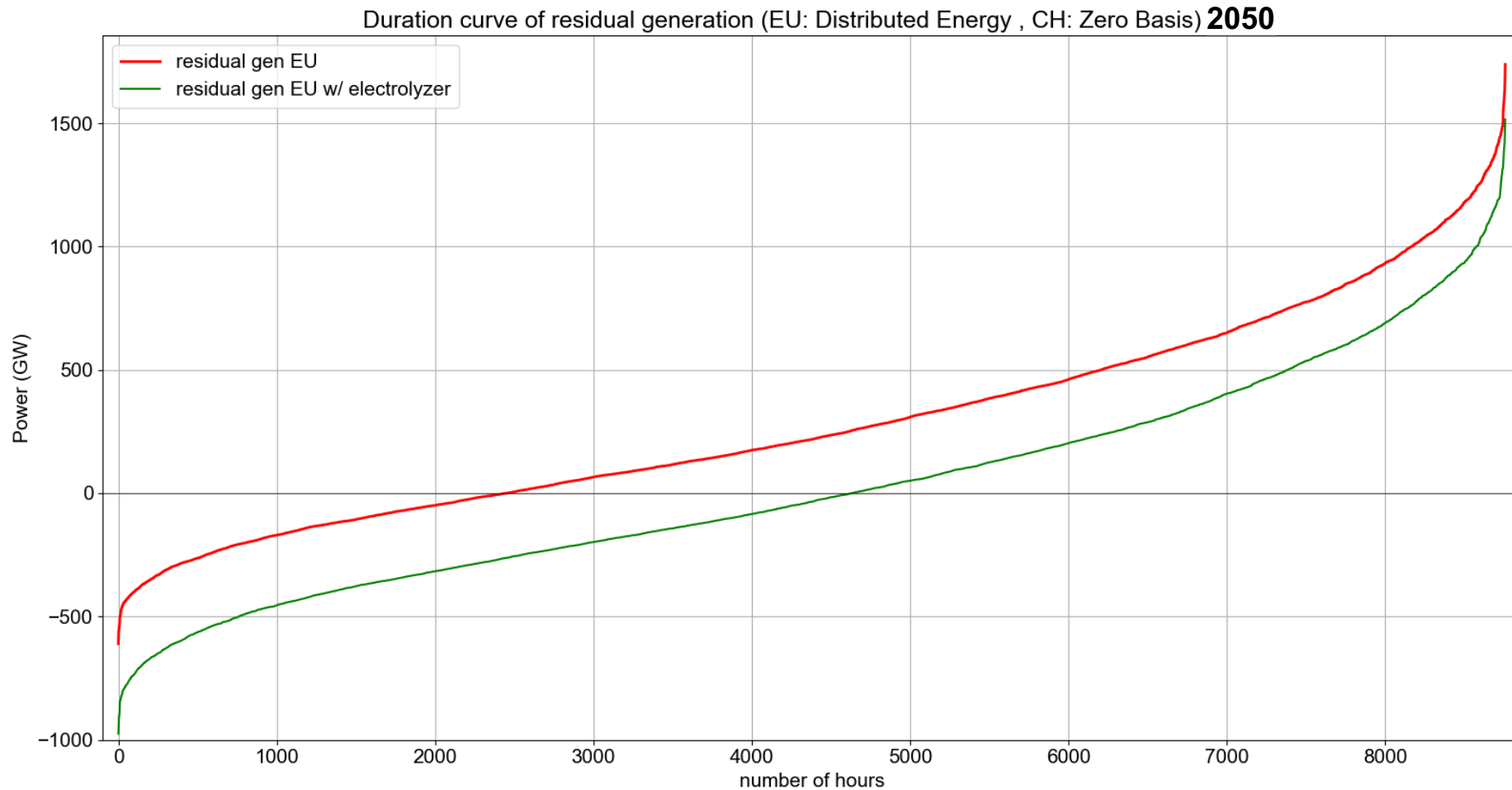
Background

A lot of renewable energy, but not always there

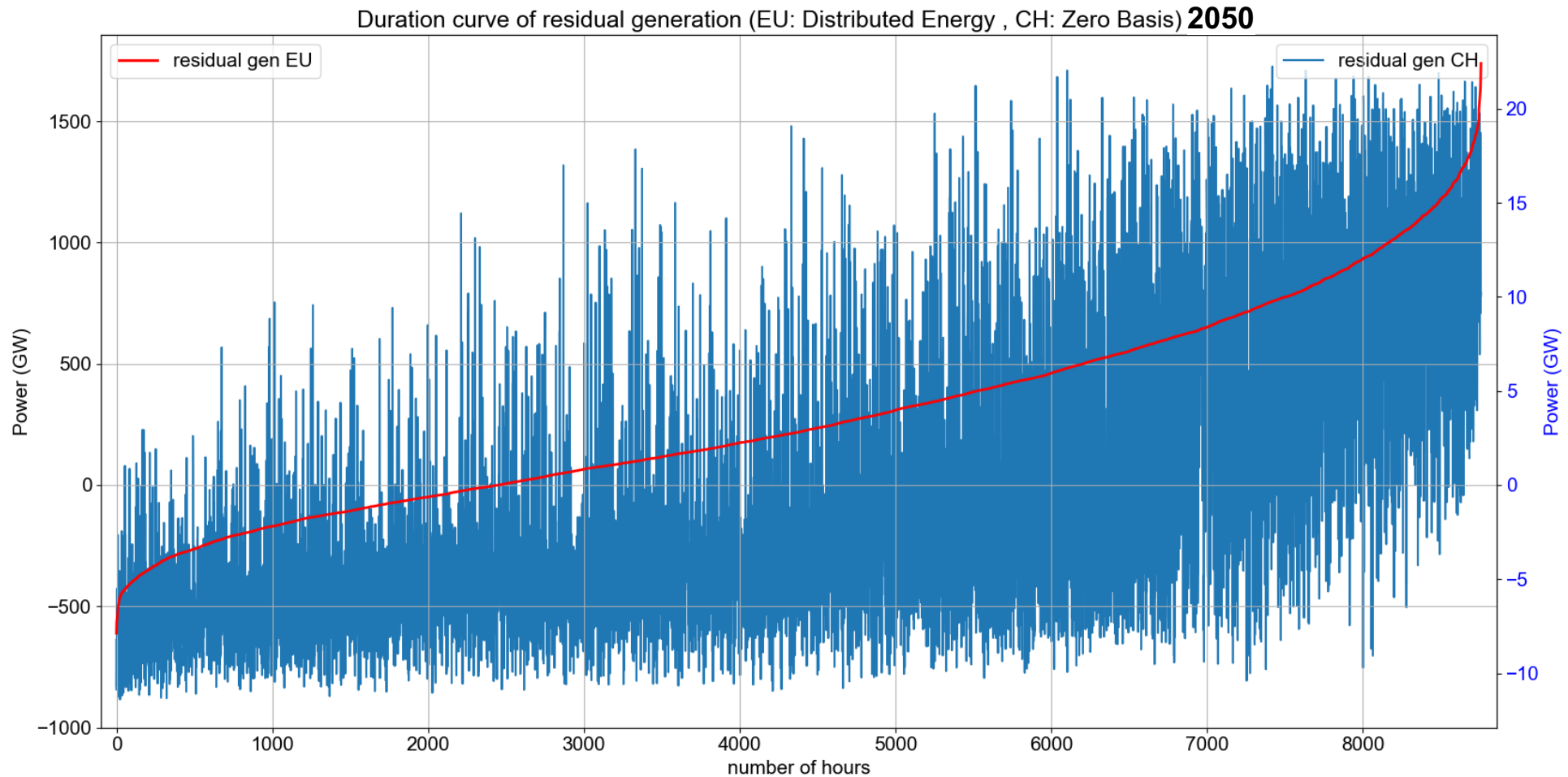


Background

A lot of renewable energy, but not always there



Background: CH has deficit when EU has also deficit



Question

How will the massive penetration of variable renewable resources impact the electricity prices in Switzerland?

Question

How will the massive penetration of variable renewable resources impact the electricity prices in Switzerland?

1. Model-based approach

2. Data observation-based approach

Estimation of electricity prices in future scenarios

Analysis performed by means of FEN's in-house tool "FlexECO"



Nodal:

- Considers cross-border transfer capacities
- Different price per node

Look-ahead:

- Solved for one whole year
- Considers time-dependencies
- Assumes that market participants perform accurate forecasting

Marginal-cost-driven:

- Units scheduled according to their marginal cost
- Assumes well functioning competition

Estimation of electricity prices in future scenarios

Analysis performed by means of FEN's in-house tool "FlexECO"



Model parameters calibrated to match price variability:

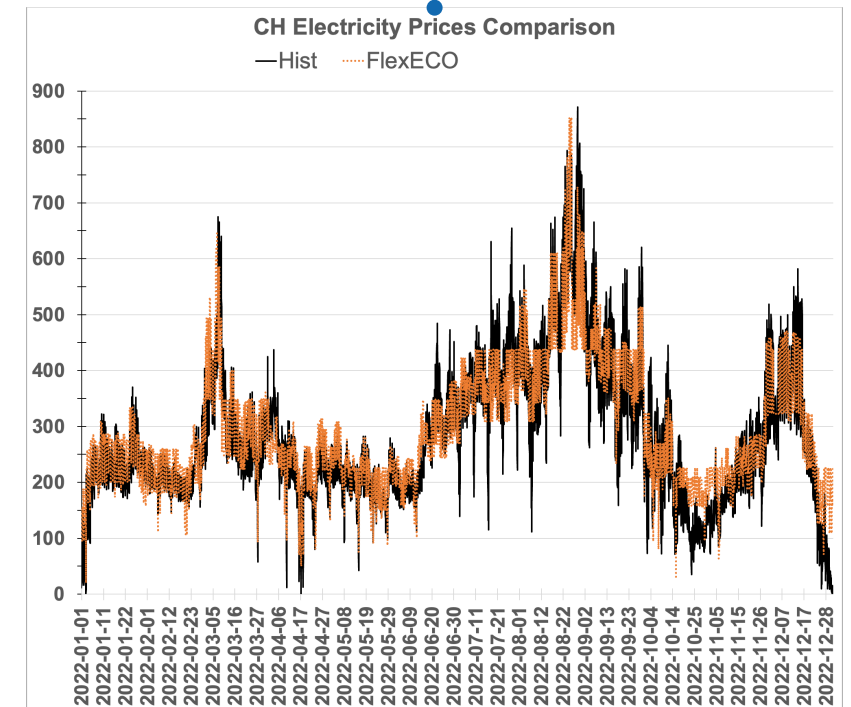
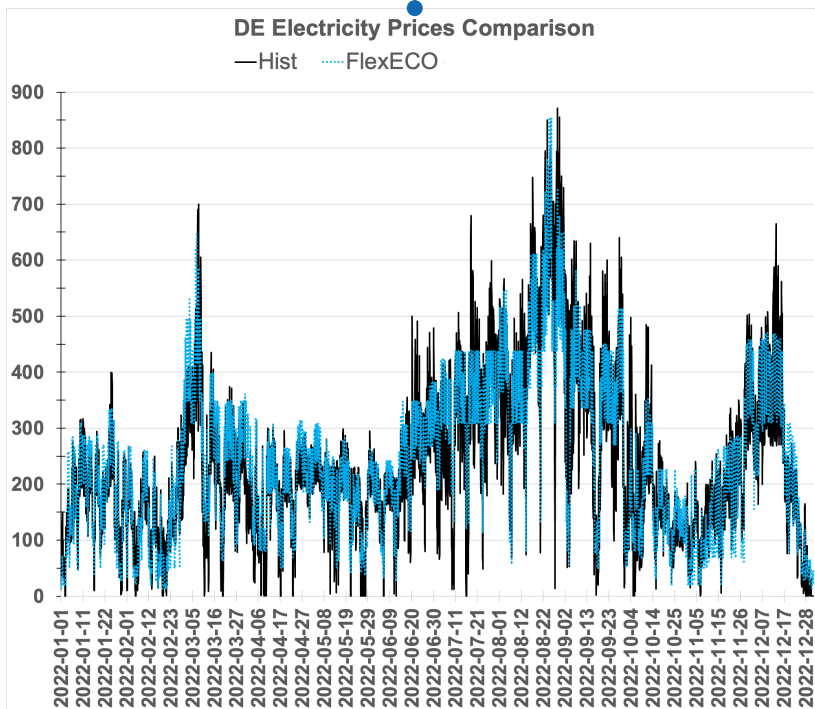
- Units clustered to reflect size and age
- Availability of generation units
- Ramping rates and ramping costs
- Down bidding
- Gas price timeseries adjusted to reflect expected variability

FlexECO used in various studies performed by FEN:

- Opportunity cost assessment of hydropower reserve providers
- SACH: System Adequacy of the Swiss Electricity Supply
- Subsidy framework for enhancing the H2 economy in CH

Estimation of electricity prices in future scenarios

Analysis performed by means of FEN's in-house tool "FlexECO"



Estimation of electricity prices in future scenarios

Analysis performed by means of FEN's in-house tool "FlexECO"

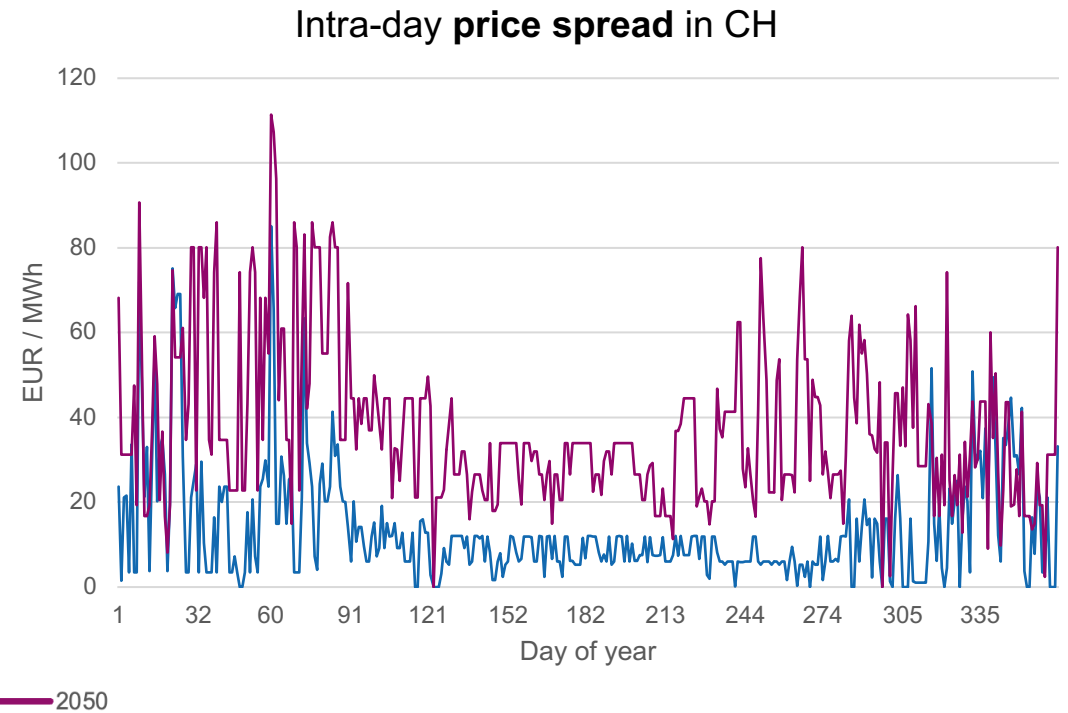
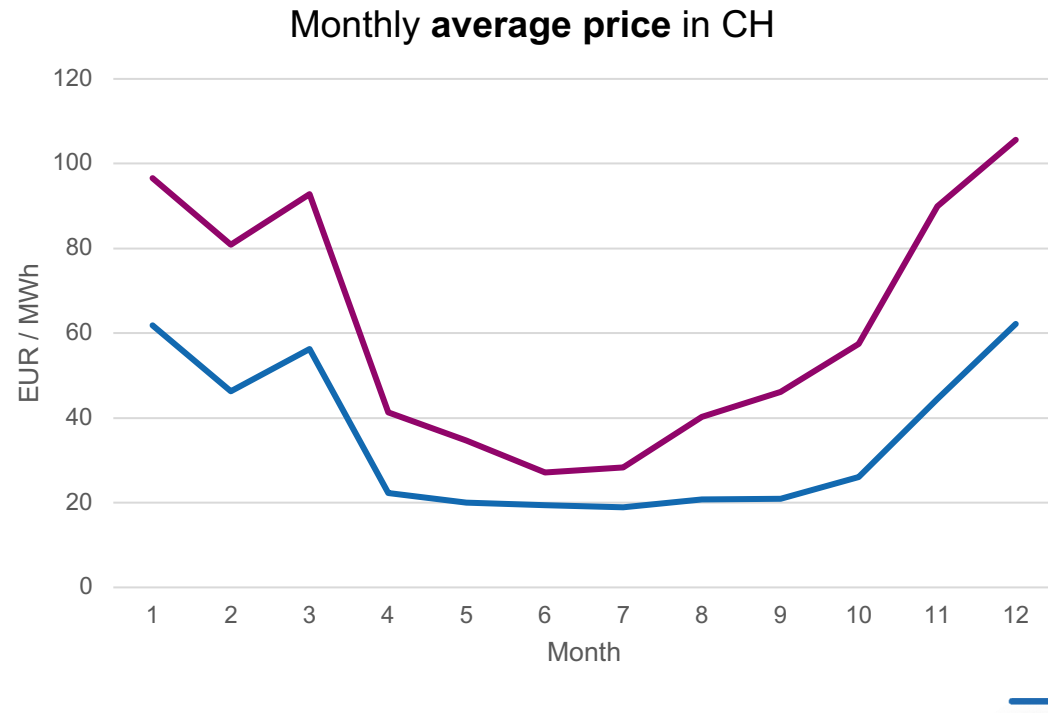


In the coming slides, results are shown for:

- European countries according to TYNDP 2020
- Switzerland according to scenario computed via Nexus-e
- A reference scenario, and a scenario assuming significant reduction of the NTCs between CH and its neighbors

Results

Seasonal and intra-day price volatility increases



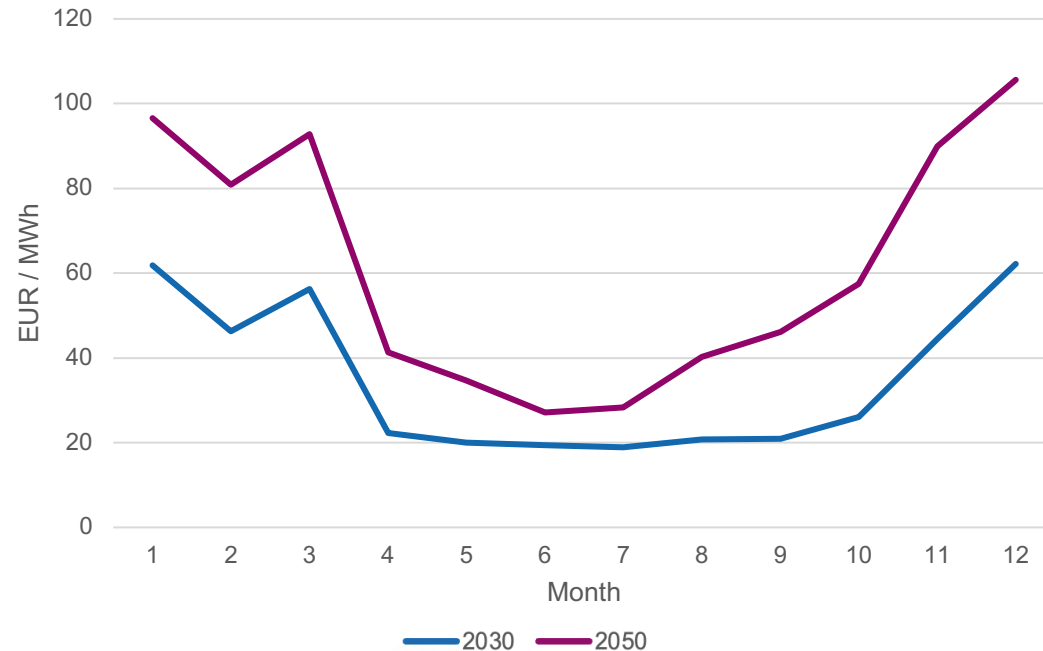
- The seasonal price spread increases
- “Cheap” summers vs. “expensive” winters
- Expensive generators cover the lack of renewable energy

- Significant intra-day price volatility, especially in winter
- Increasing need of flexible generators to be ramping up / down
- Opportunity for flexibility solutions

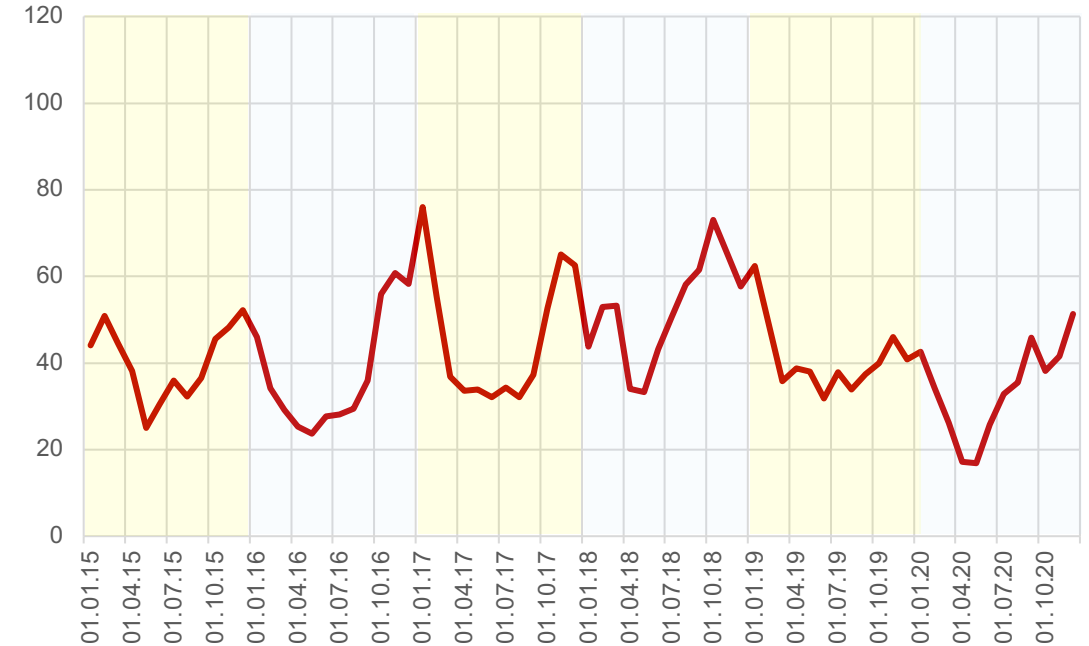
Results

Seasonal and intra-day price volatility increases

Monthly average price in CH



Historical monthly average prices in CH

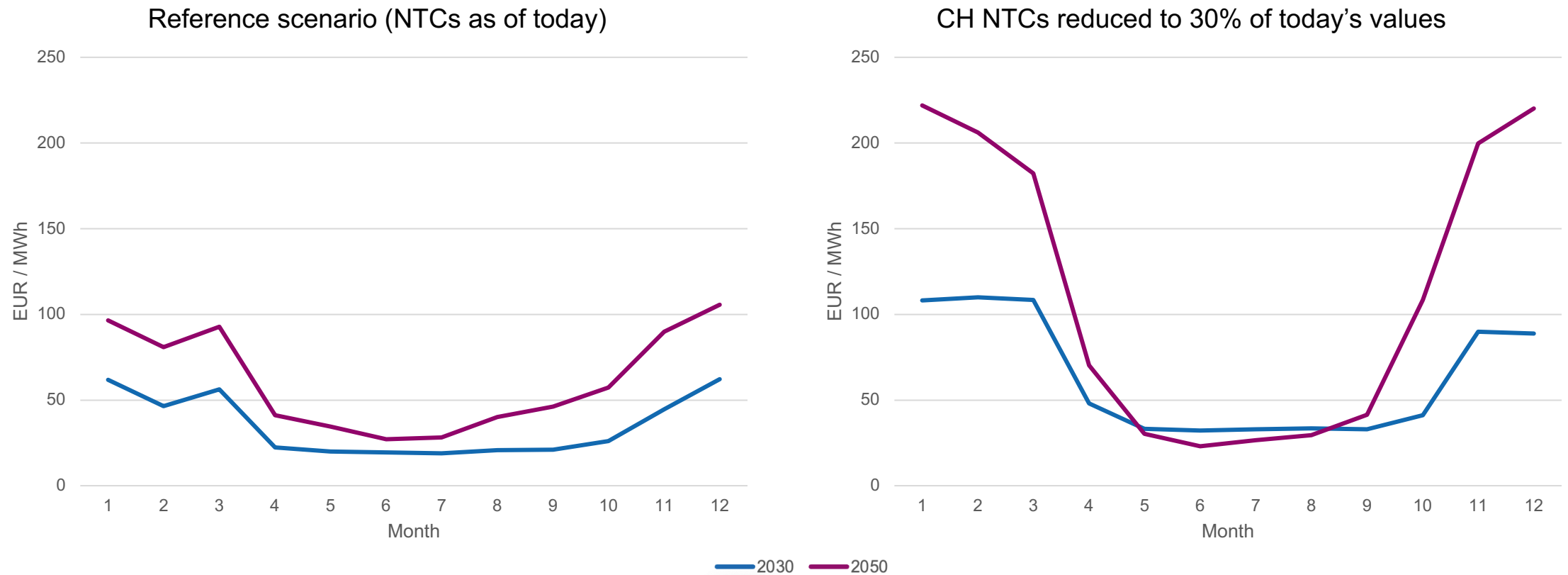


- Seasonal volatility is typical in CH
- Usually, low “plateau” does not last 6 months, but it can happen
- Winter peak around 60 EUR / MWh

Results

Reduced integration of CH in EU market increases volatility

Monthly average electricity price in CH



Question

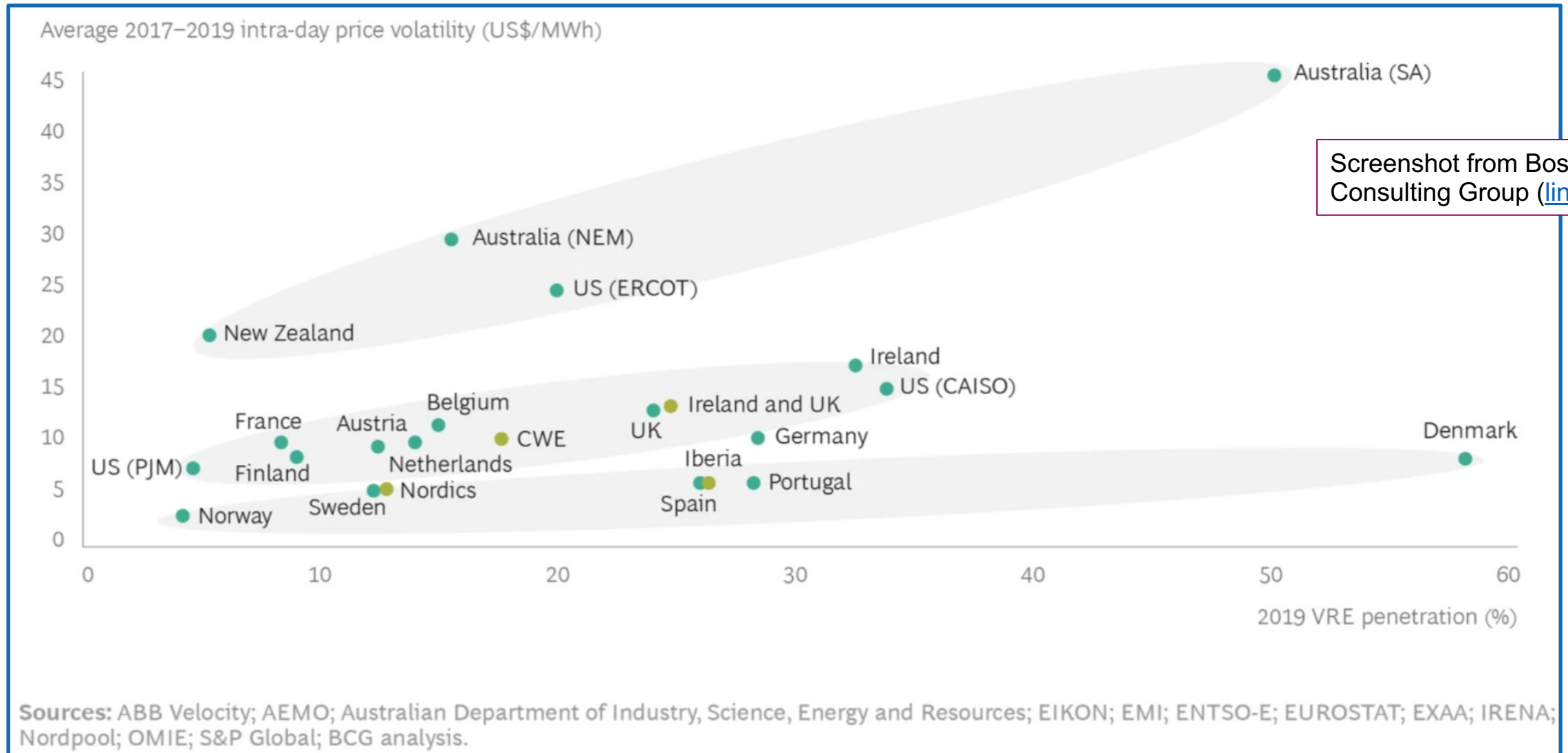
How will the massive penetration of variable renewable resources impact the electricity prices in Switzerland?

1. Model-based approach

2. Data observation-based approach

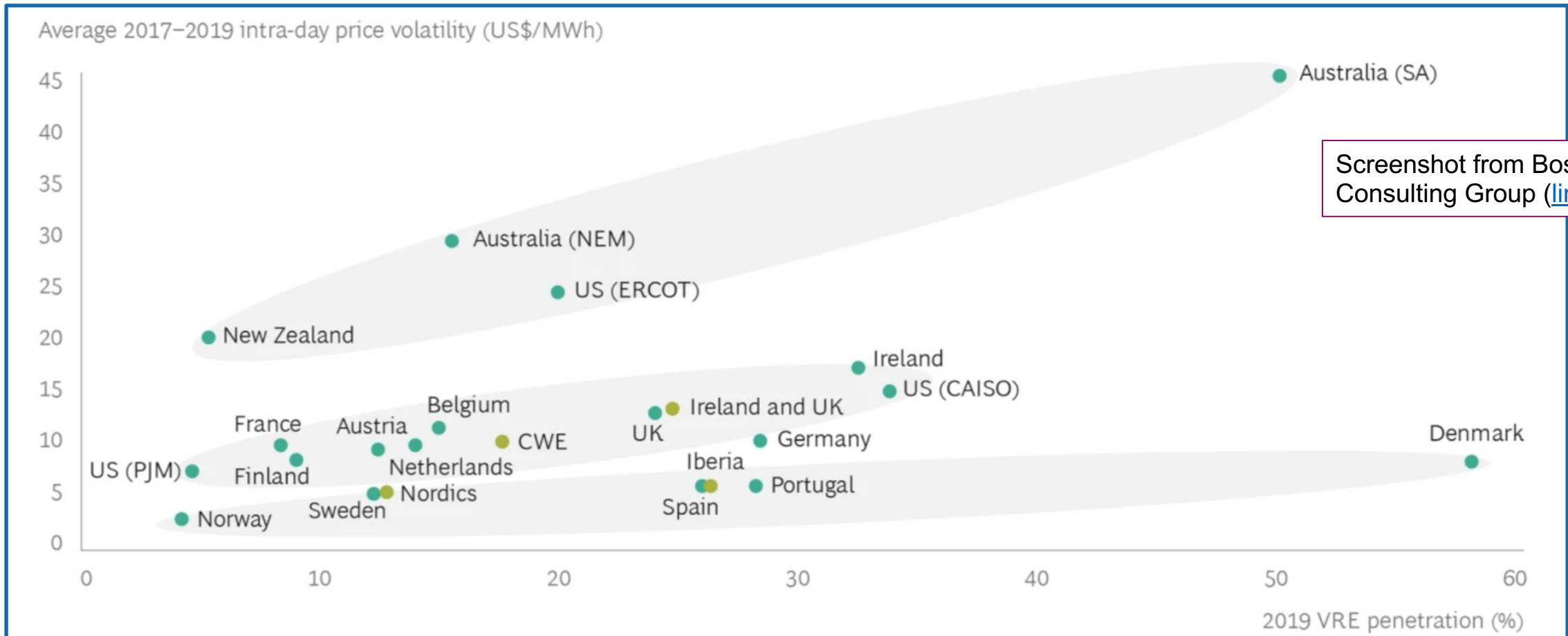
Analysis of historical electricity prices with a global look

According to article published by BCG



Analysis of historical electricity prices with a global look

According to article published by BCG



Screenshot from Boston Consulting Group ([link](#))

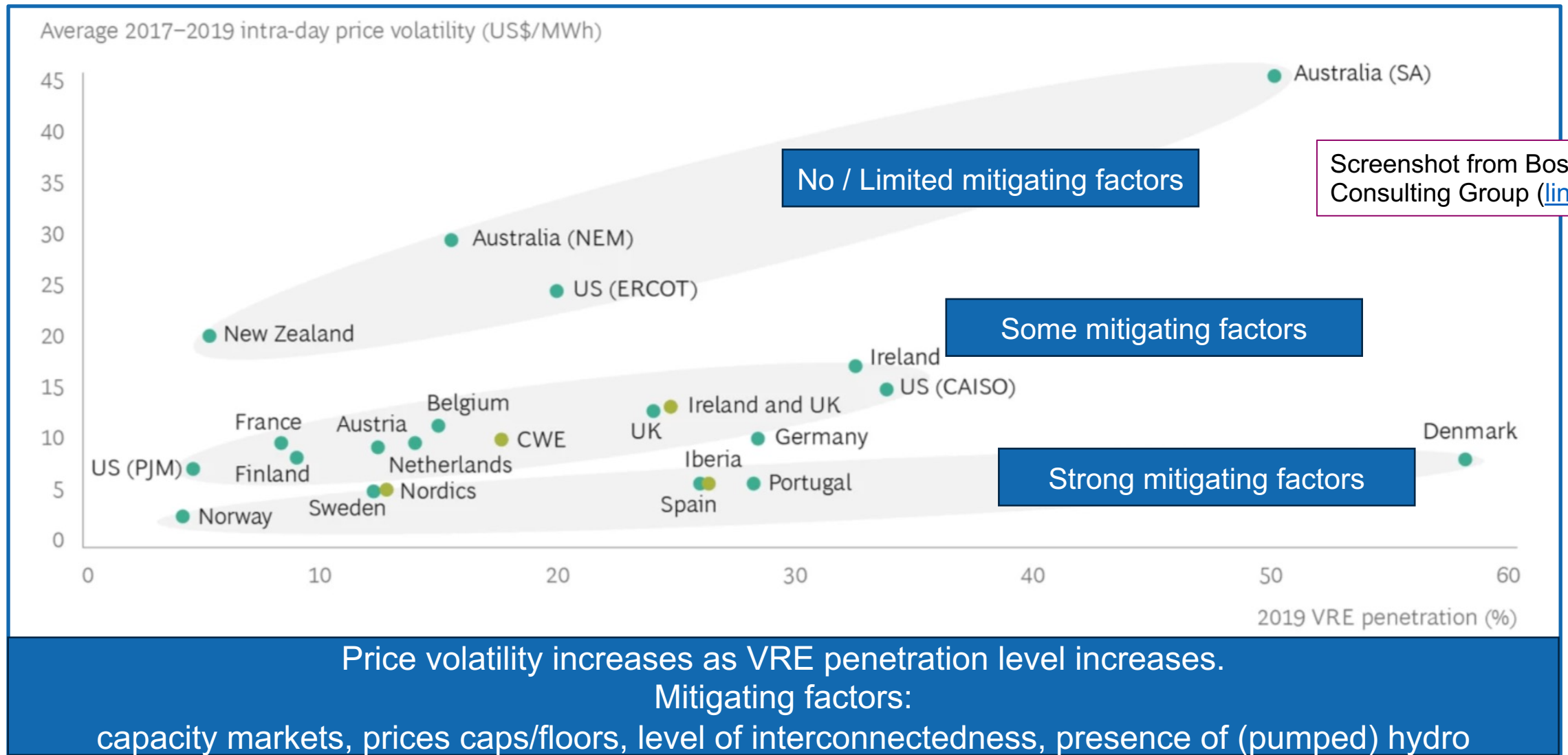
Price volatility increases as VRE penetration level increases.

Mitigating factors:

capacity markets, prices caps/floors, level of interconnectedness, presence of (pumped) hydro

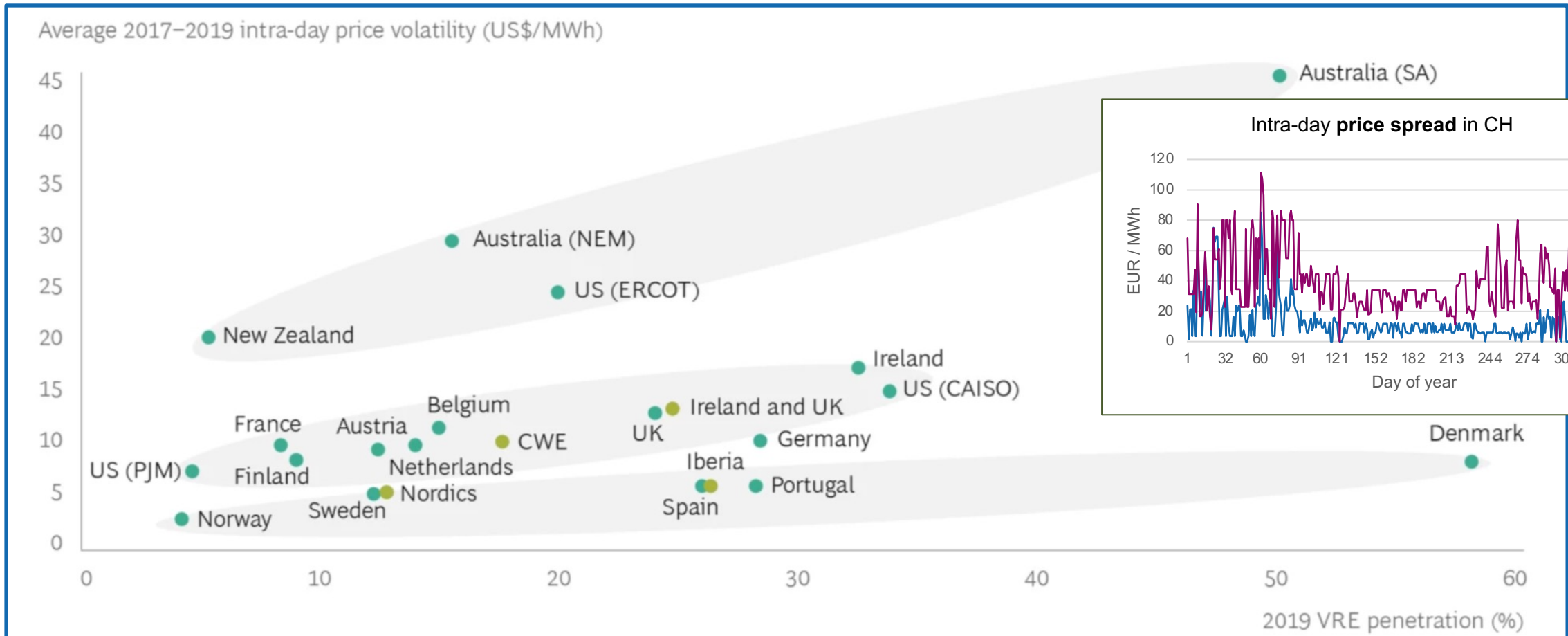
Analysis of historical electricity prices with a global look

According to article published by BCG



Analysis of historical electricity prices with a global look

According to article published by BCG



Price volatility increases as VRE penetration level increases.

Mitigating factors:

capacity markets, prices caps/floors, level of interconnectedness, presence of (pumped) hydro

Closure

Discussed today:

- Increasing variable renewable proliferation eventually increases electricity price volatility
- Mitigation factors delay the increase, but we are heading to this direction in Europe as well
- Being part of an interconnected electricity market reduces the impact on price variability
- Volatility increases the value of resources which can “bridge the mismatch”

For further discussion:

- What additional costs emerge from increasing price volatility? (cost of hedging against uncertainty)
- How the ramping-driven cost evolve in the future?
- Will the price signals allow investment costs to be recovered?
- Is scarcity pricing required?

Dr. Adamantios Marinakis
Principal Expert
marinakis@fen.ethz.ch

Research Center for Energy Networks
Sonneggstrasse 28
8006 Zürich

info@fen.ethz.ch

+41 44 632 41 85

<https://www.fen.ethz.ch/>

<https://www.linkedin.com/company/fen-ethz/>

