Use cases of the H2RES model and comparison with other energy planning tools

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100 Years of Faculty of Mechanical Engineering and Naval Architecture University of Zagreb

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Overview

- Models created in H2RES
- Examples of the results
- Comparisson
- Discussion and conclusions

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Created models

- Croatia
- North Macedonia
- South East Europe region model (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Kosovo, Montenegro, North Macedonia, Romania, Serbia)
- Possible creation of individual SEE region country models

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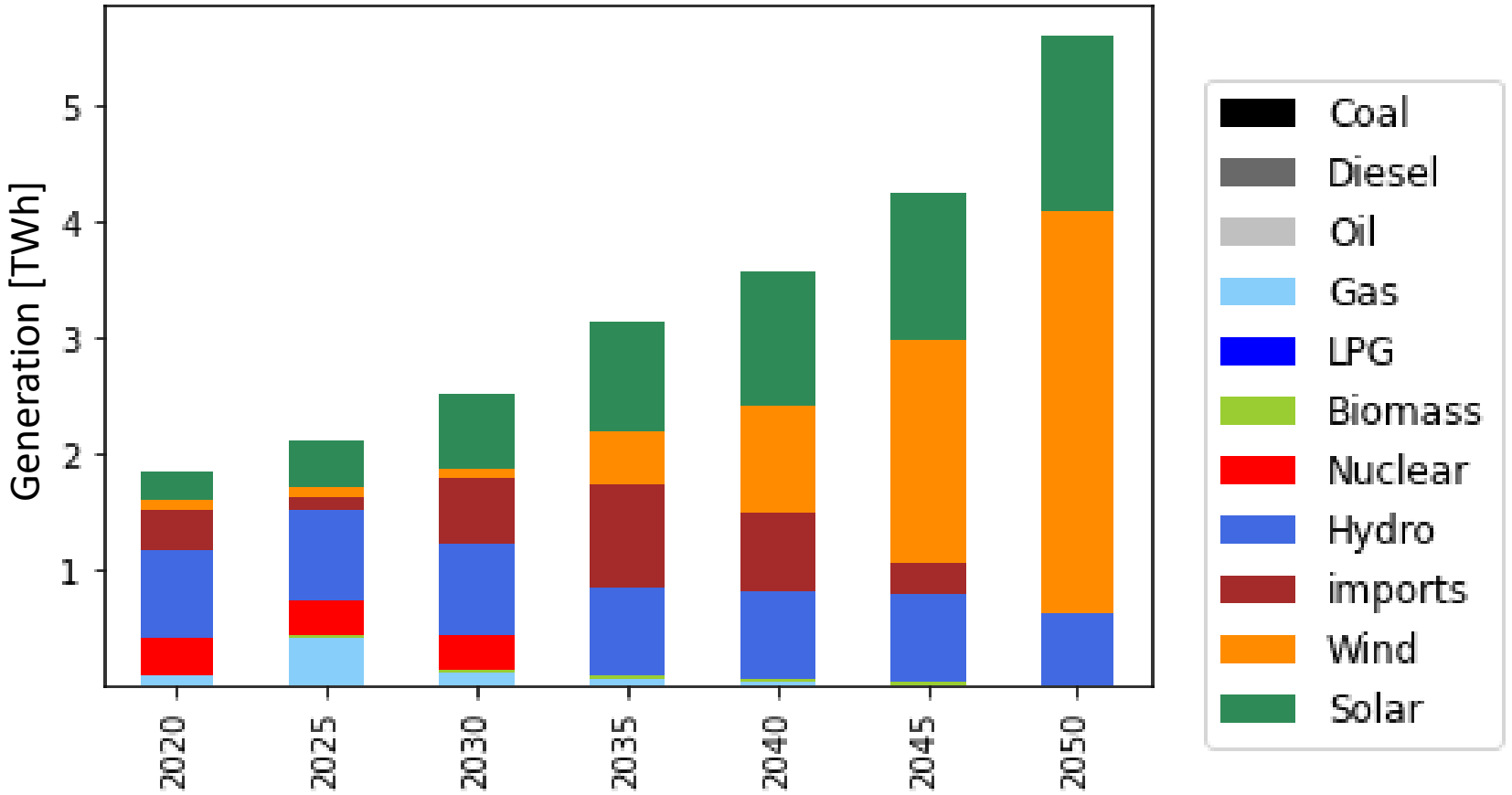
Electricity generation in Criatia



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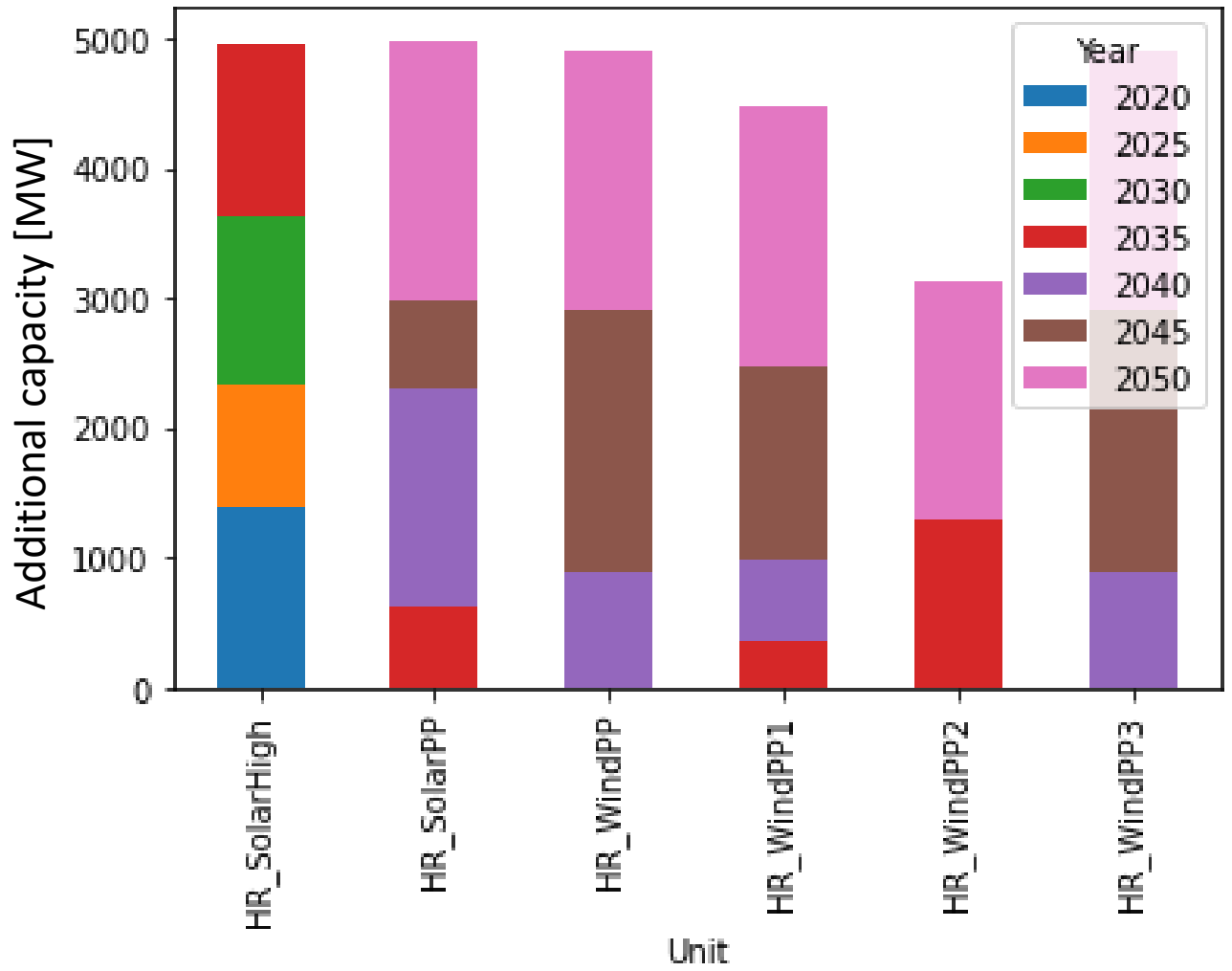
Investments in VRES



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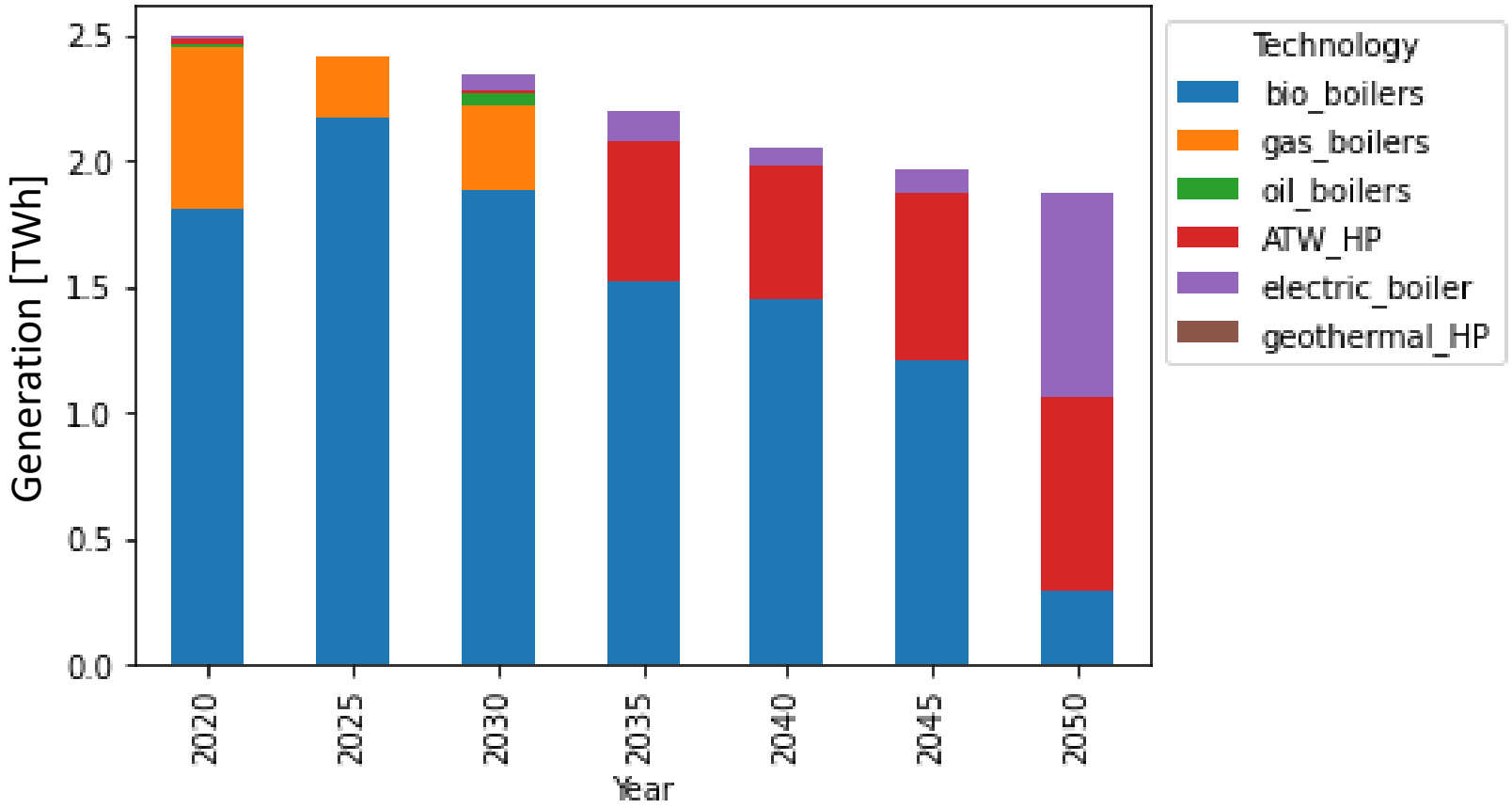
Heat generation



Generation by year and fuel/technology (2020 - 2035)

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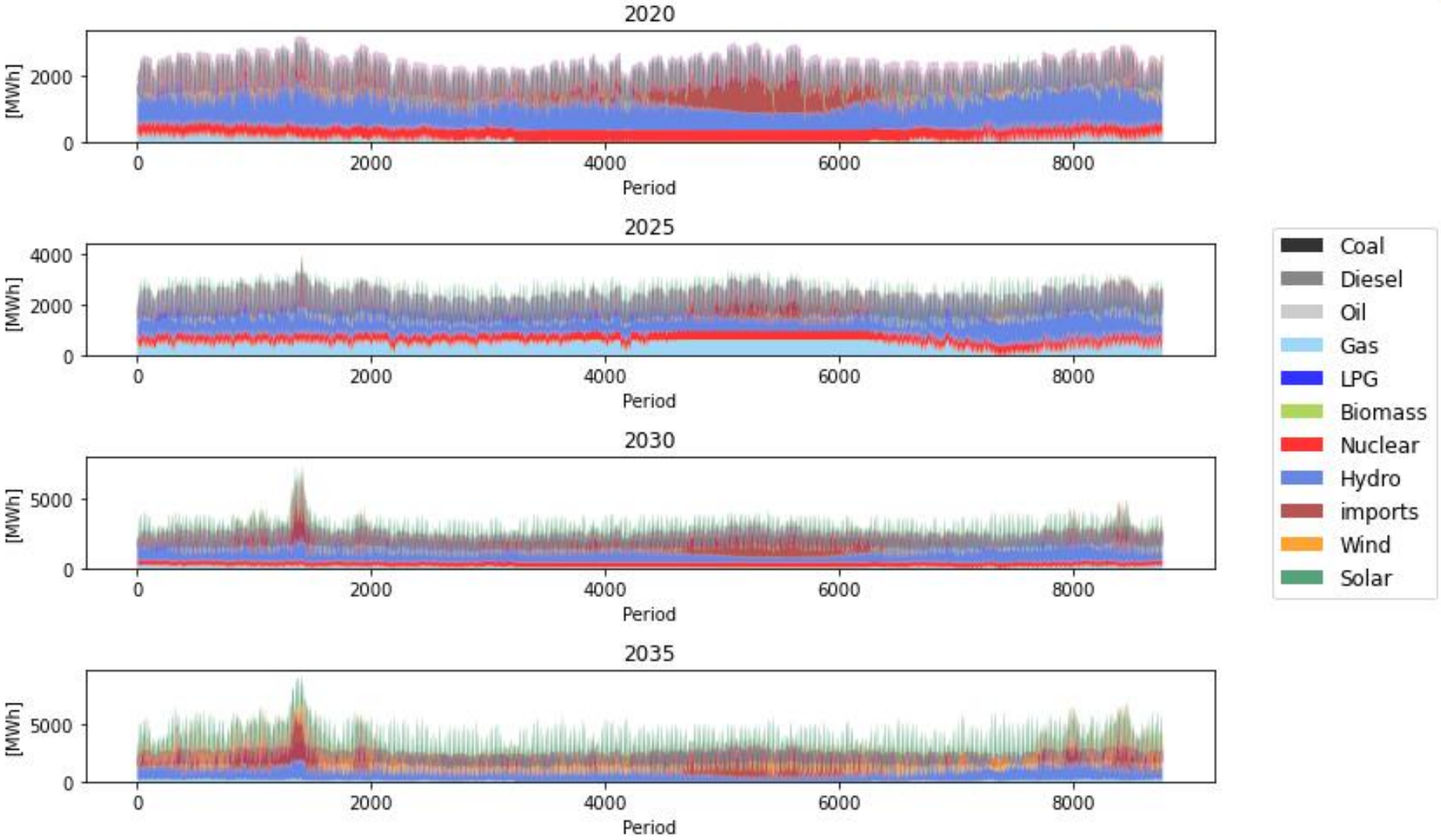

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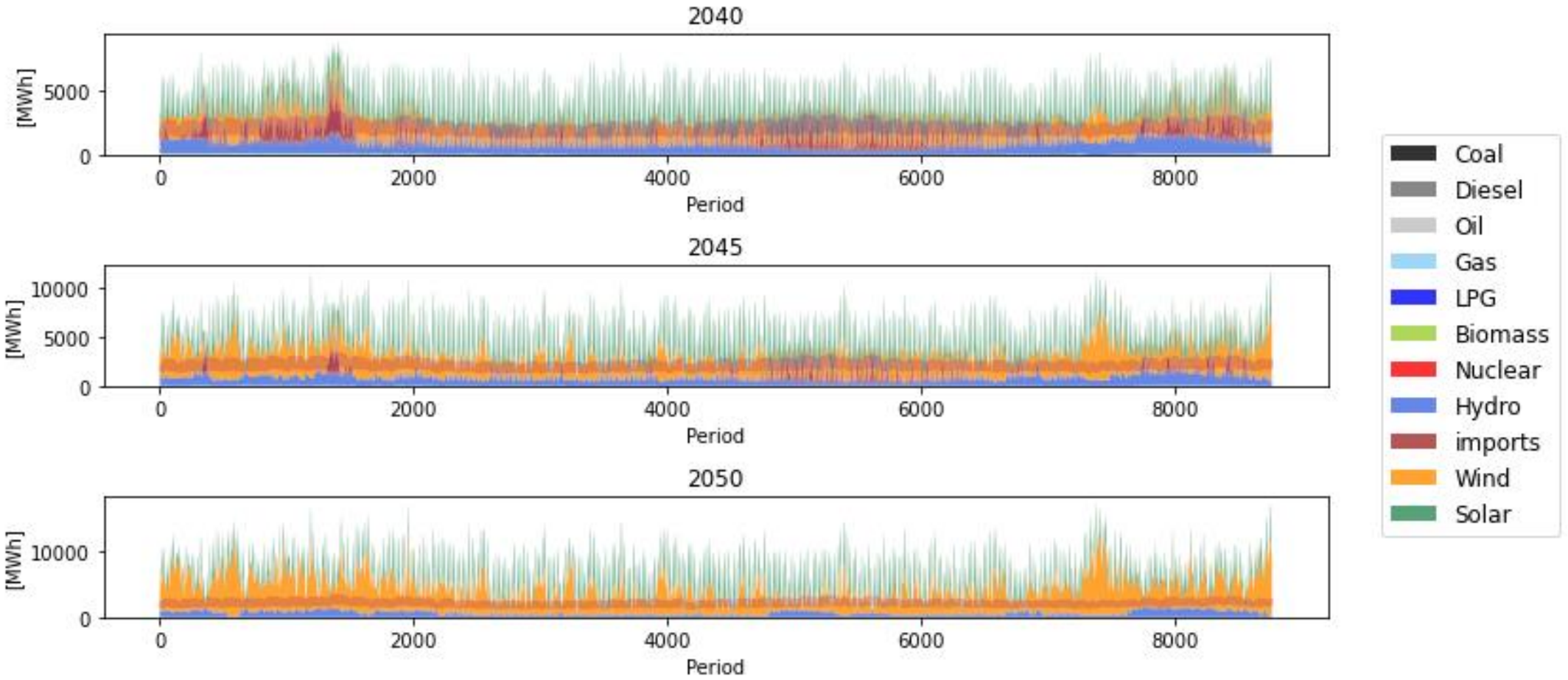
Generation by year and fuel/technology (2040 – 2050)



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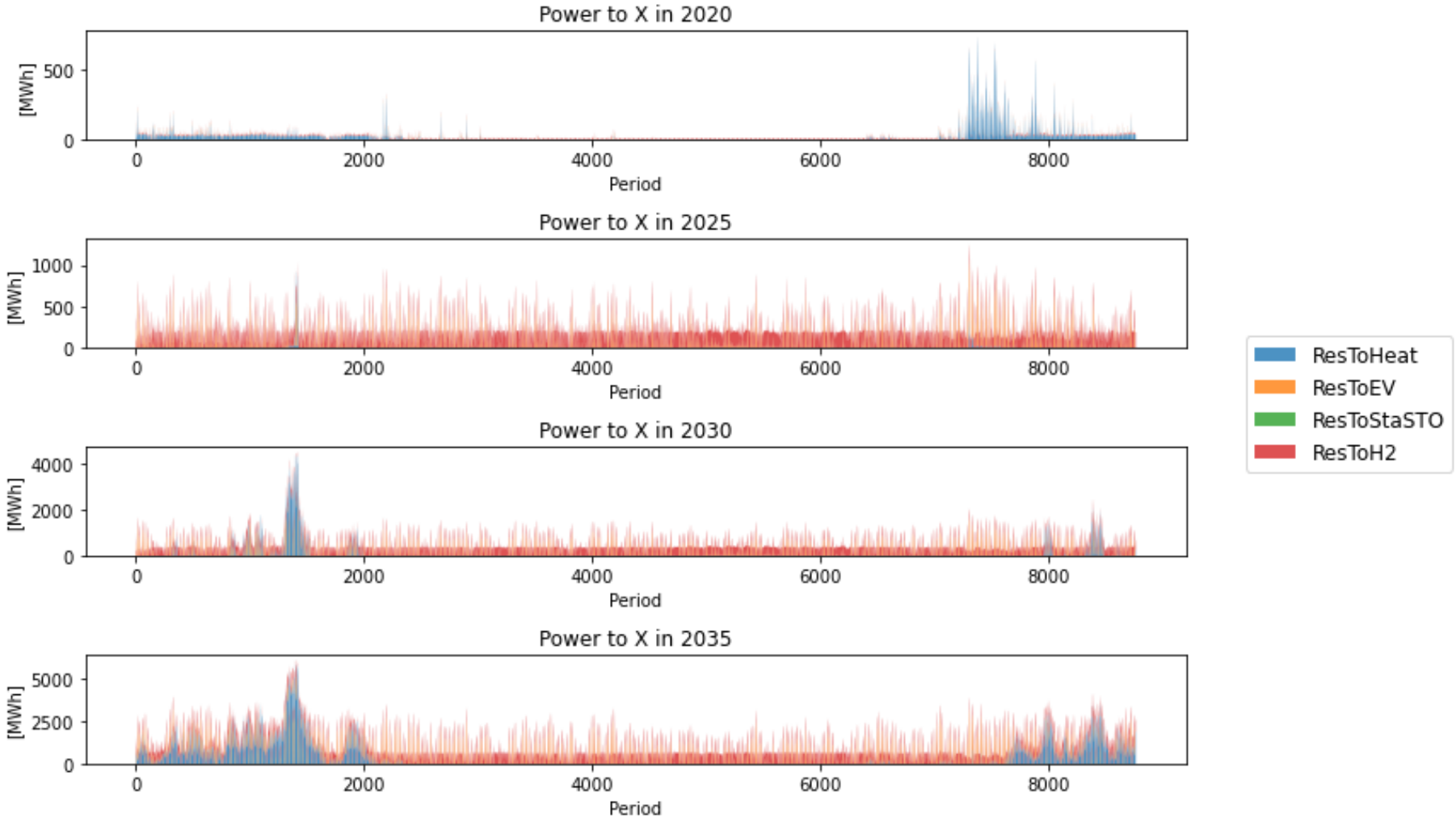
Flexibility options (2020 - 2035)



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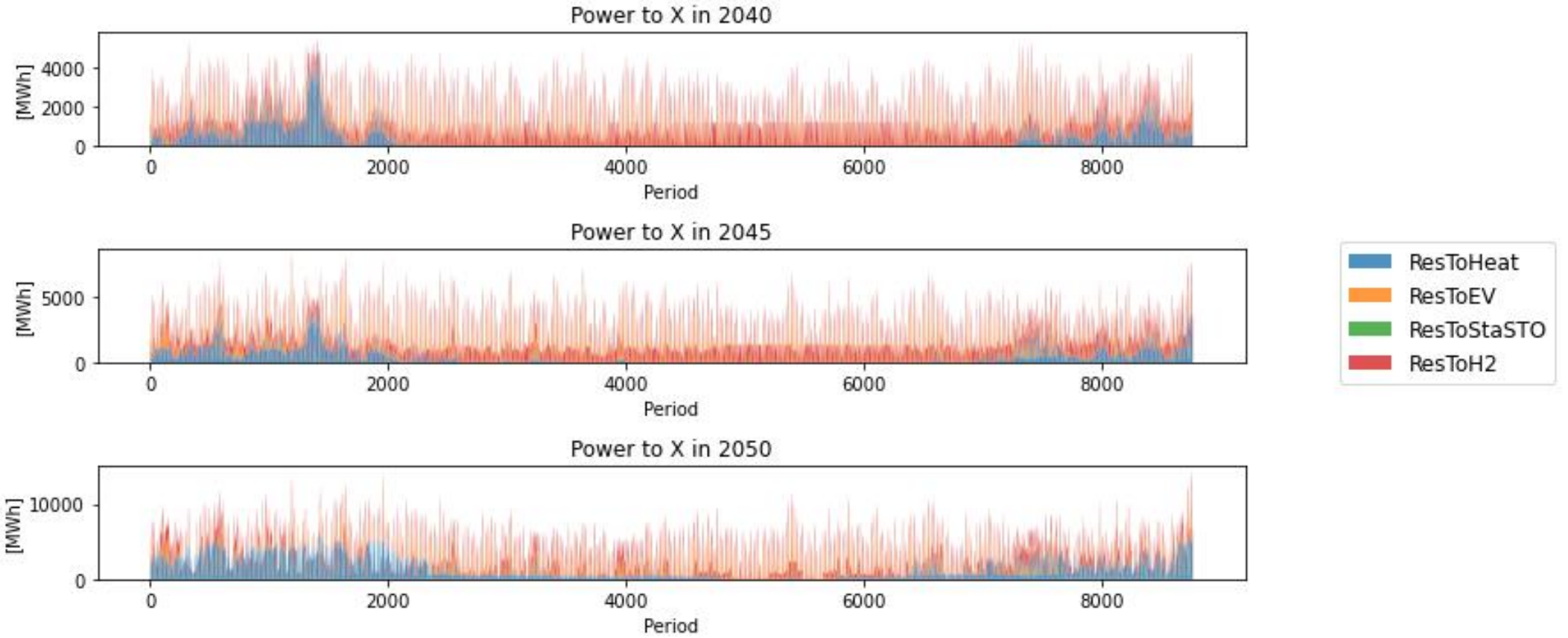

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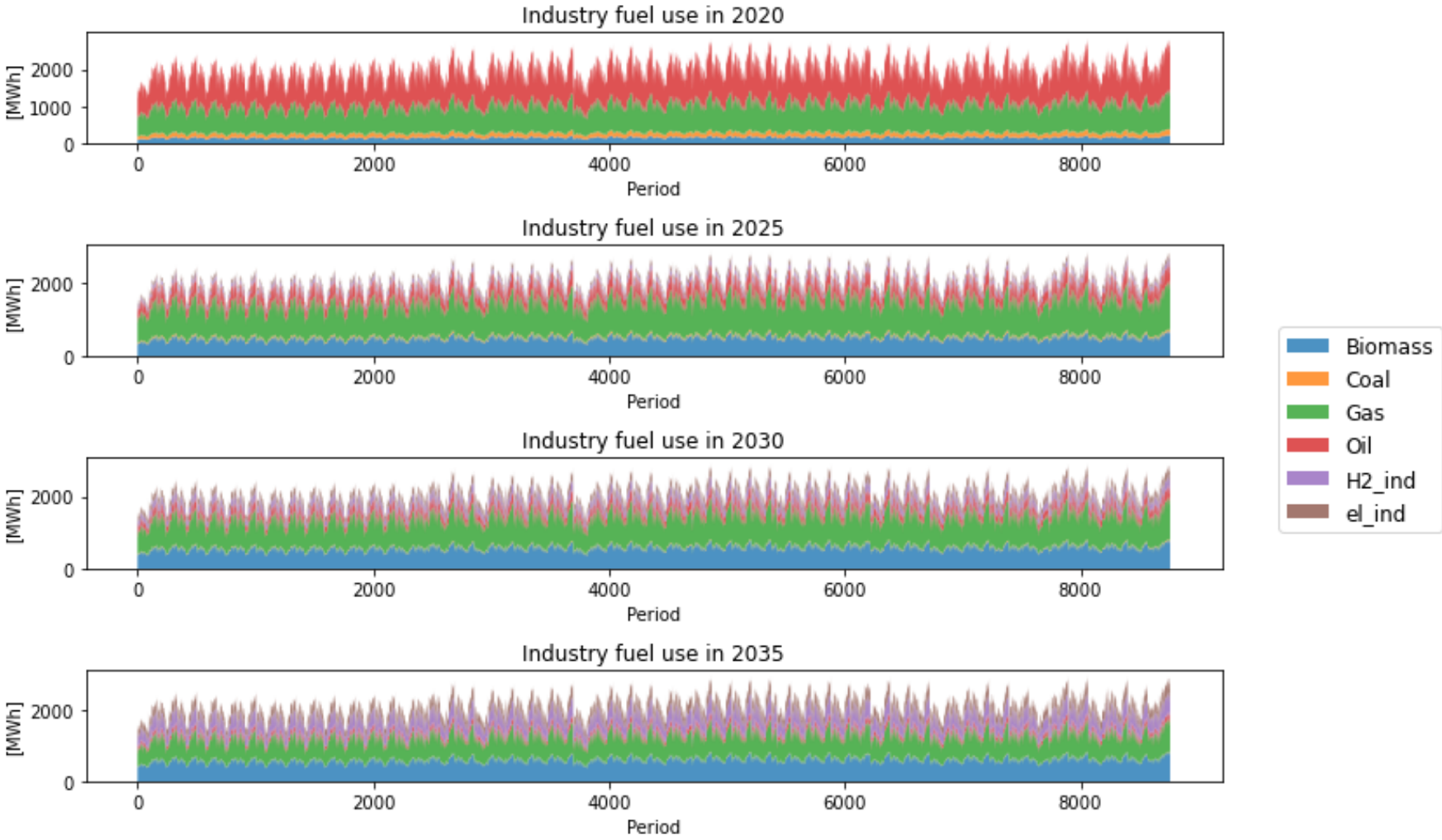
Energy supply in industry (2020 – 2035)



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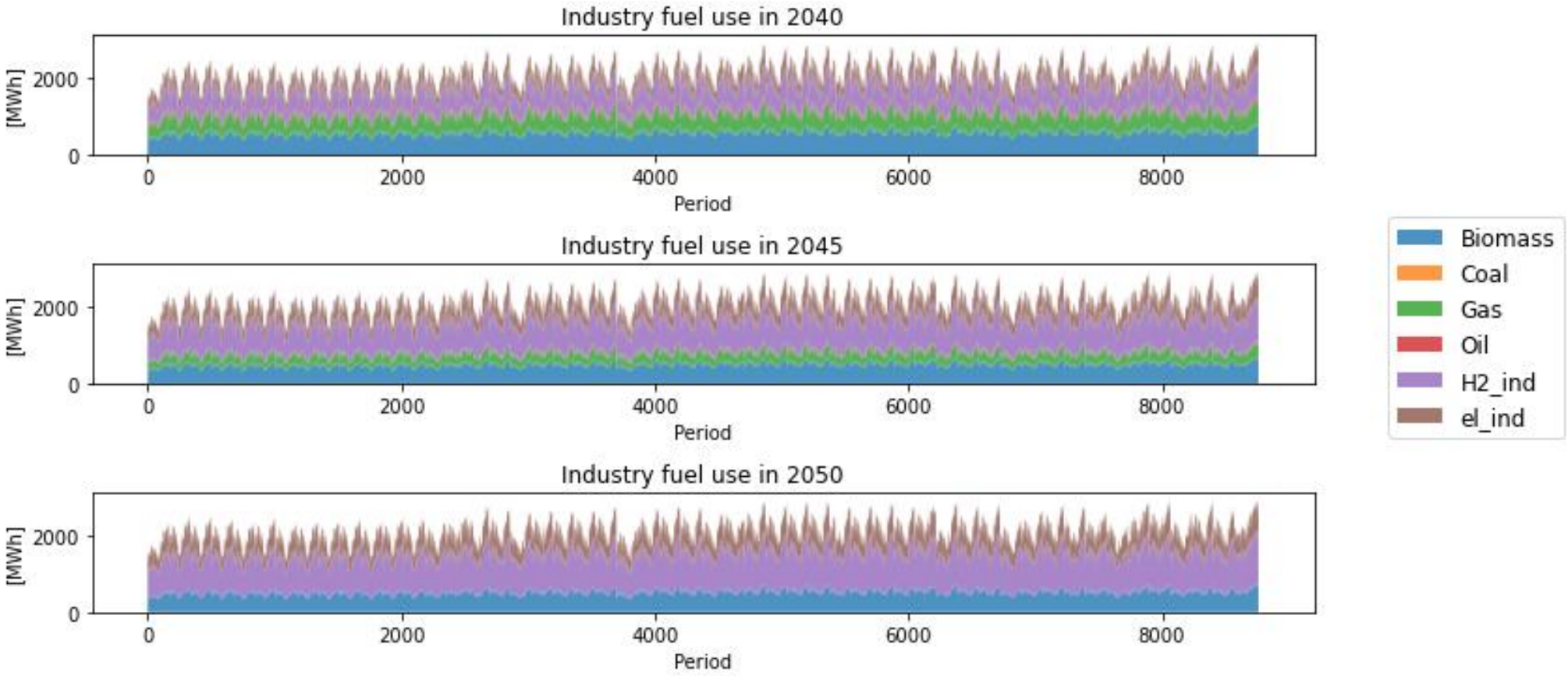
Energy supply in industry (2035 – 2050)



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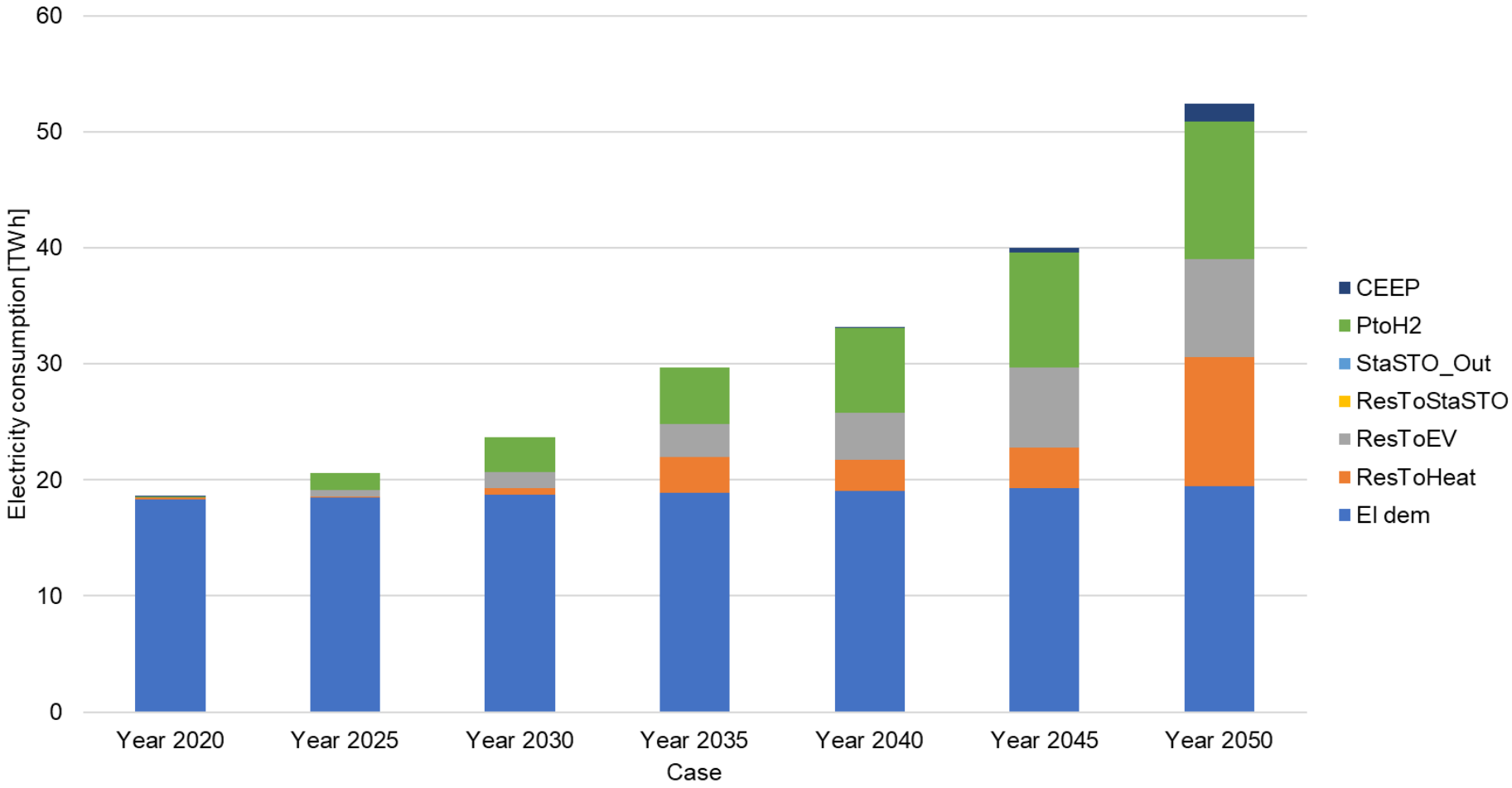
Electricity consumption



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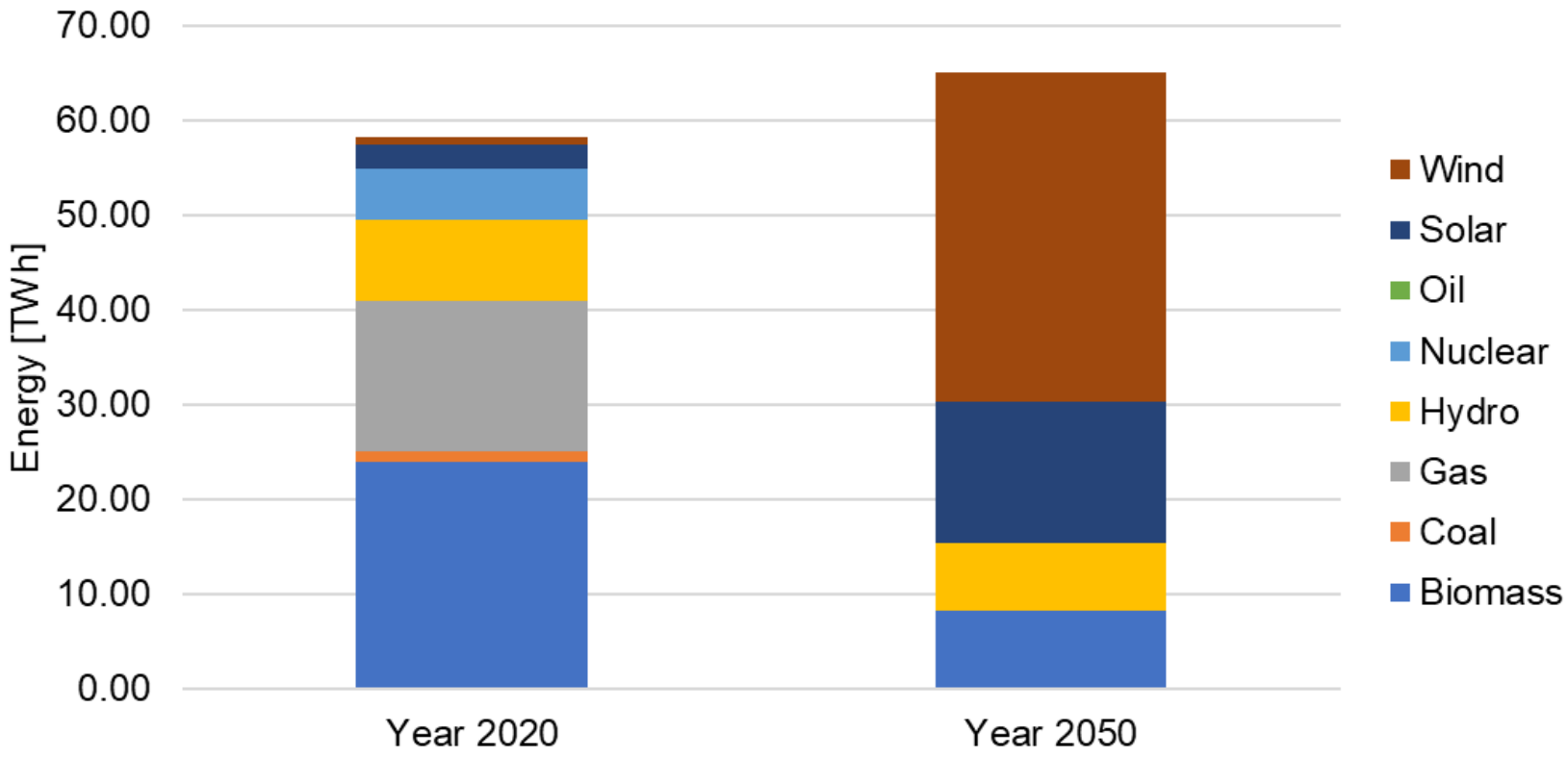
Primary energy supply



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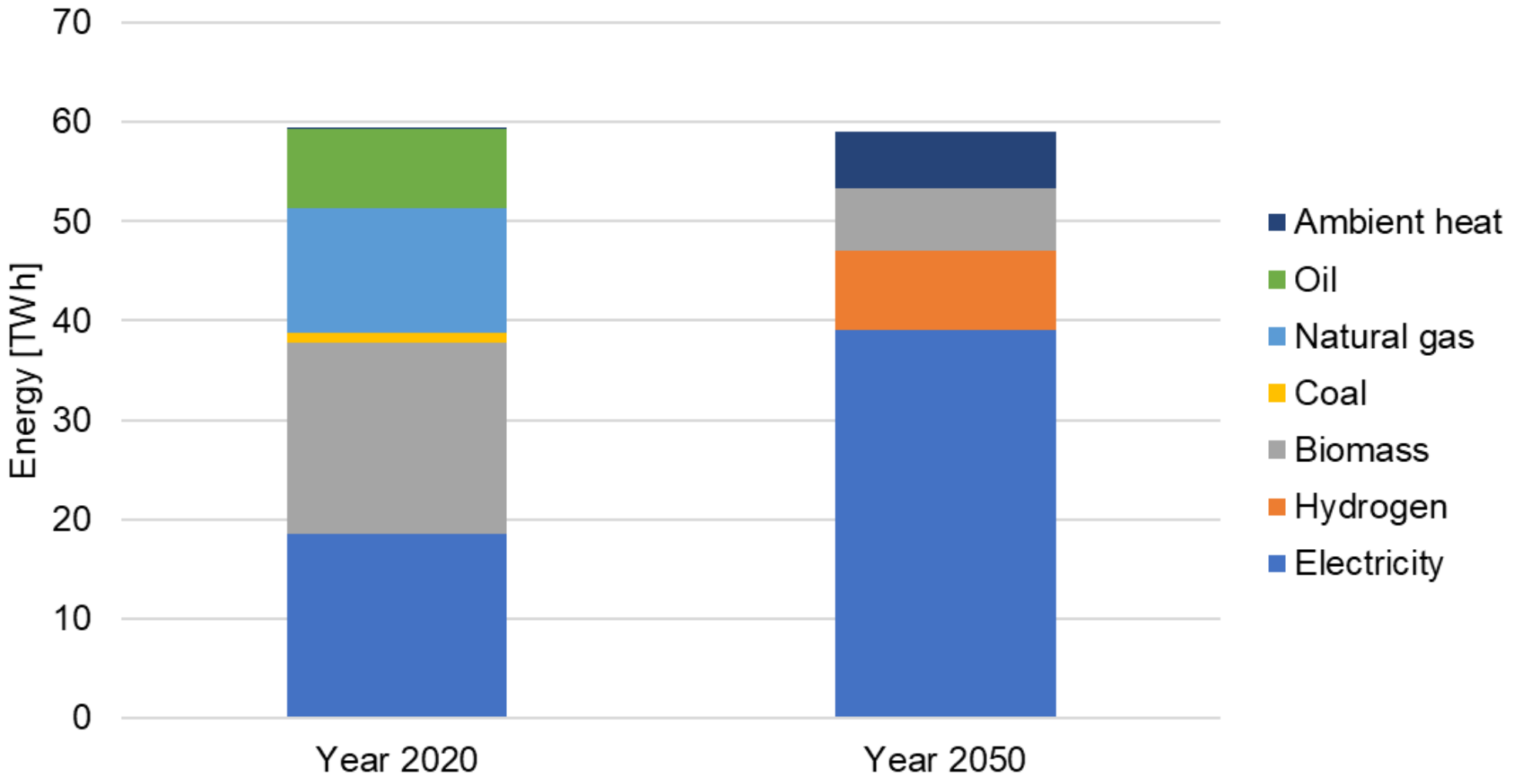
Final energy supply



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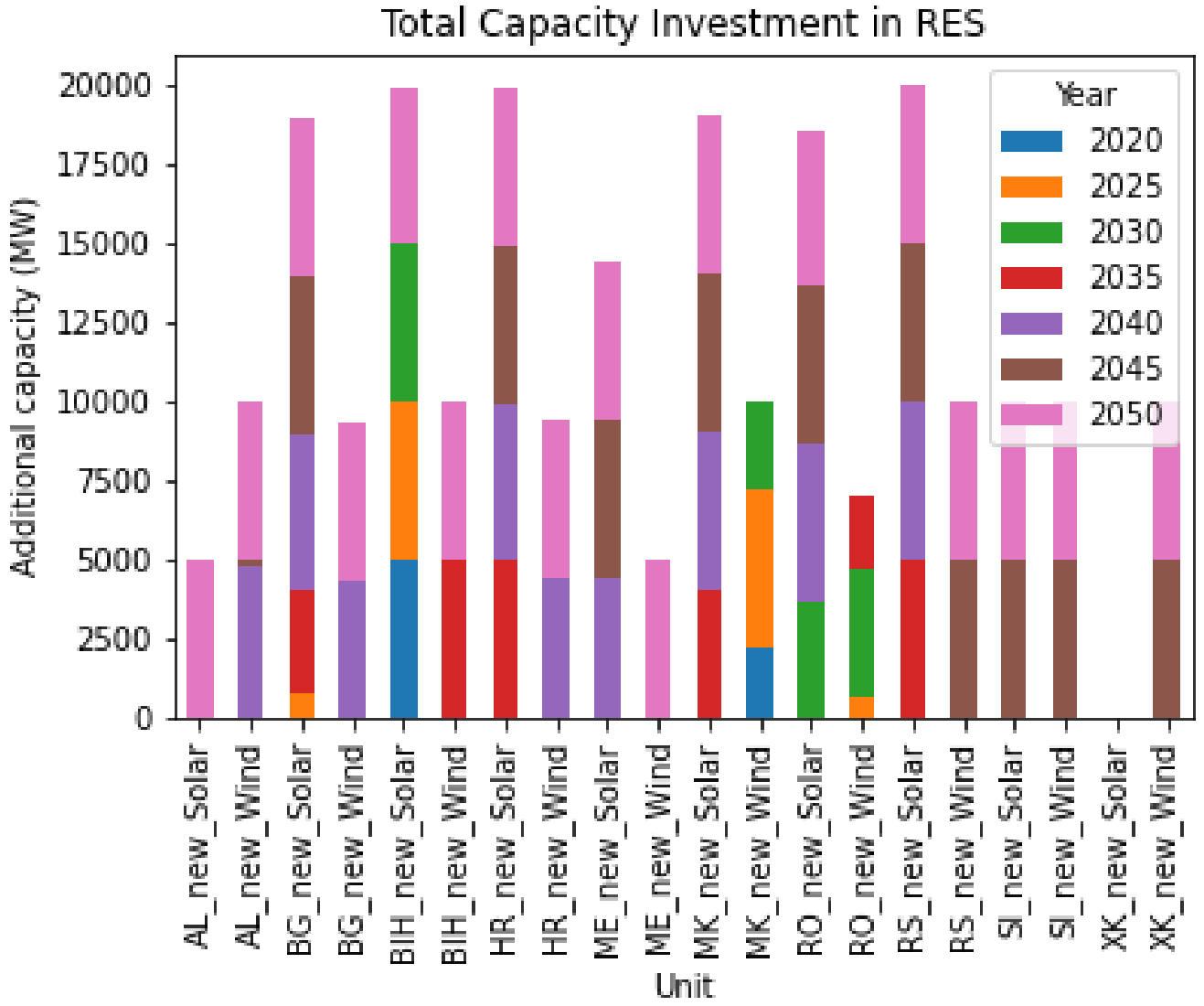
South East Europe region - investments



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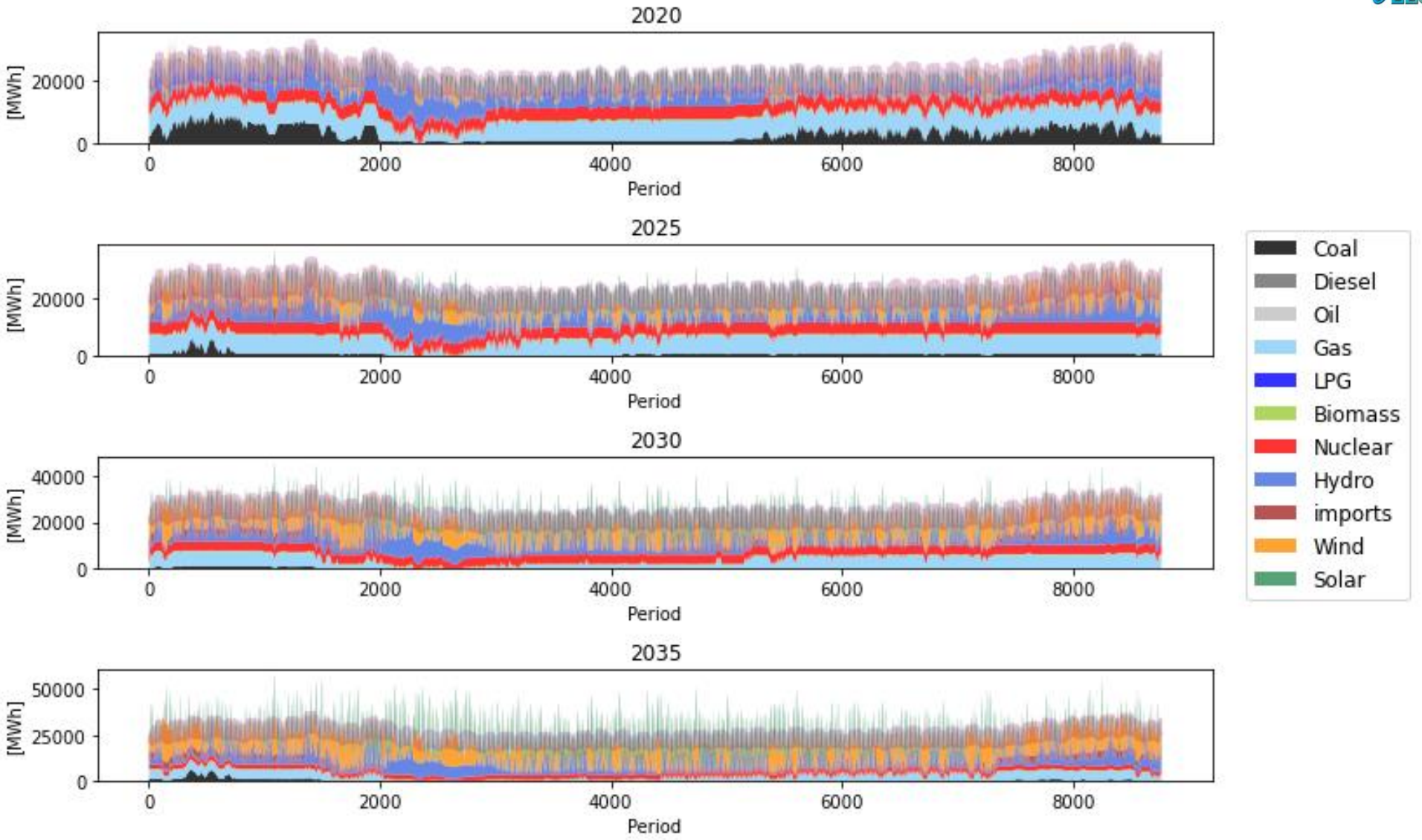
South East Europe region (2020 – 2035)



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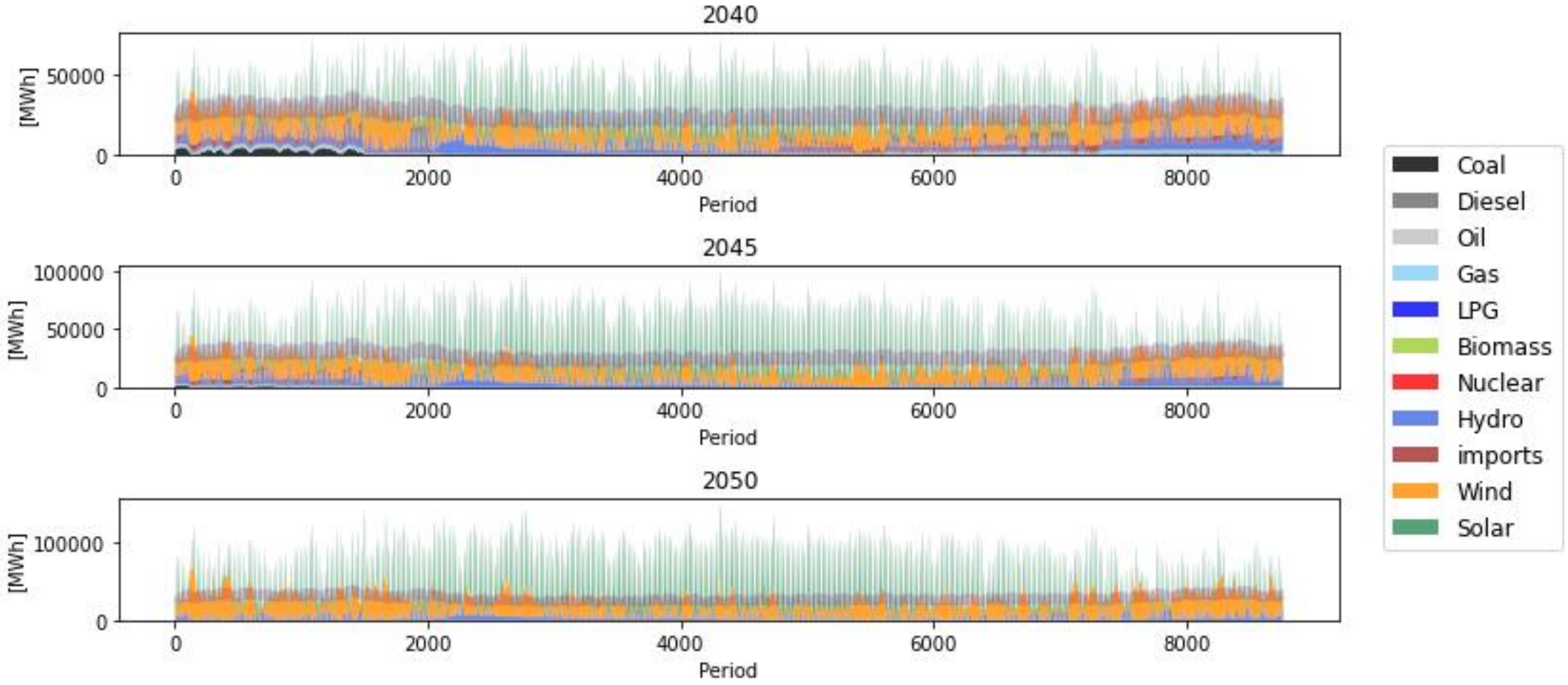
South East Europe region (2040 – 2050)



Comparisson of the cappabilities

- Capable of modelling nearly entire energy system
- Load dispatch and investment planning
- Comparable with other commercial energy modelling systems - PLEXOS

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Heating

Name	PLEXOS	H2RES
CHP	Not available	Available
Modelling of each district heating system separately	Available	Available
Capacity expansion	Implemented	Implemented

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Industry

Name	PLEXOS	H2RES
Total demand	Modelled as a heating node	Available – Logit approach
Application of P2G	Available only if “gas” module is included	Available

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Transport

Name	PLEXOS	H2RES
Electric vehicles	Available – predefined demand	Available – predefined demand
Hydrogen fuel cell vehicles	Not available	Available – predefined demand
Internal combustion vehicles	Not available	Implemented (in testing phase)
V2G	Implemented	Implemented
Capacity expansion	Not implemented	Implemented (in testing phase)

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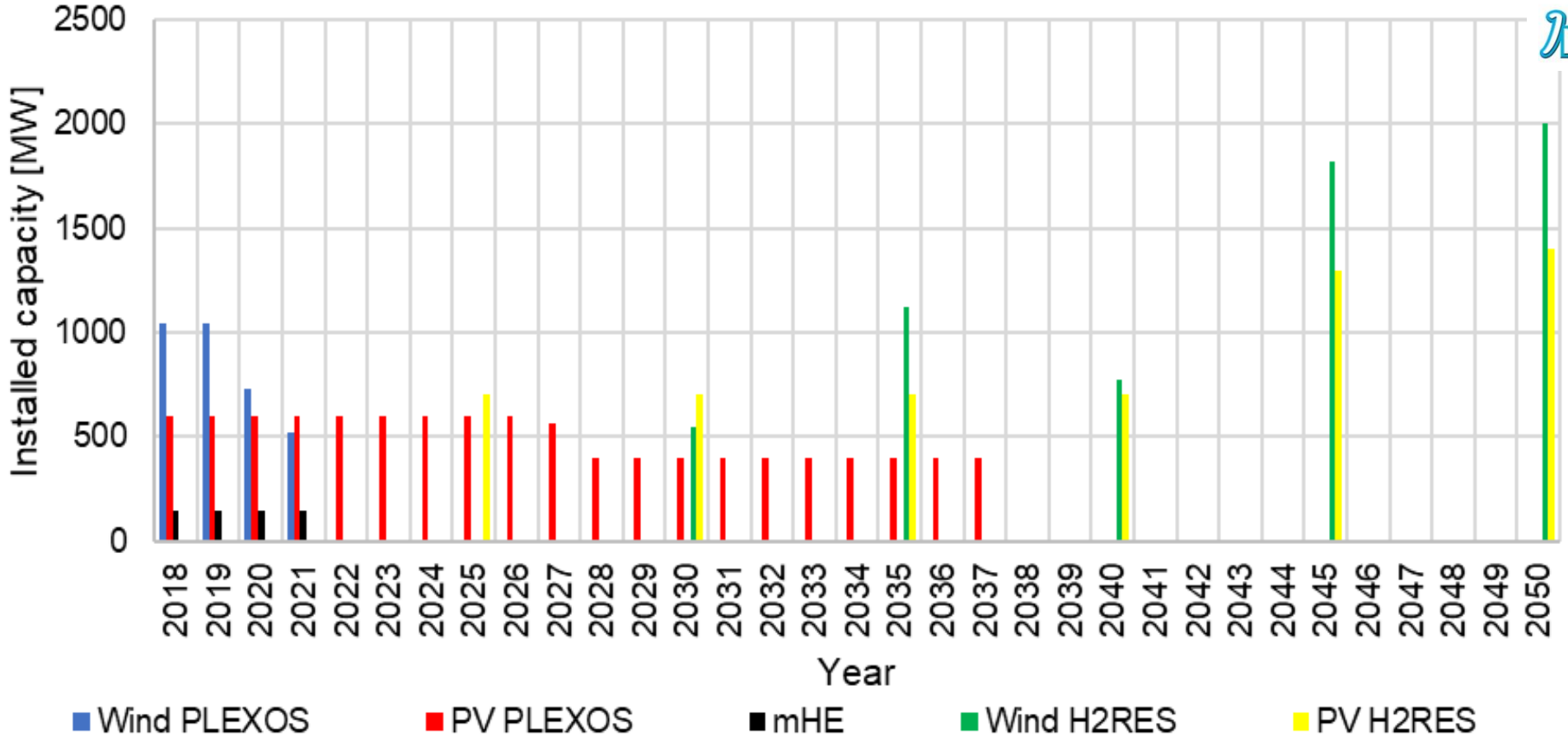
Electricity generation

Name	PLEXOS	H2RES
Capacity expansion	Implemented	Implemented
Scheaduling optimization	Implemented	Implemented

Investment in VRES – H2RES vs PLEXOS



Tendency to invest in VRES at the start of the planning horizon.

These investments are not mandated by CO2 limits, but by the low operating cost of VRES

The problem not present in H2RES although the maximum investment is higher

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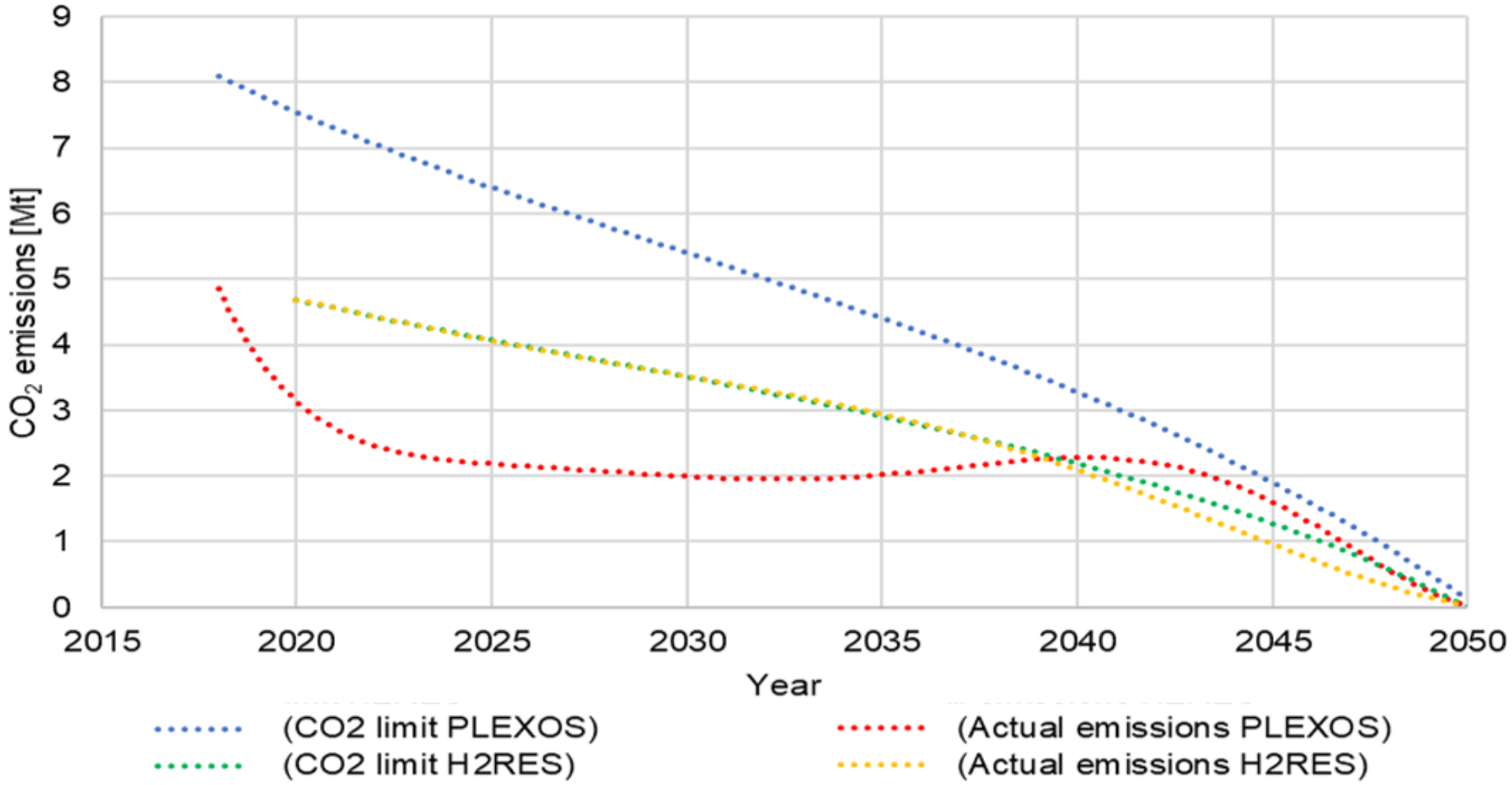
Comparisson of CO2 emissions



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Applications of H2RES

- No limit in size of the region
- Fully modelled power system and heating systems
- Fully modelled industry
- Electric portion of the transport modelled in this stage (complete version is in the works)
- Latest version – fully modelled electricity, heat and industry system

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Conclusion

- Comparable capabilities with commercial software
- Outperforming in some aspects
- Capability to fully define desired planning and simulation horizon – no necessity for time slices
- Computational time kept low as an effect of used linear architecture
- Open – source architecture
- Community driven

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THANK YOU FOR YOUR ATTENTION!

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H2RES competition

- The H2RES model and user manual are availiable for download at the website: https://h2res.org/download/
- Modellers that submit the model of their national energy system that is:
  - 100 % RES in total energy supply
  - No more than 5 % CEEP
  - Cheaper than the scenario based on fossil fuels
  - No more than 30 % of final energy supplied by biomass
  - Respects the limitations on installation of VRES capacities
  - Possesses no more than 48 hours worth of electricity storage in a form of battery stationary storage

Become eligible for the prize: **Fee waiver** for the next SDEWES conference

10 prizes are available