Reproducing the evolution of import and export electricity price curves in Belgium, in the framework of a European power market

Freiburg, 23rd May 2022

Introduction

- Scope of the problem
- Endogenous representation of power trade
- Exogenous approach (price-quantity curves)
  - Conceptual design
  - Dispatch model
  - Import/export curves
  - Implementation in TIMES
- Comparison
  - Advantages and disadvantages of the exogenous approach

Scope of the problem

Why is it important to model electricity import/export in a consistent way in a national model?

- Reproduce electricity price fluctuations
- Account for other countries' exceeding produced power
- Better tracking of electricity import/export emissions

Scope of the problem

Why is it important to model electricity import/export in a consistent way in a national model?

- In particular, for Belgium this is a very influent aspect
  - Belgium's interconnection (38%) is much higher than EU requirements by 2030 (15%) [a]
  - More interconnection capacity is foreseen (almost doubled in 2040) [b]

[a] ELIA, *Electricity scenarios for Belgium towards 2050*, 2017
[b] ENTSO-E, *TYNDP 2020 Scenario Report*, 2020

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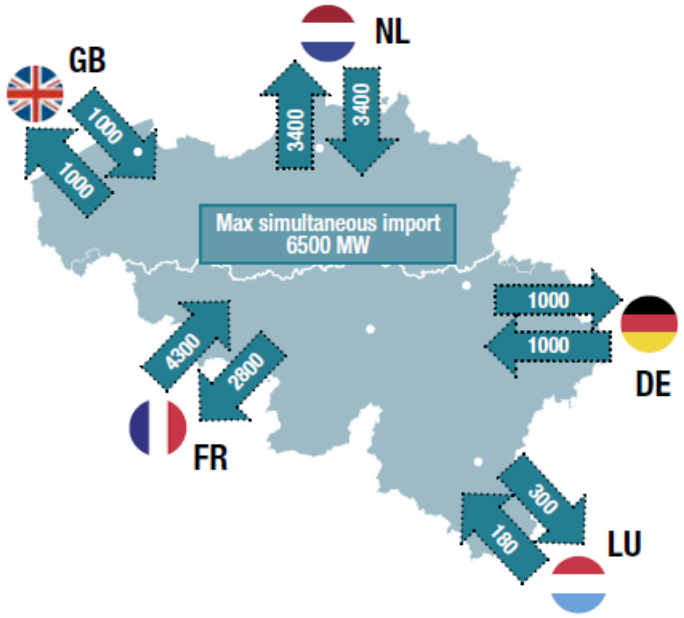
Endogenous representation

A multi-regional approach

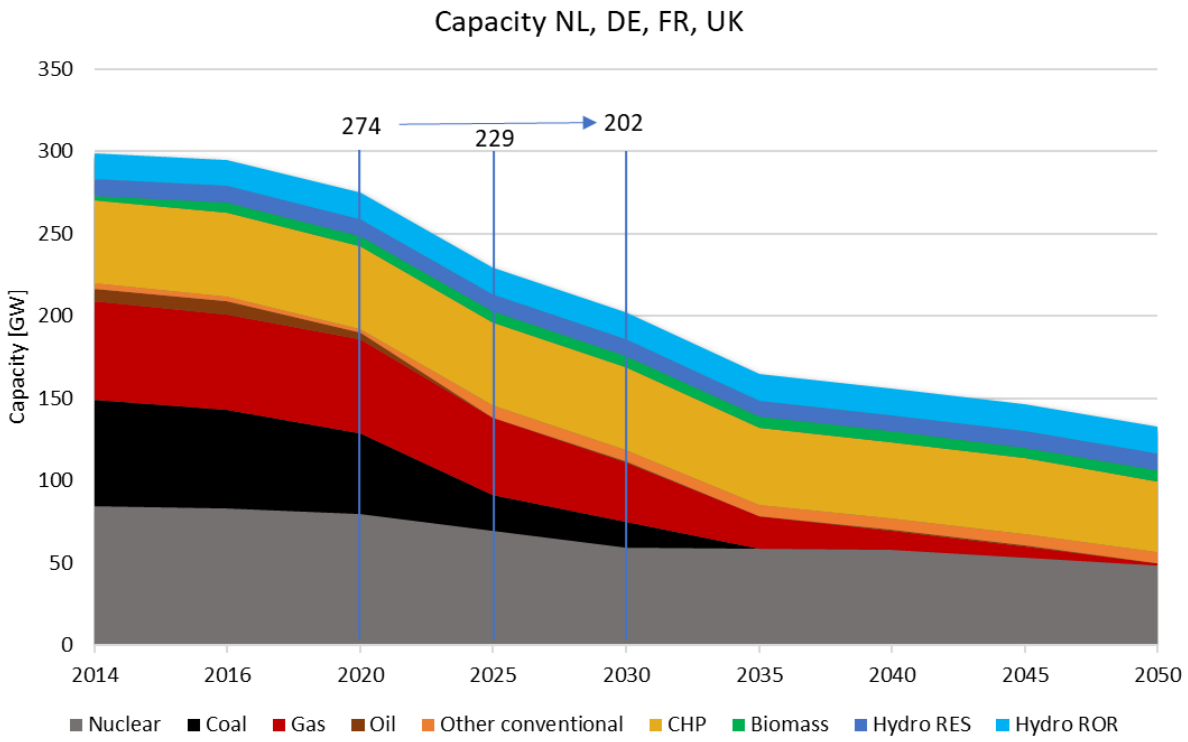


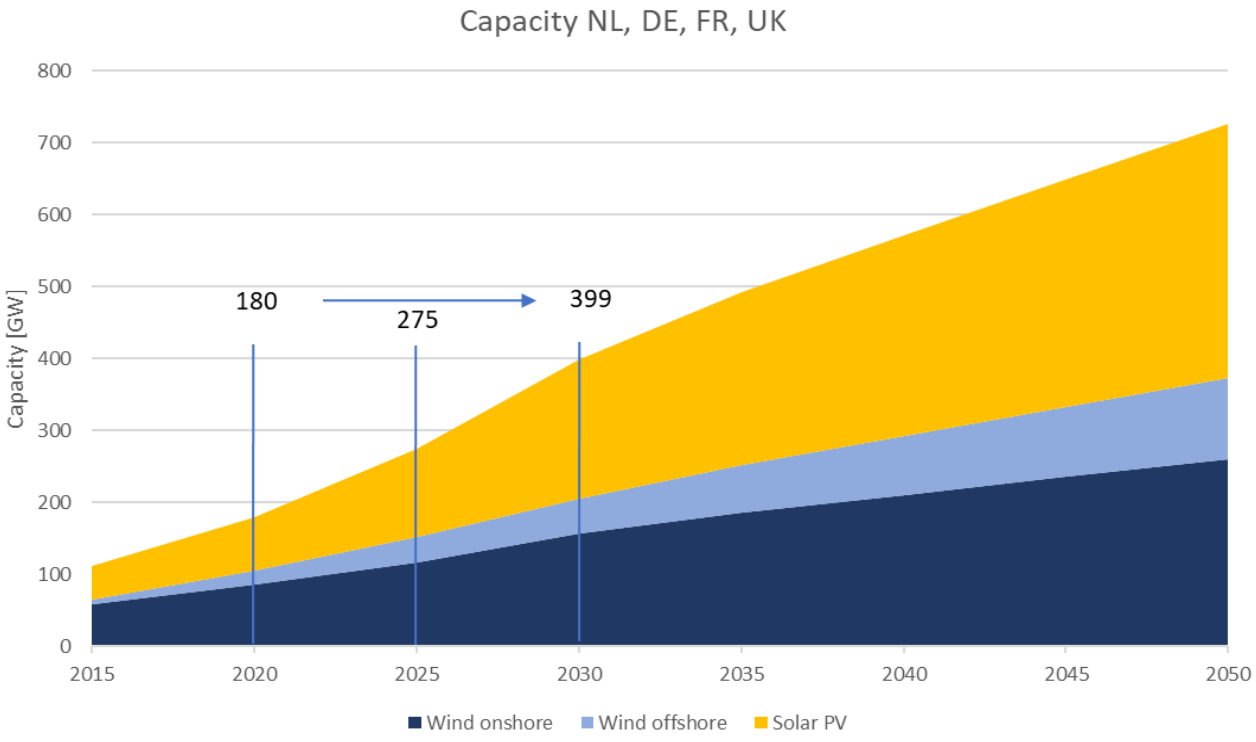
ELIA, *Electricity scenarios for Belgium towards 2050*, 2017

- Neighboring countries included in the model, but only for their power sector
- Neighboring countries' power sector:
  - Power demand built exogenously
  - Power plants capacity (and availability) in input, also renewables
  - Possibility to invest in extra gas-based capacity (and in High Renewable Ambition scenario, also PV + batteries)
  - Same carbon price as in Belgium
- Data source: TYNDP

Endogenous representation

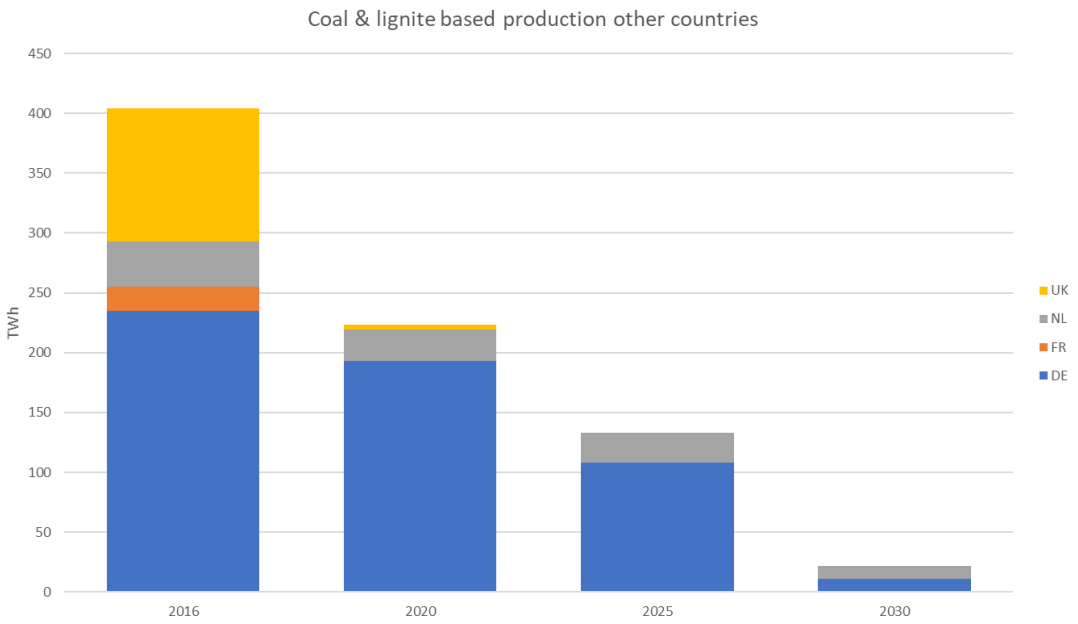
Installed capacity evolution





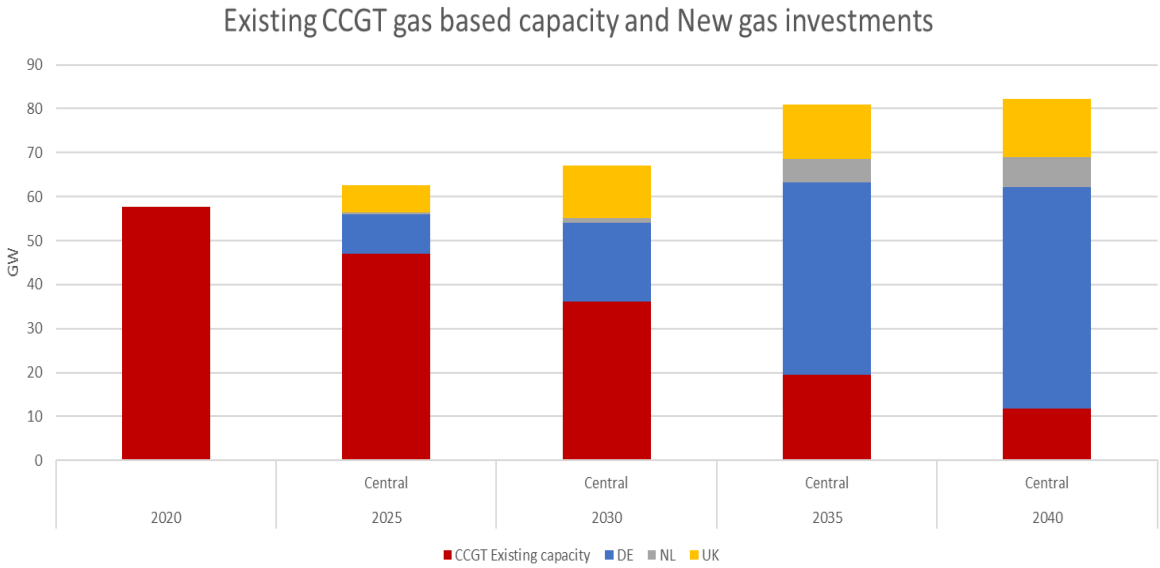
Endogenous representation

Behavior of the model



- Consistent investment in new gas power plants in neighboring countries

- Phase-out of coal would be much faster in the neighboring countries then expected/constrained



The exogenous approach: electricity import price curves

Conceptual design

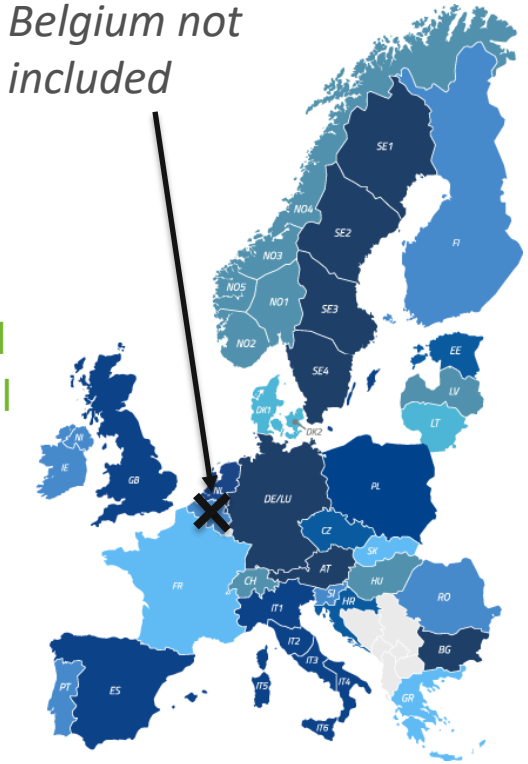
Price/demand projections

Capacity forecasts

Model simplifications/ assumptions

European-level dispatch model

Belgium not included



PSE, *Impact report 2019*

Import price-quantity curves

Export price-quantity curves

TIMES-BE

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The exogenous approach: electricity import price curves

Dispatch model: assumptions and inputs

Model assumptions

- 56 zones
- Hourly resolution
- No transport cost
- No losses
- Price of import = marginal production price

Capacity information

- NTC between zones → TYNDP
- Generation capacities → TYNDP 2020
  - 2025 → National trends scenario
  - 2030-2040 → Distributed energy scenario
  - 2050 → Distributed energy scenario decarbonized

Techno-economic parameters

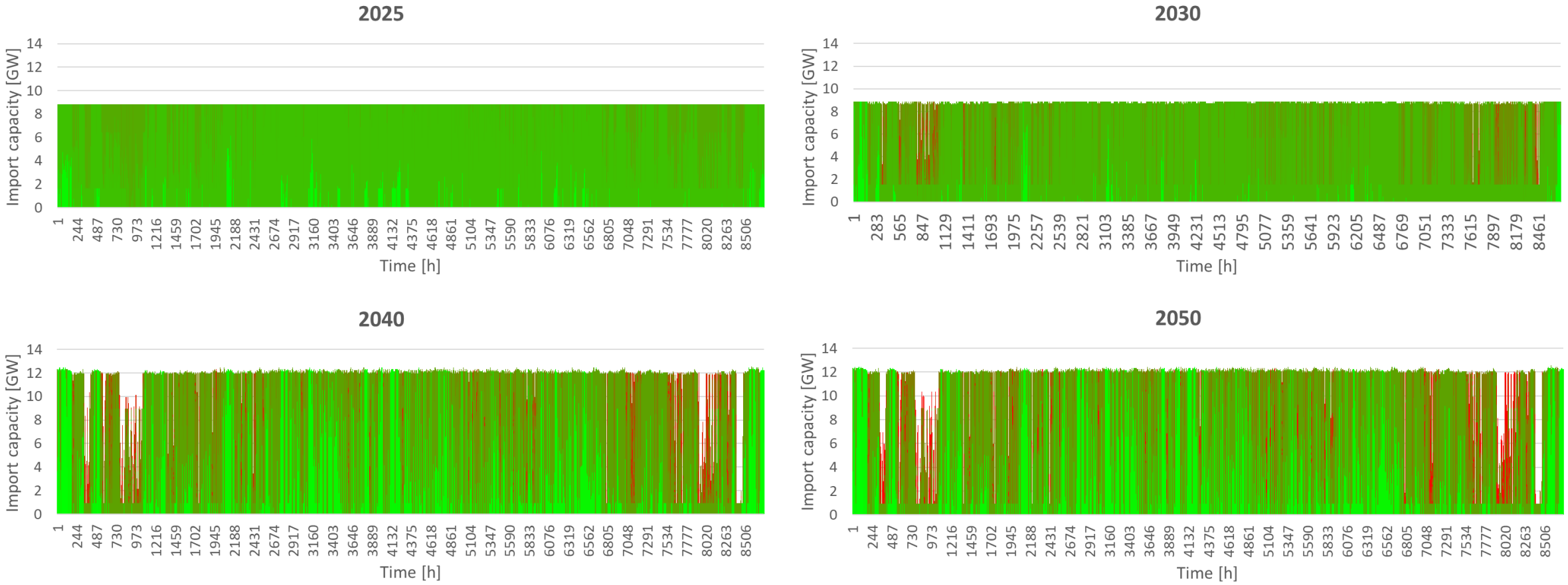
- Demand TS → TYNDP
- Renewable TS → PECD
- Climate year 2012
- Efficiency and emission factors → TYNDP
- Storage technologies → hydro (ROR, RES and PHS) and batteries
- Fuels and carbon price projections → WEO 2019 SD

Cost curves method

- Initial run with BE to determine storage evolution (then fixed)
- Removal of BE, and setting of increasing import/export levels in different runs → Price-quantity curves

Input data - Imports

Neighboring countries export price curves (hourly)



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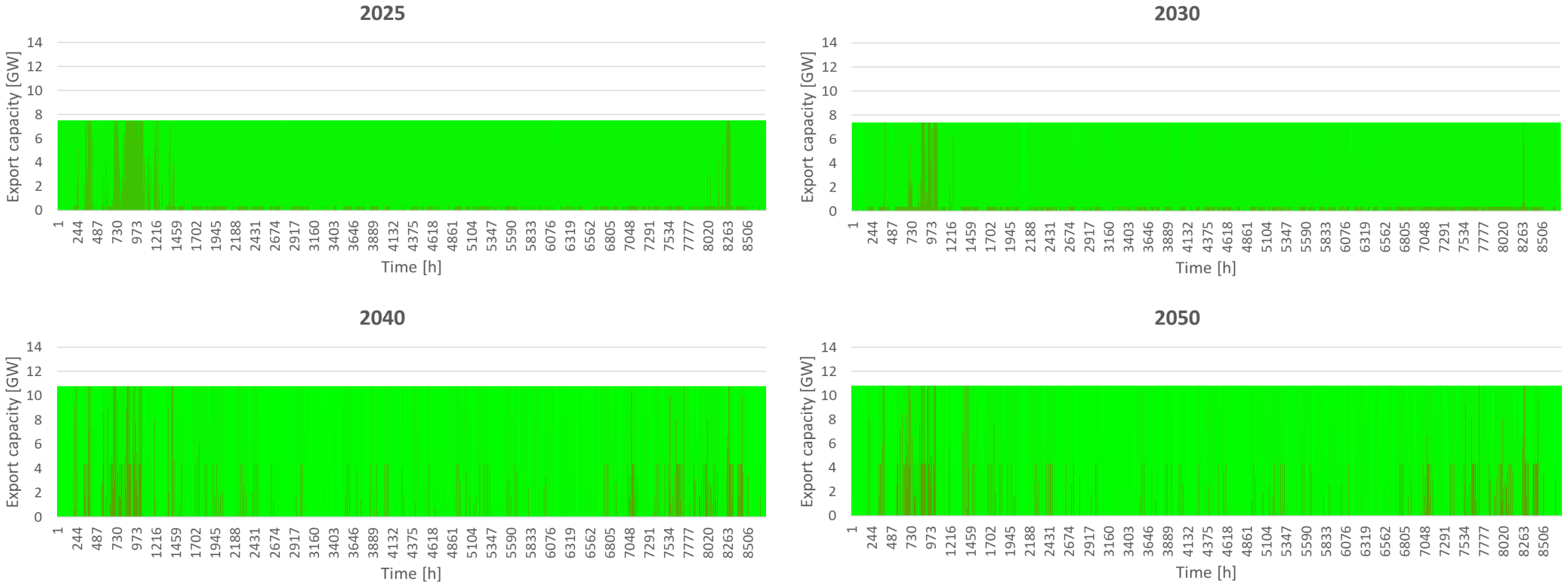
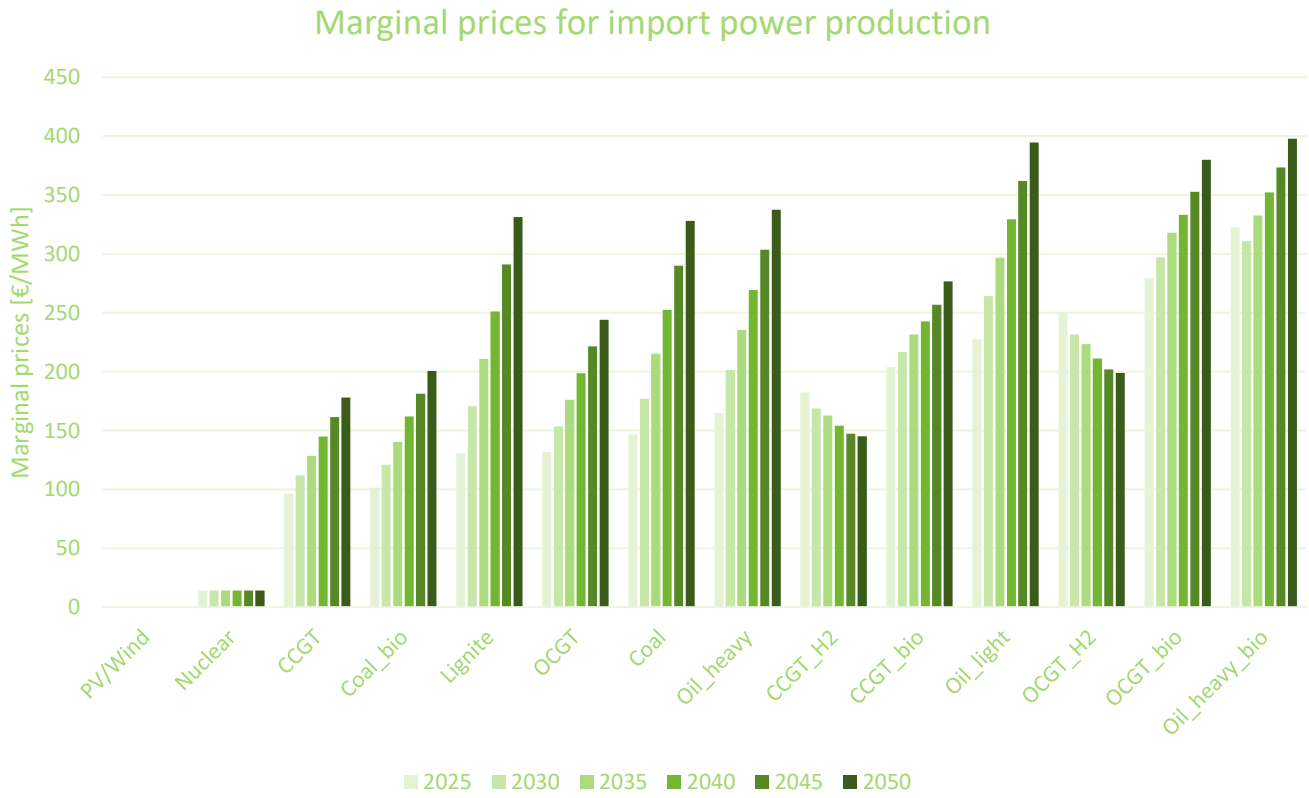


The new approach: electricity import price curves

The implementation in the model

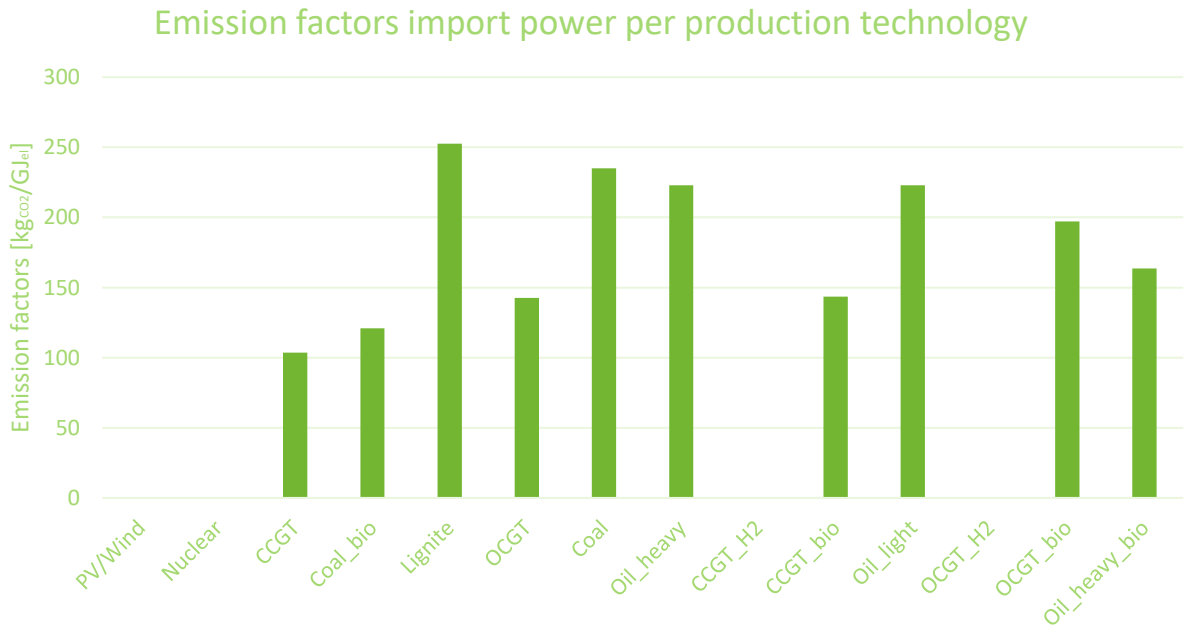
- One process per each import power production technology (from the dispatch model)
- Price changing in each period



The new approach: electricity import price curves

The implementation in the model

- Emission factors correlated to each technology (no need to do further assumptions)



The new approach: electricity import price curves

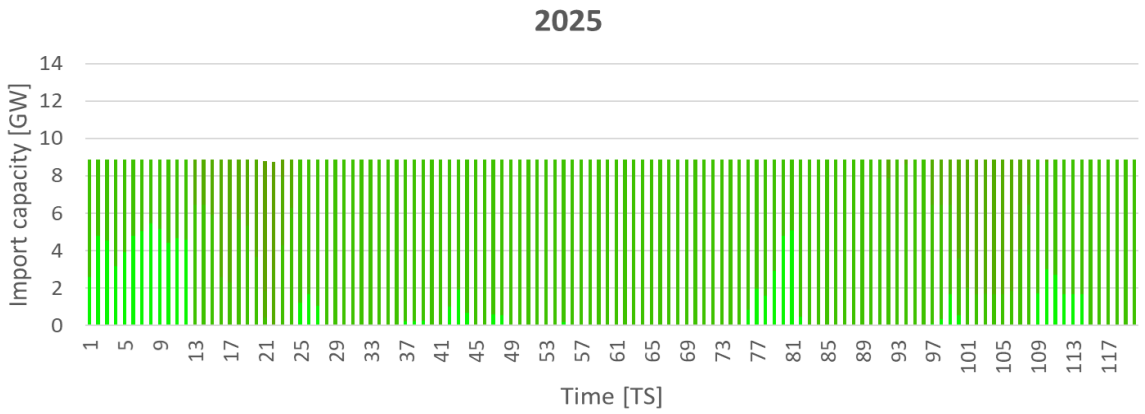
The implementation in the model

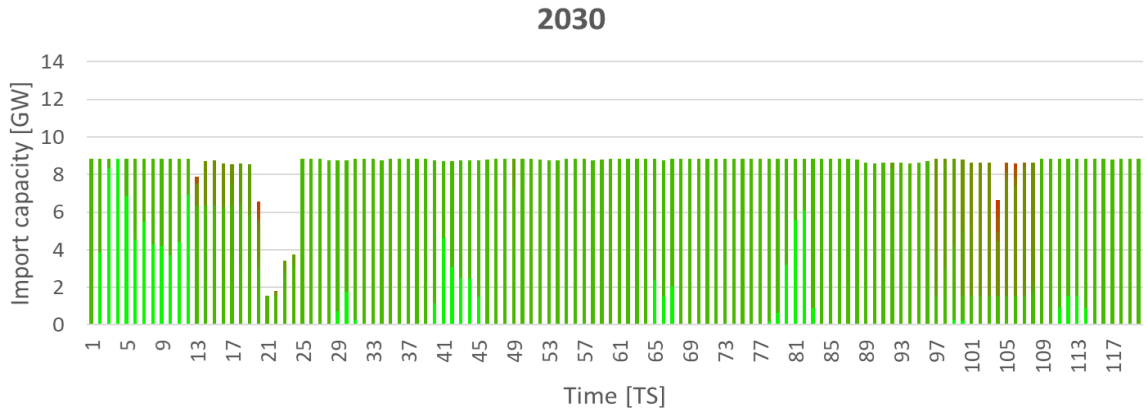
- Using the availability factors of the different import/export technologies, we then reproduced the price-quantity curves

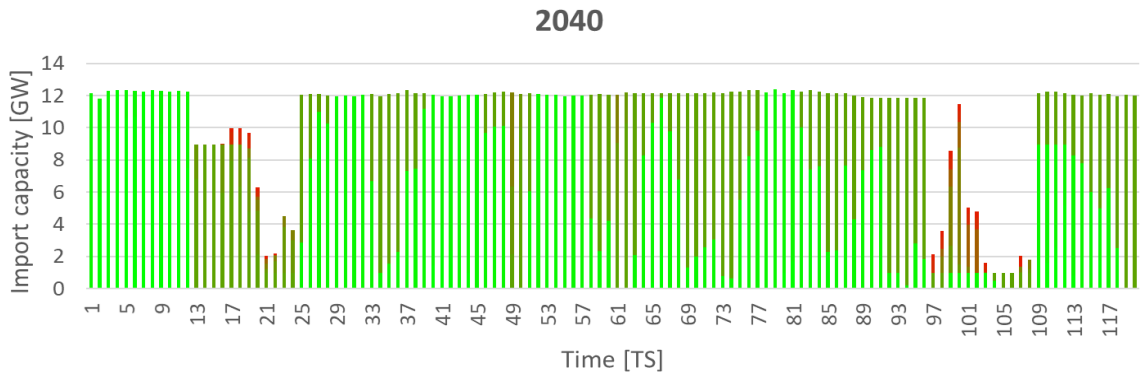
- Price curves have been time-sliced, obtaining →

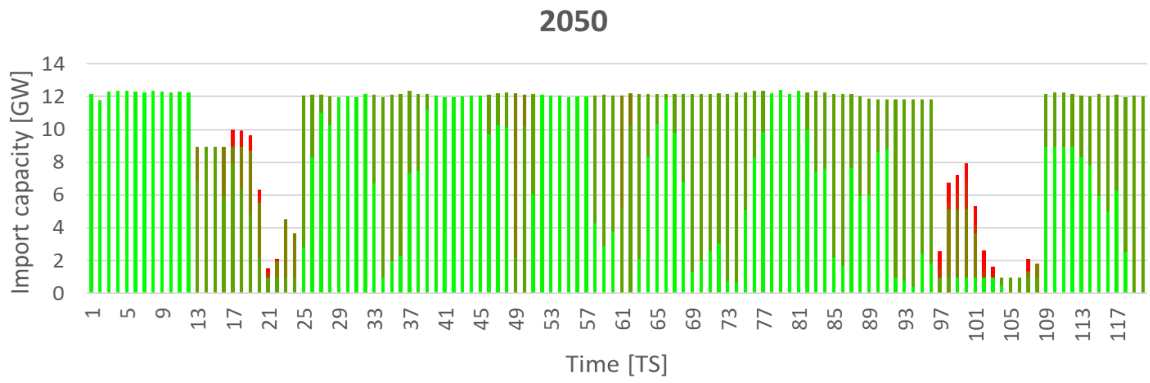
The new approach: electricity import price curves

Neighboring countries export price curves (time-sliced)







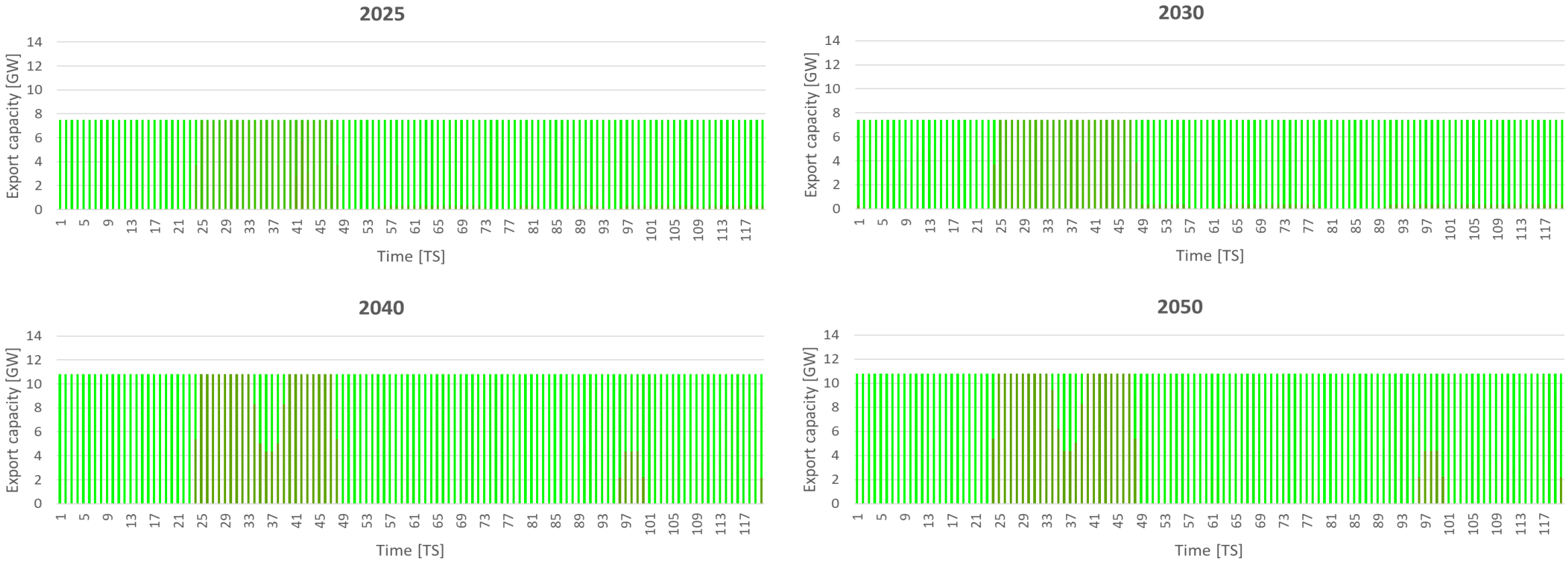


Power price [€/MWh]

0 400

The new approach: electricity export price curves

Neighboring countries import price curves (time-sliced)



Results of the model

Comparison with the endogenous representation (1)

- Advantages coming with the new approach:
  - No risk of overinvestments in neighboring countries to avoid power-related emissions in BE
  - Reduced computing time
  - More realistic representation, with the inclusion of more countries/zones

Results of the model

Comparison with the endogenous representation (2)

- Disadvantages of the new approach
  - Endogenous effects of capacity investments in the power sector of neighboring countries are not represented (even if the operation is regulated with the same assumptions in the two approaches)
  - Accountability of power exports-related emissions (as power production and power exports reporting are decoupled)

Next steps

What can still be improved?

- Solve the problem of accountability power exports-related emissions
- Increase the representativeness of the TS by including the time series of import/export prices in the TS tool

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Thank you for the attention

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EPOC 2030-2050

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FOD Economie, K.M.O., Middenstand en Energie

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