Open low emission scenarios for Europe until 2050: Energy system results and balancing measures

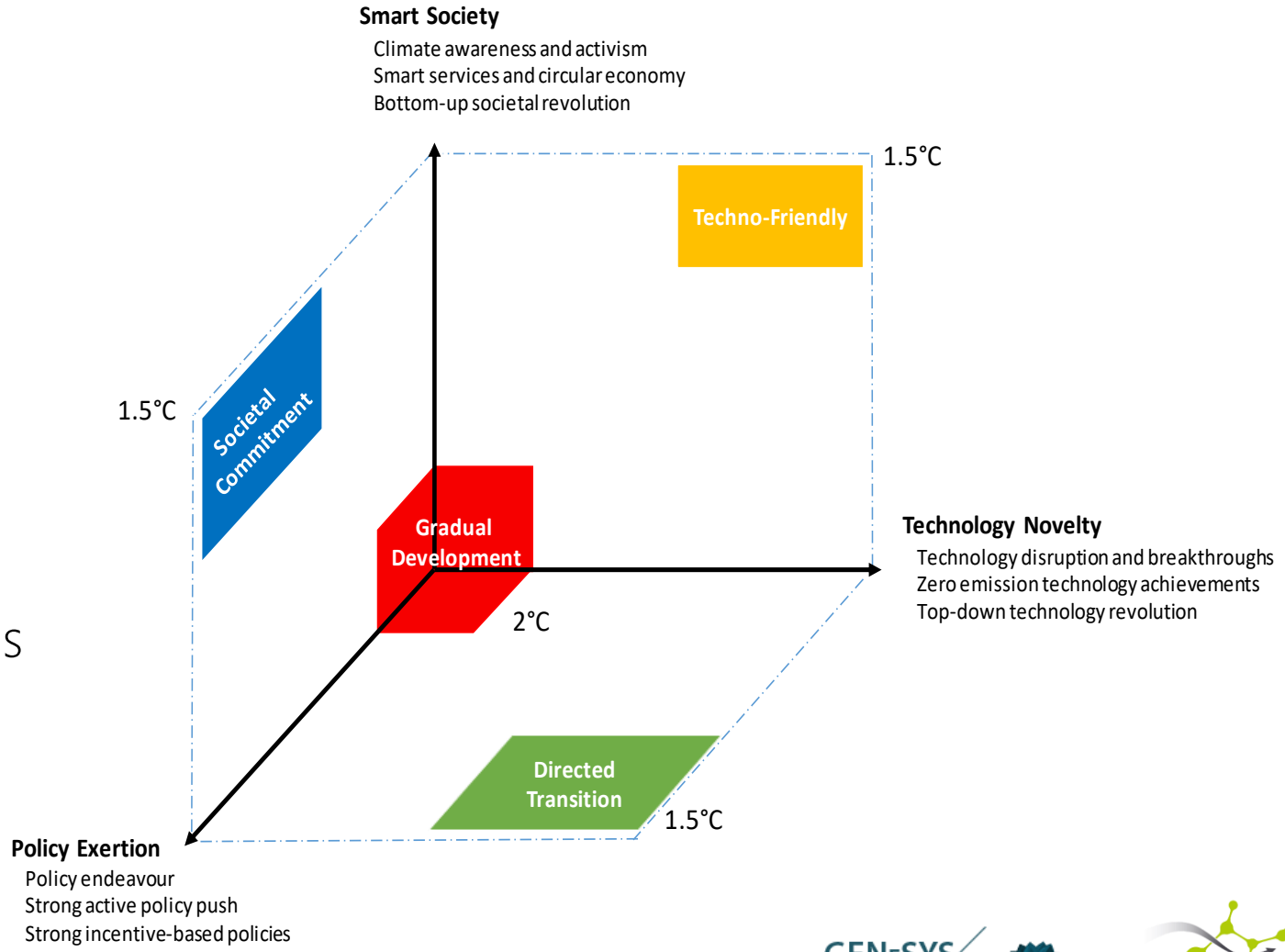
openENTRANCE WORKSHOP

16.01.2023

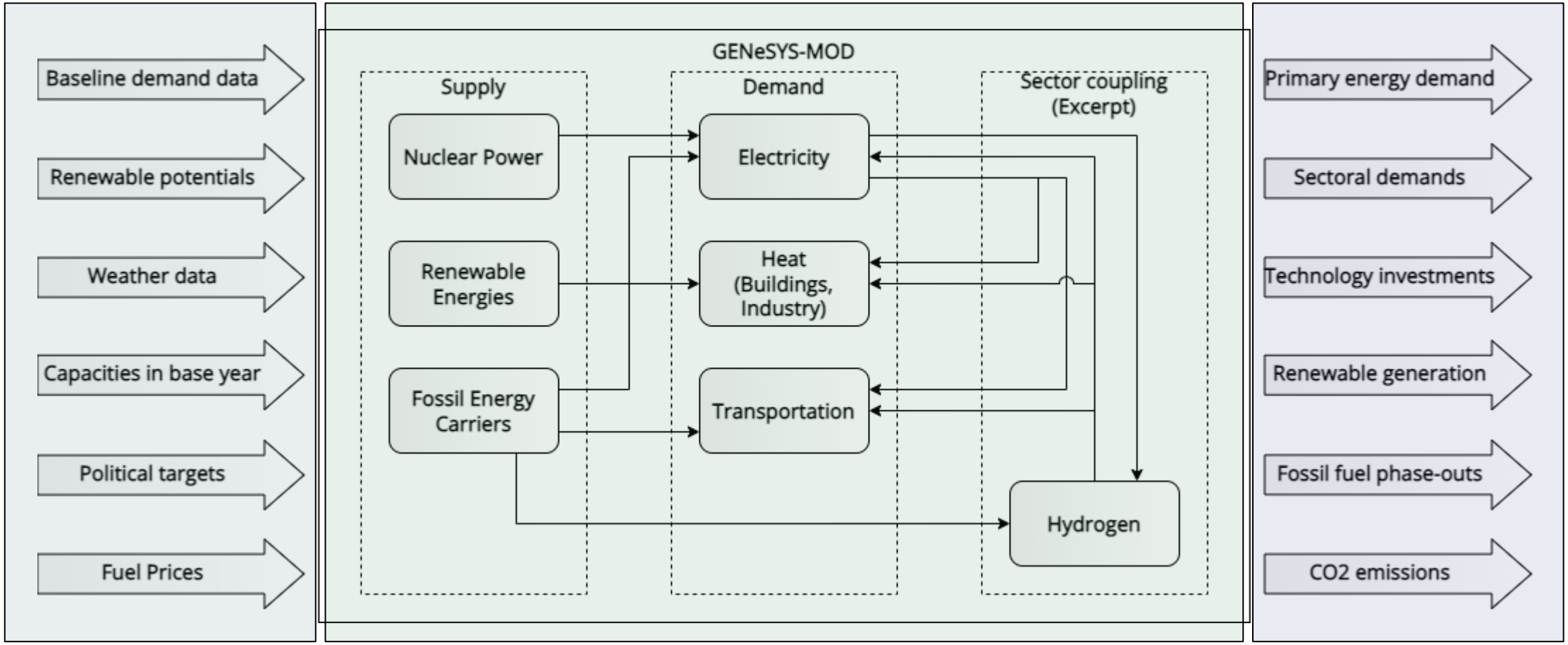
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 835896

The openENTRANCE storylines

- Directed Transition
  - Strong policy push
- Societal Commitment
  - Willingness of society
- Techno-Friendly
  - High technological progress
- Gradual Development
  - Little of everything



The Global Energy System Model – GENeSYS-MOD



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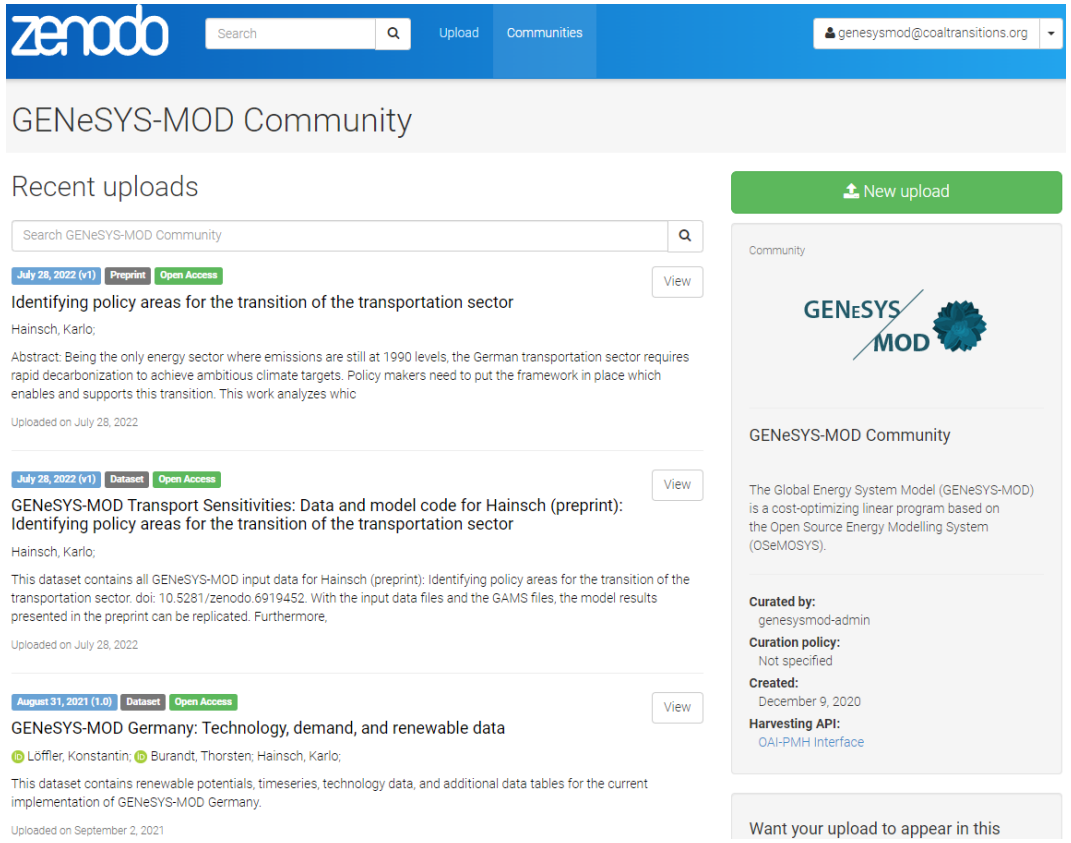
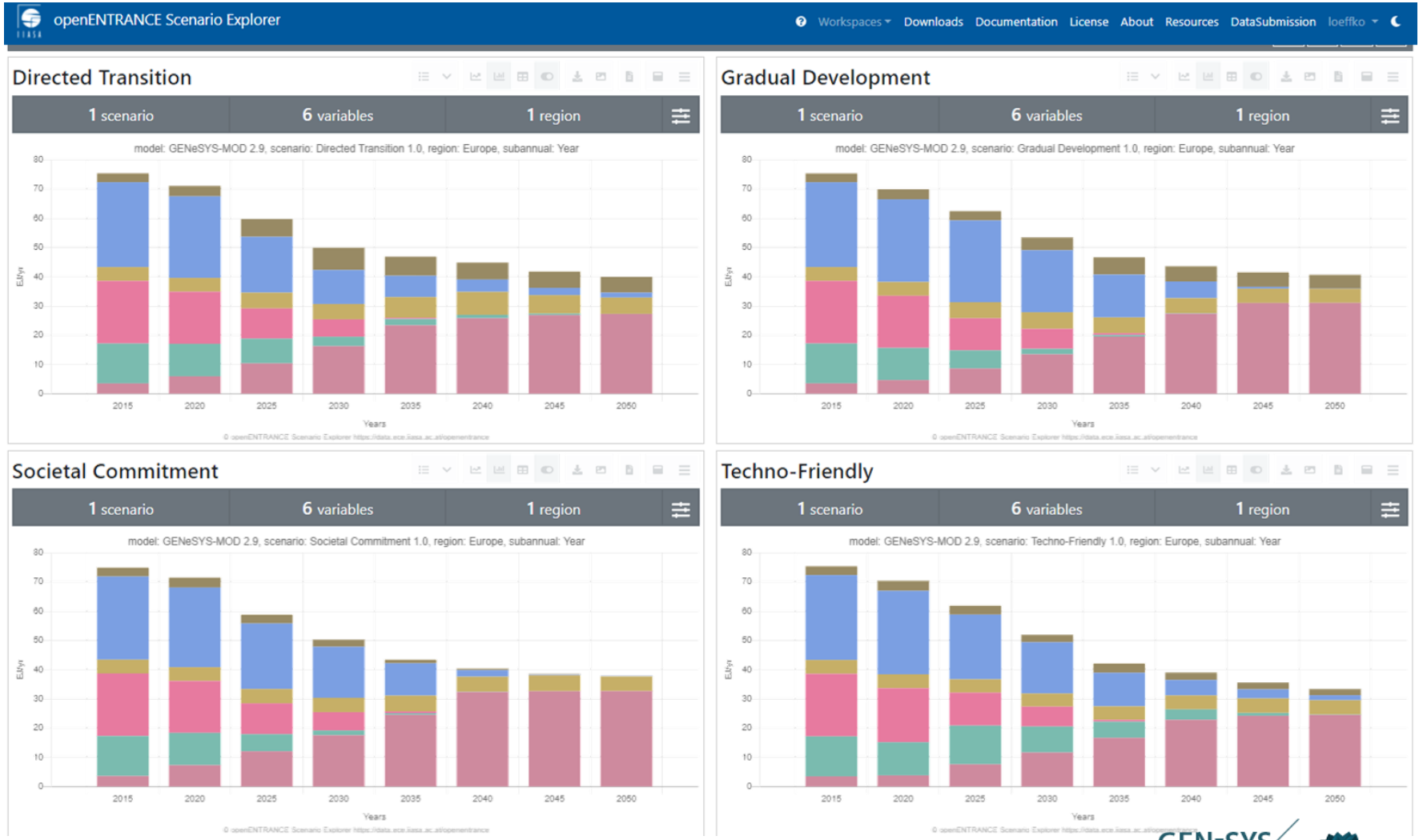
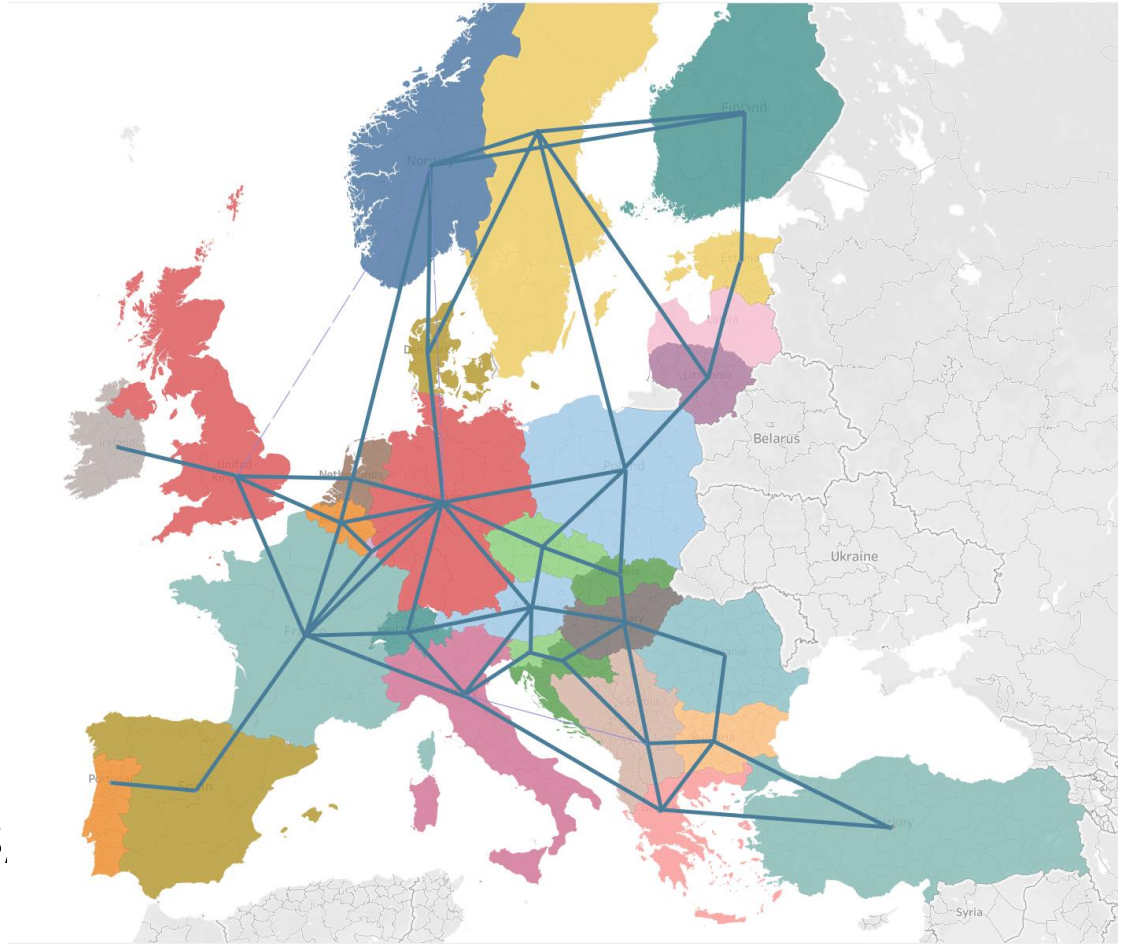


Results on the openENTRANCE scenario explorer

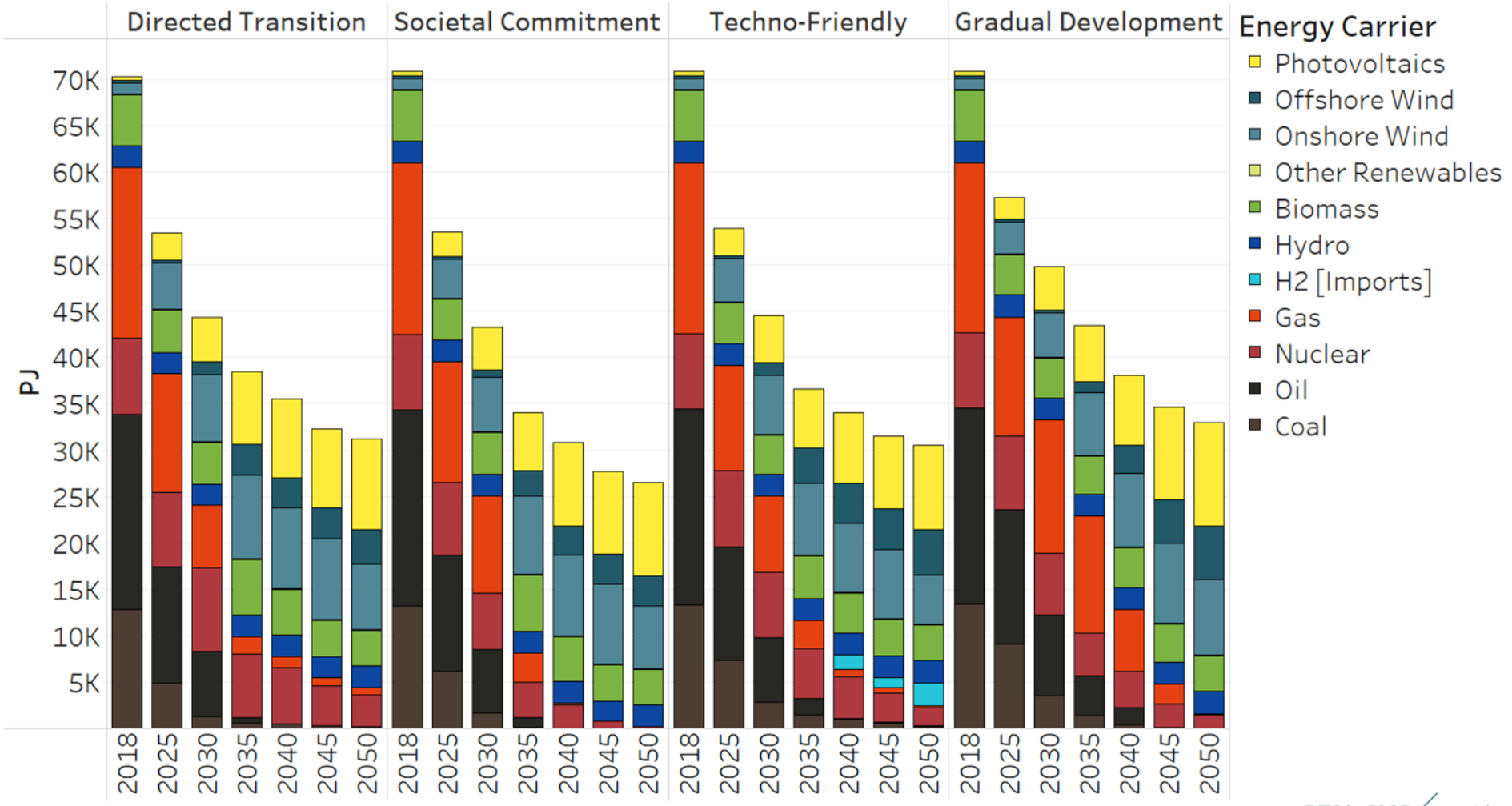


Outline of the model set-up

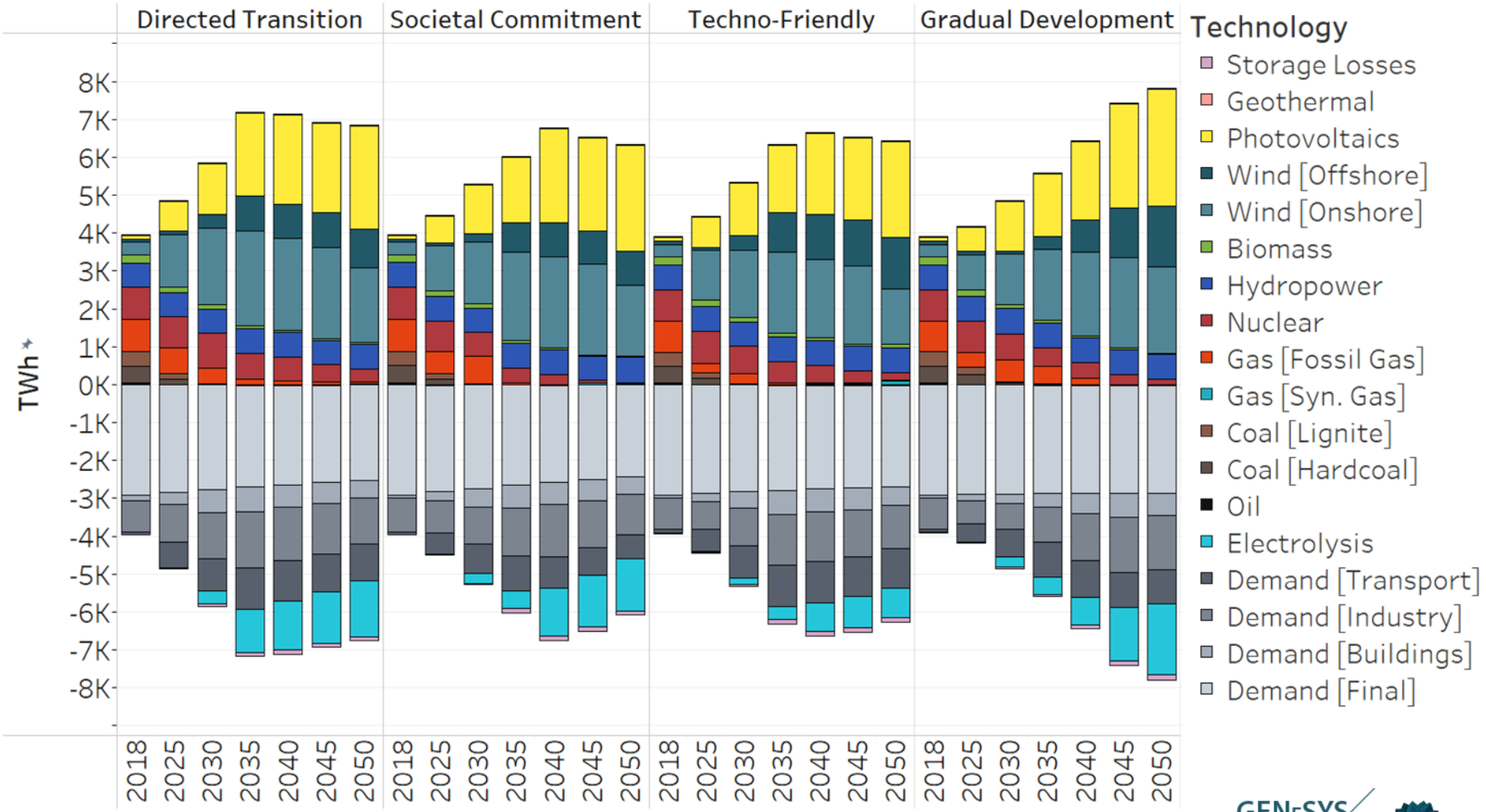
- 30 Regions (Mainland-EU, UK, Switzerland, Norway, Turkey, and the Balkan region)
- Modeled timeframe: 2018-2050
- Reduced hourly timeseries, via a reduction algorithm
- Covers the sectors: Electricity, Buildings, Industry and Transportation
- Pathway dependent features (like potential of demand shifting, political climate-targets, or breakthrough of certain technologies)



Results: Primary Energy



Pathway results - Electricity



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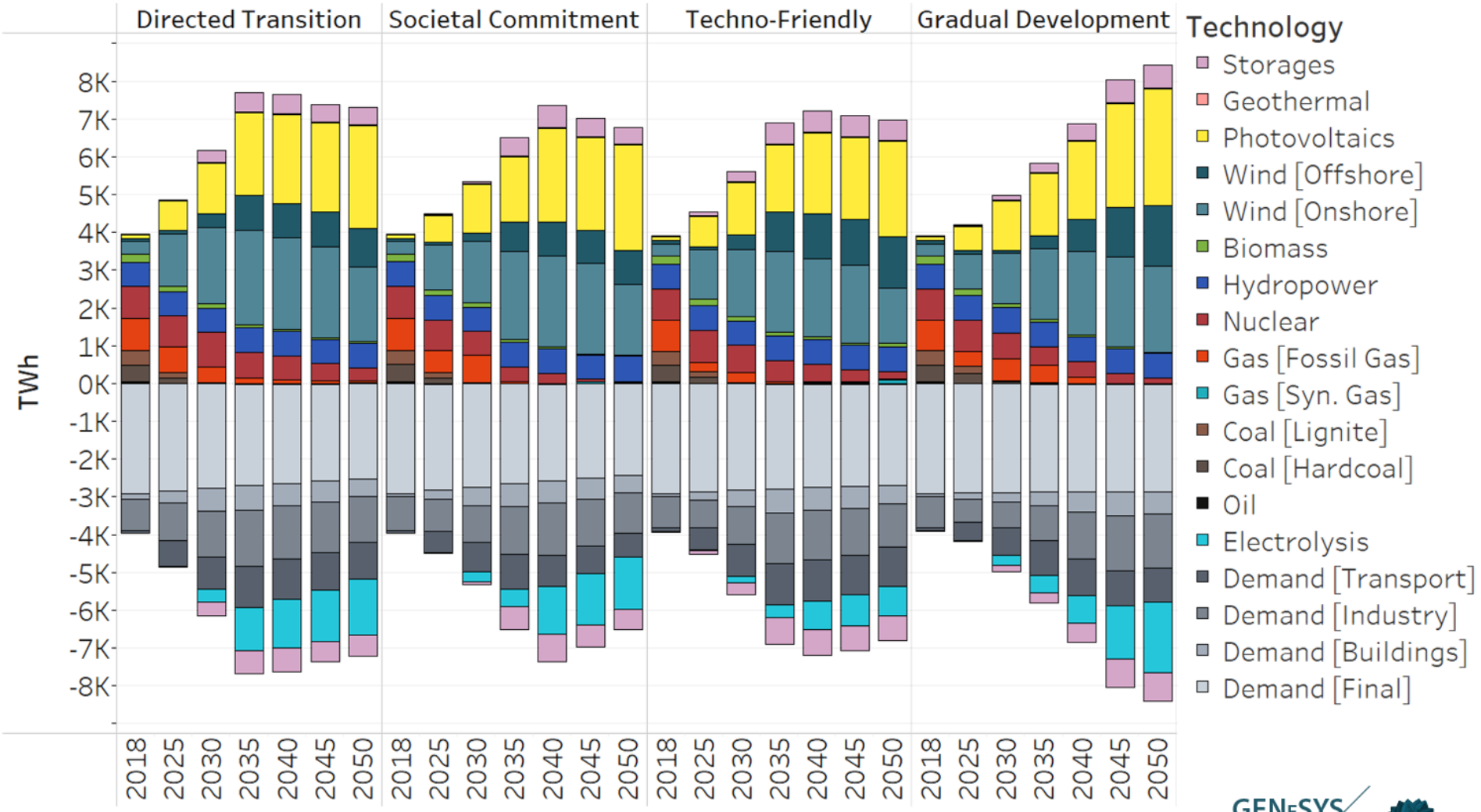
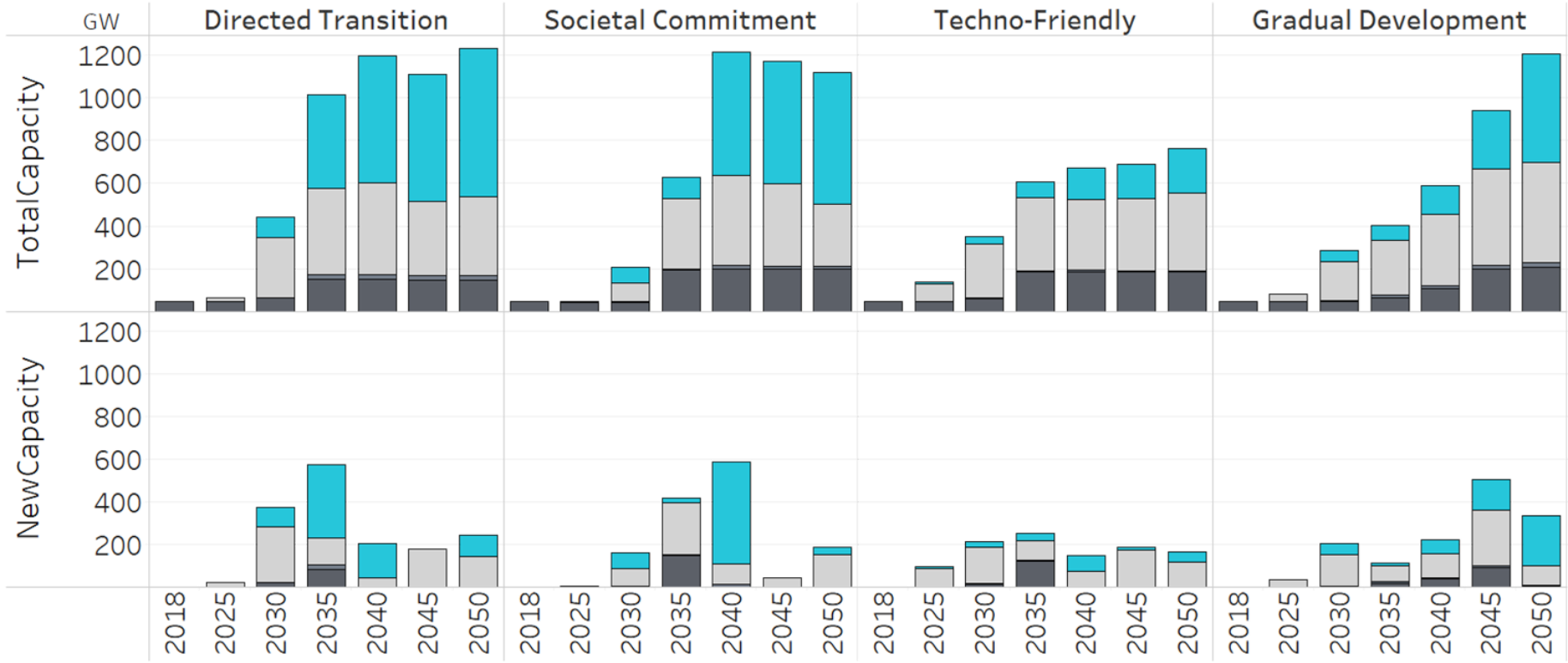


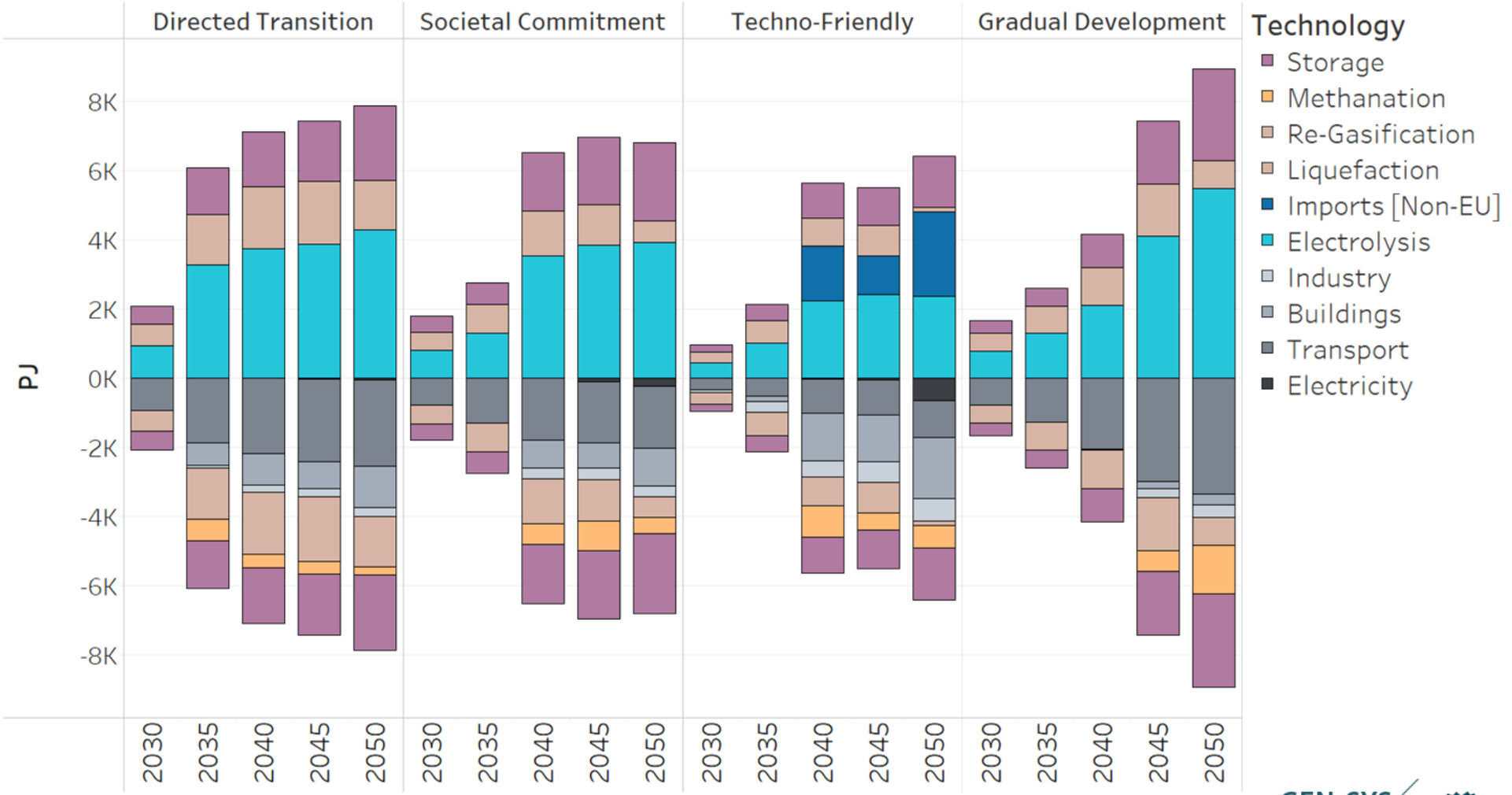
Results: Electric and hydrogen storages



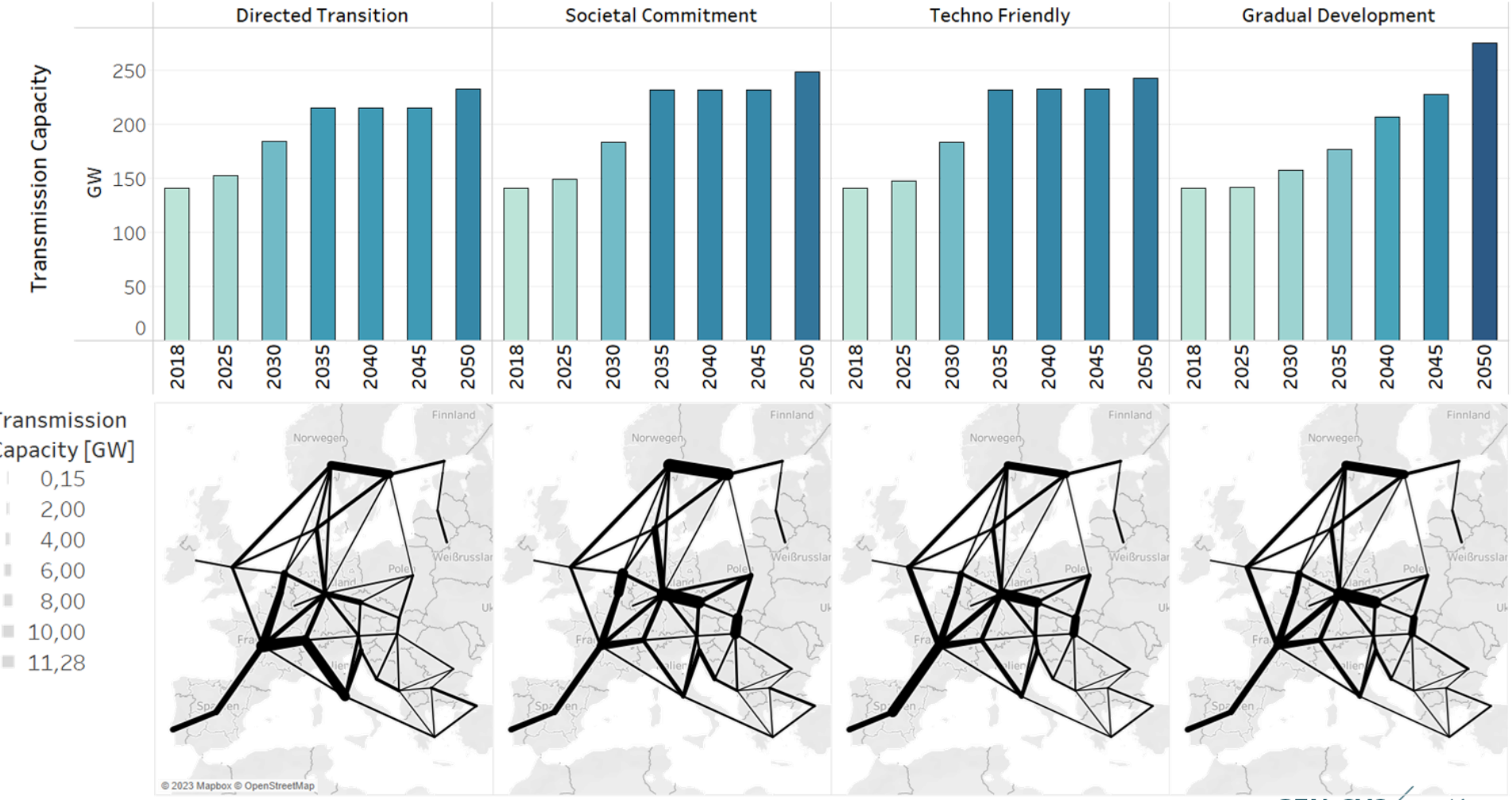
Technology

- H2 Storage
- Electric Storage [Battery]
- Electric Storage [CAES]
- Electric Storage [Pumped Hydro]

Results: Hydrogen generation and use



Results: Transmission capacity



Conclusions

- To reach the ambitious climate targets of 1.5-2°C, the energy system needs to be based on 100% renewables by 2040-2050
- With a strong focus on electrification as a sector-coupling option, this leads to a significant increase in variable renewable generation
- To balance these variabilities, different flexibility options, both short- and long-term, are required
- We cannot rely only on one type of flexibility, instead, the optimal mix of flexibility options includes a sharp increase of all available options, including electric storages, hydrogen, transmission expansion, and demand side management

Thank you for your attention!

Dr. Konstantin Löffler

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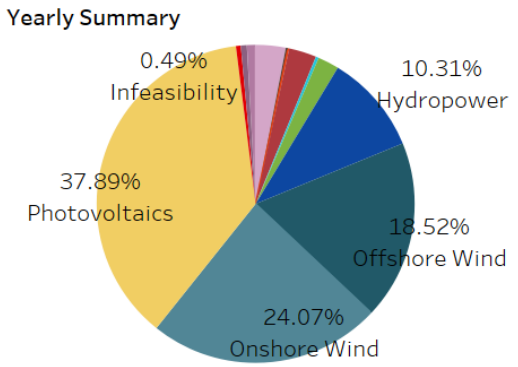
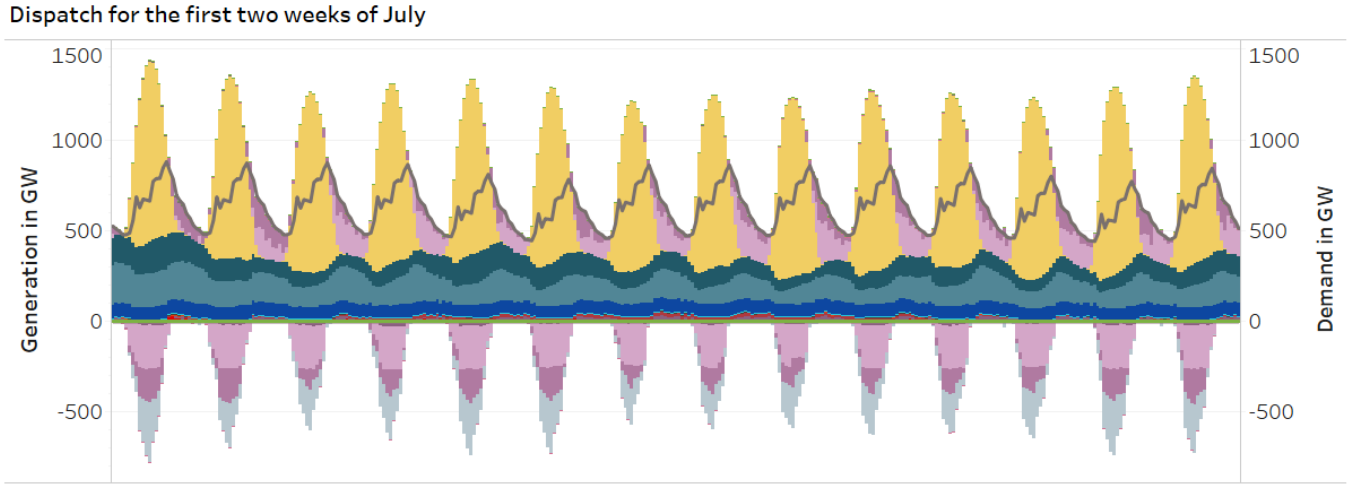
Additional Slides: openENTRANCE pathway results

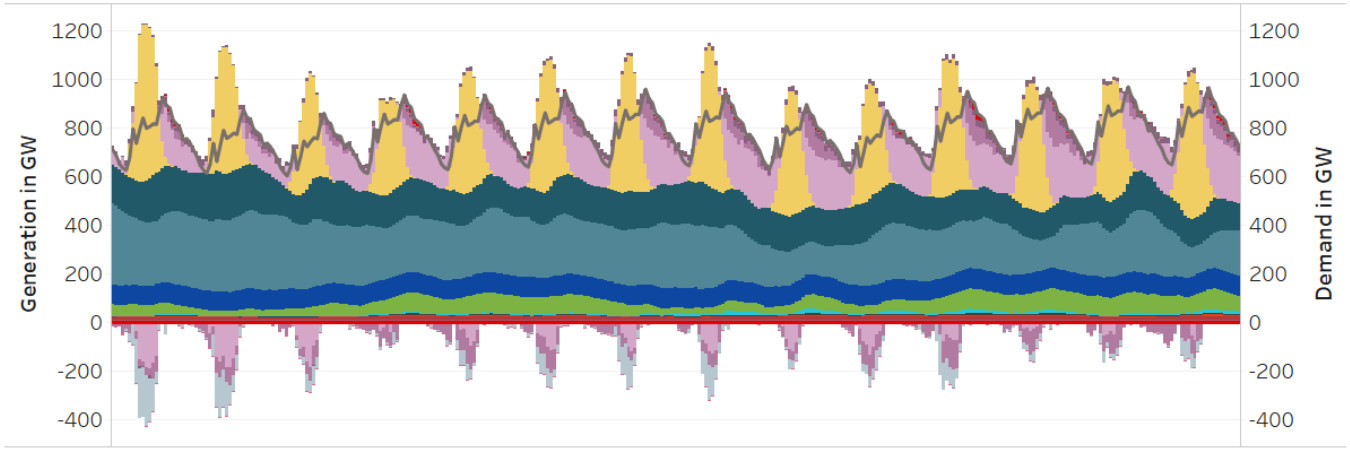
Feasibility Check: Dispatch Results



Technology

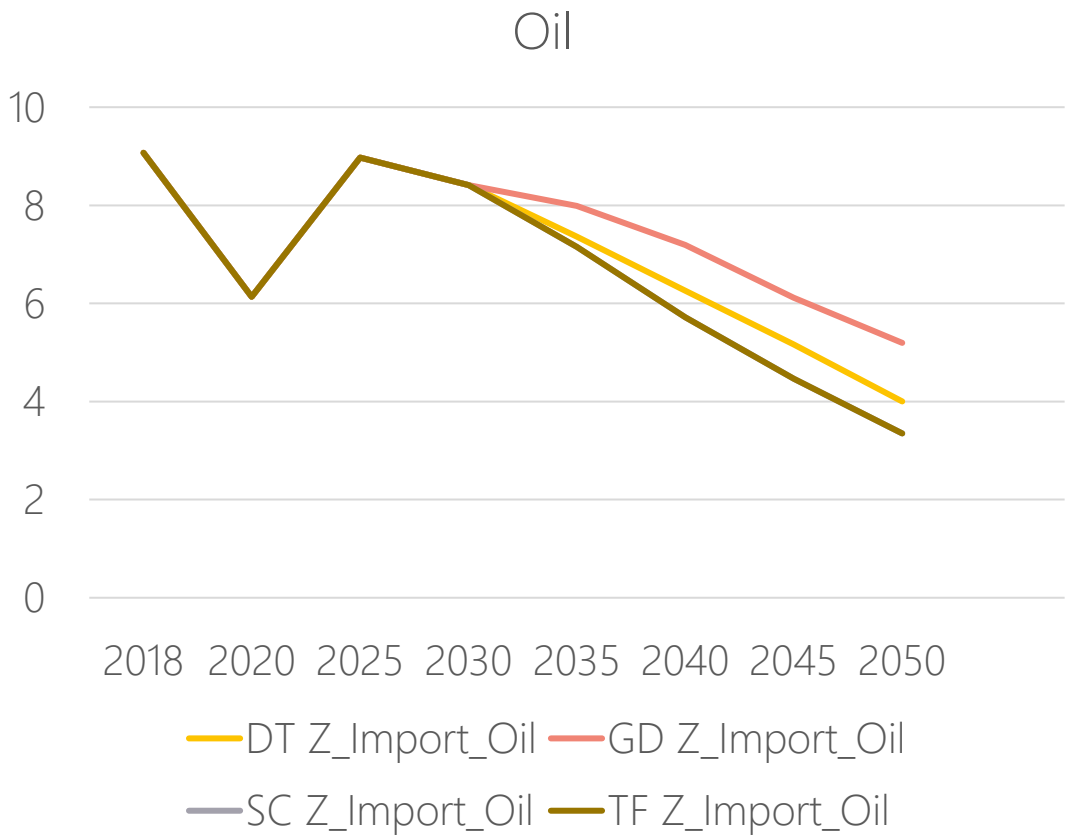
- Demand [Line]
- Infeasibility
- Transmission
- Curtailment
- Compressed-Air Electricity Storage
- Battery Storage
- Pumped Hydro Storage
- Photovoltaics
- Offshore Wind
- Onshore Wind
- Hydropower
- Biomass & Biogas
- Synthetic Gas
- Coal [w/ CCS]
- Fossil Gas [w/ CCS]
- Nuclear

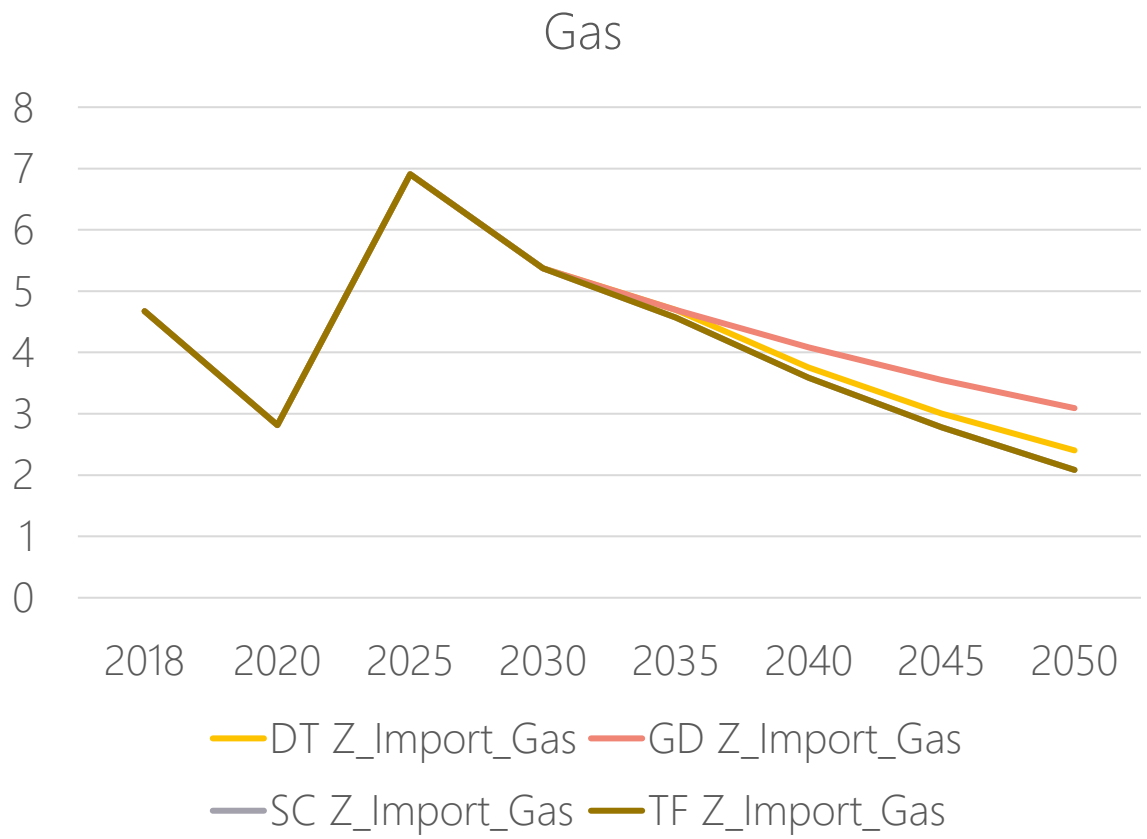




Pathway settings – CO_2 prices

Additional Slides – Fossil fuel prices [in M€/PJ]





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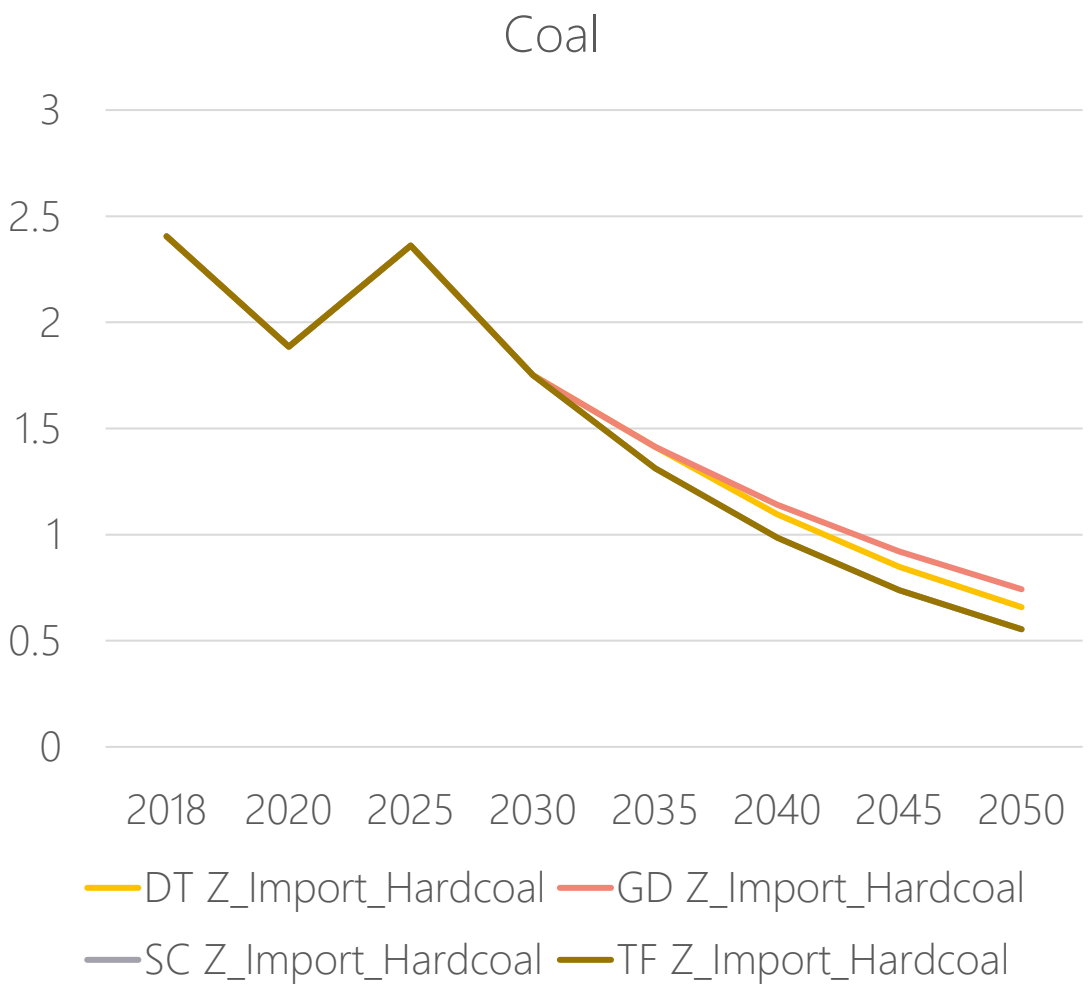
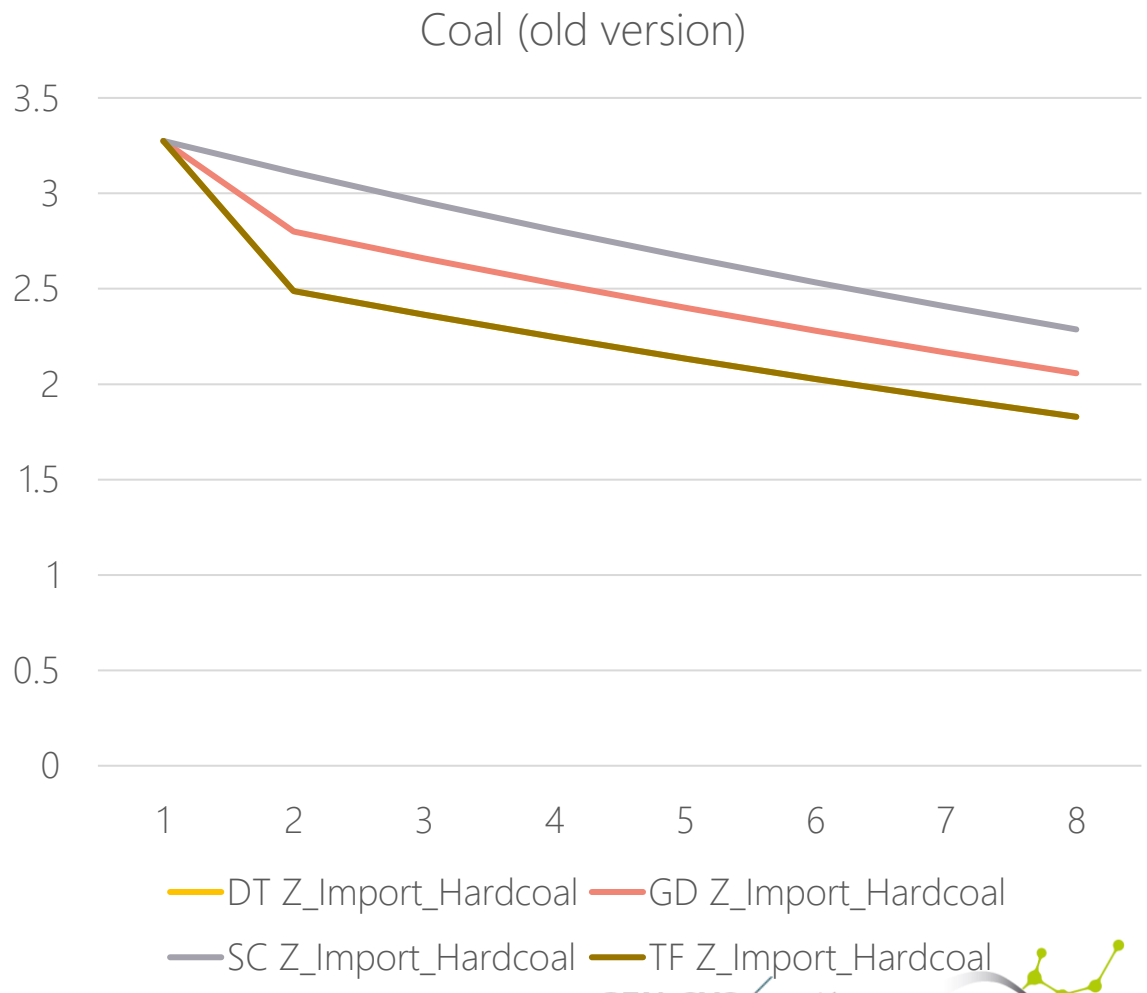
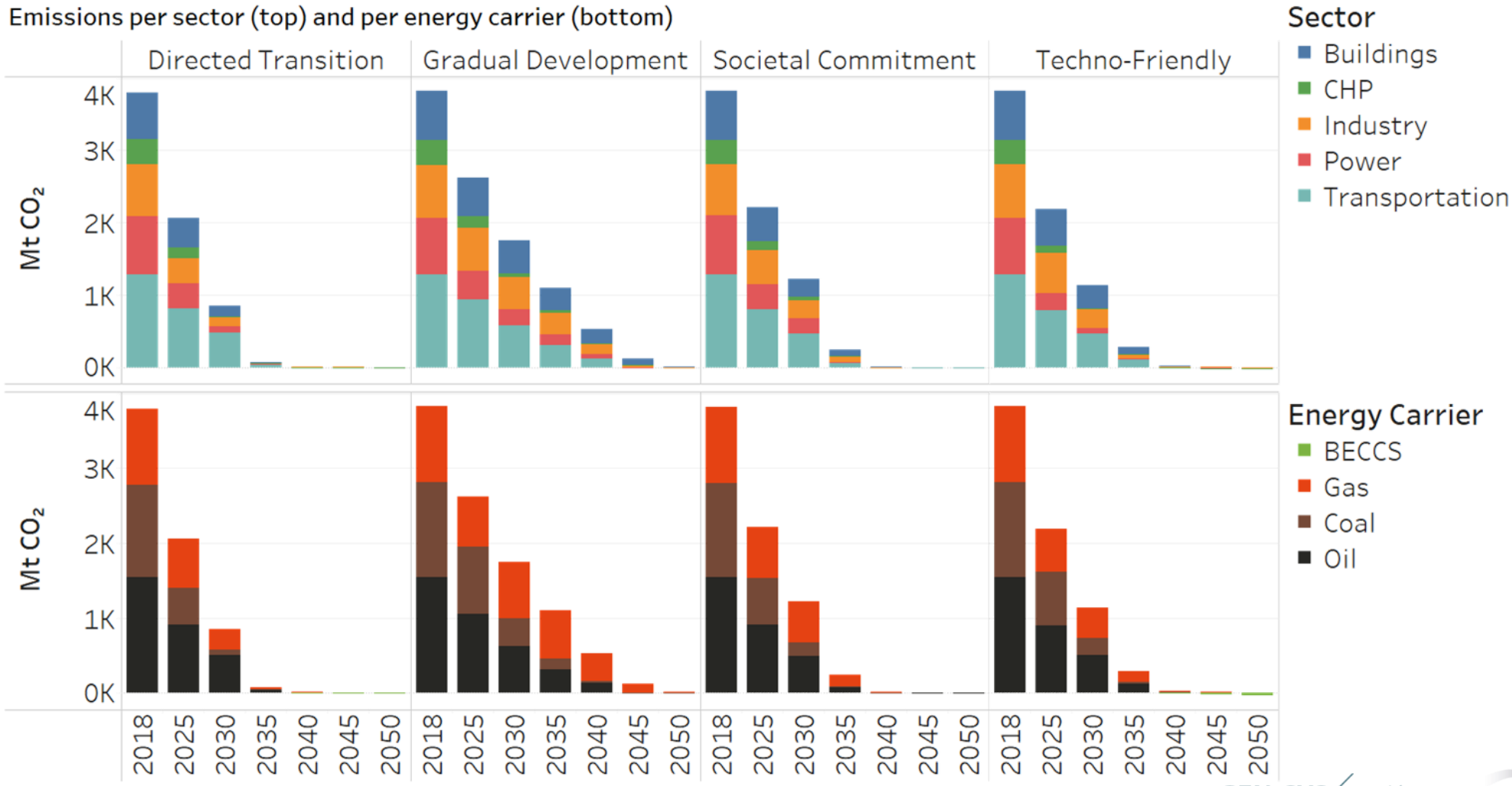
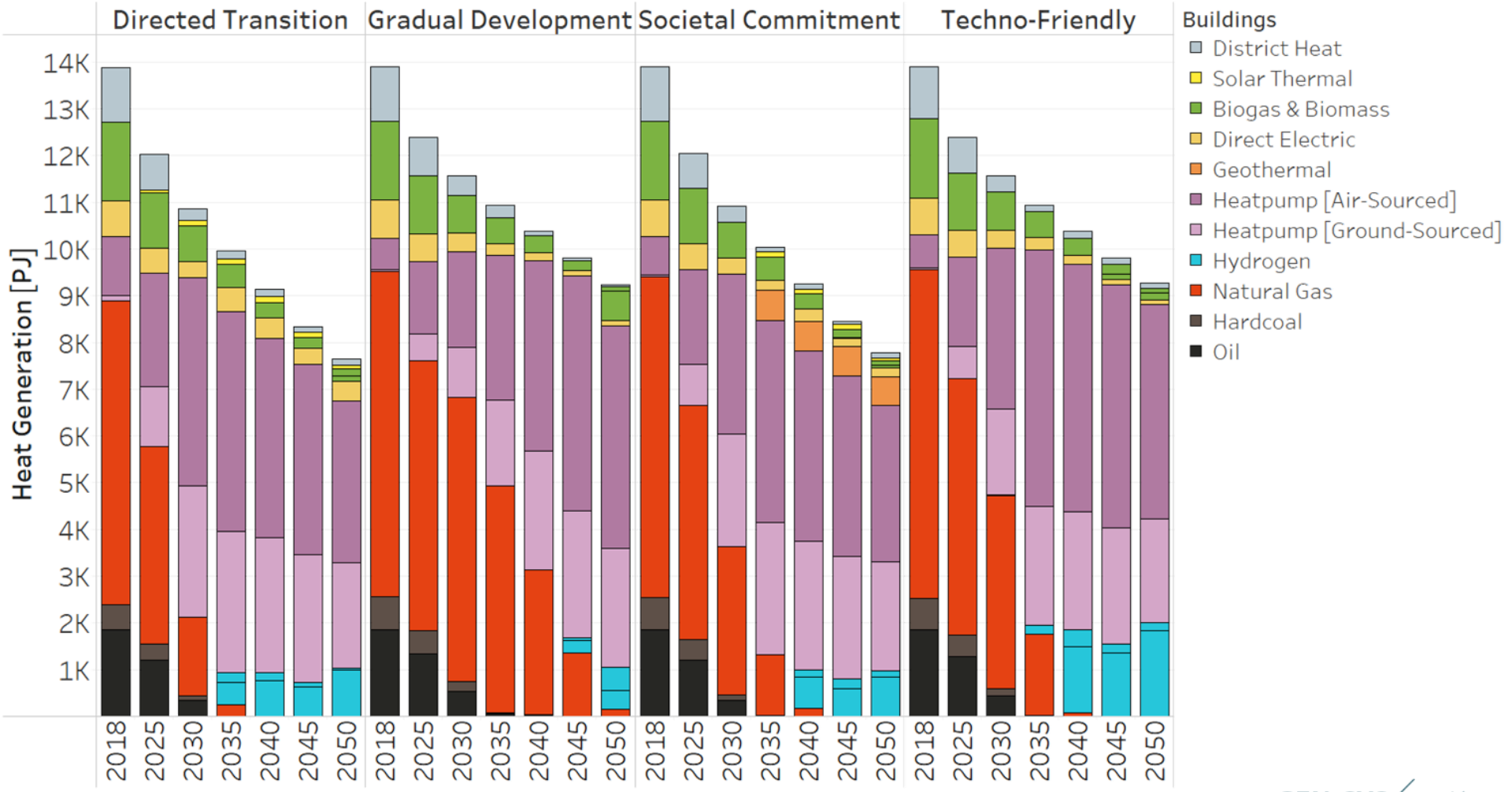




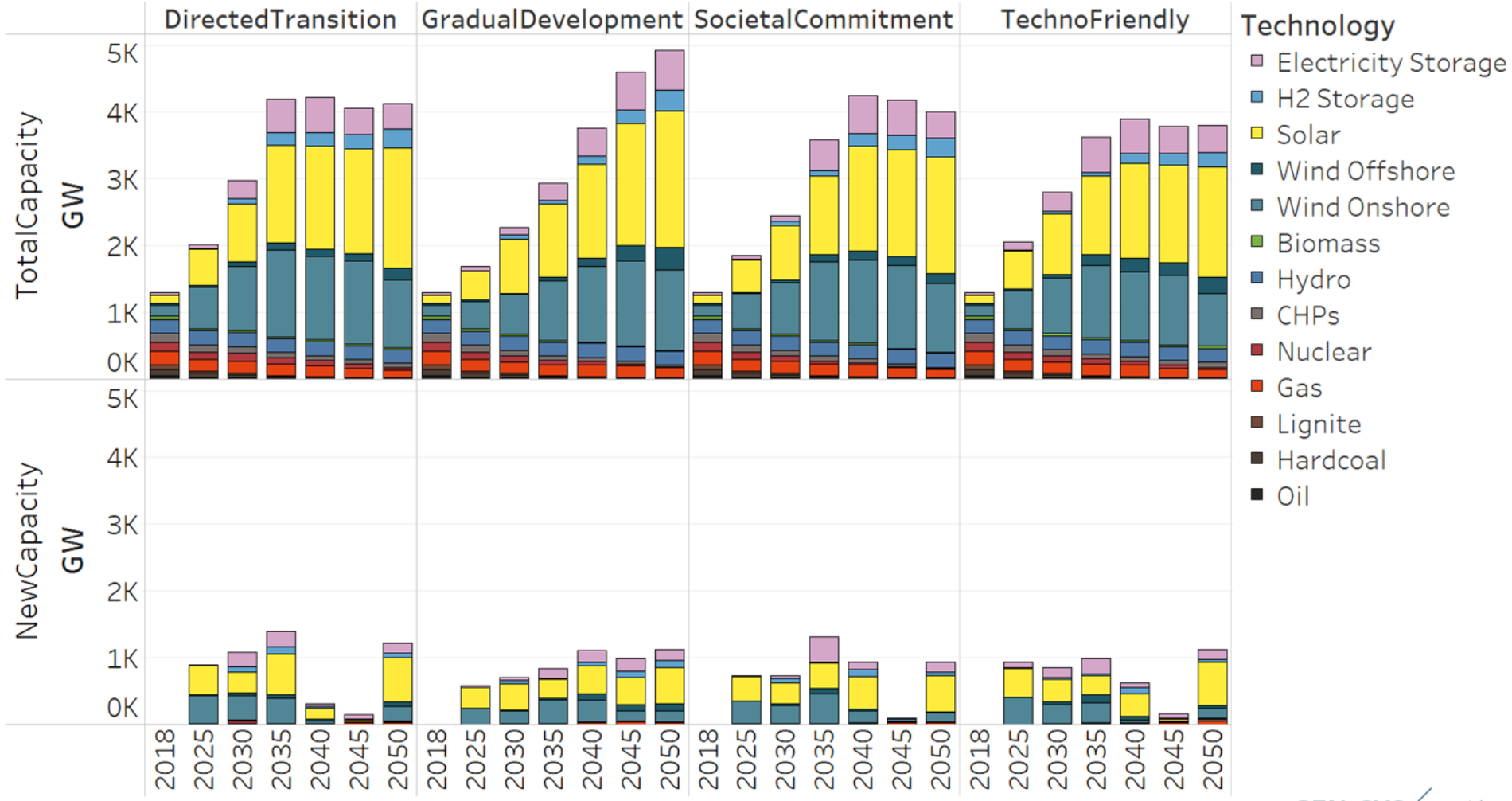
Results: Emissions



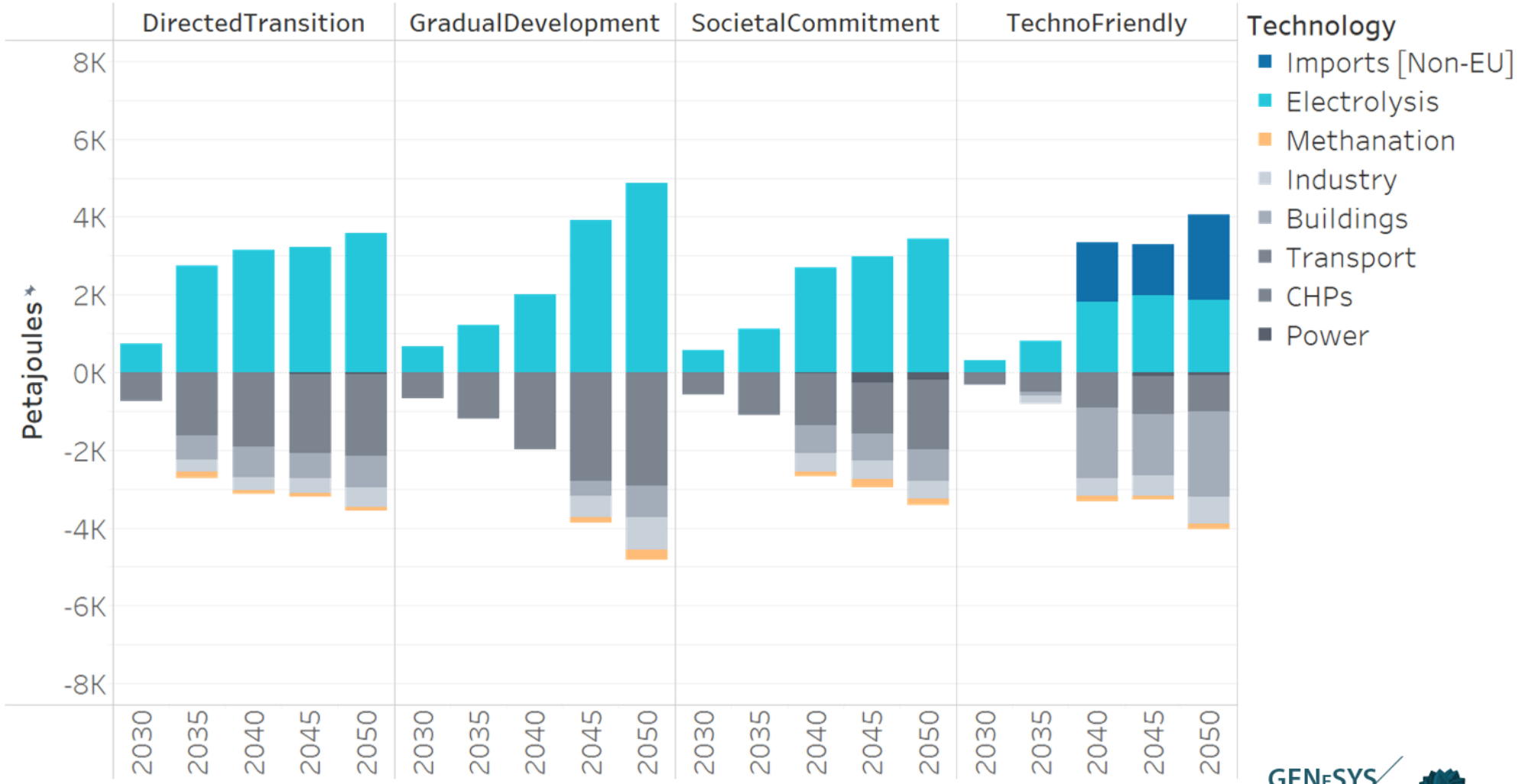
Results: Building heat



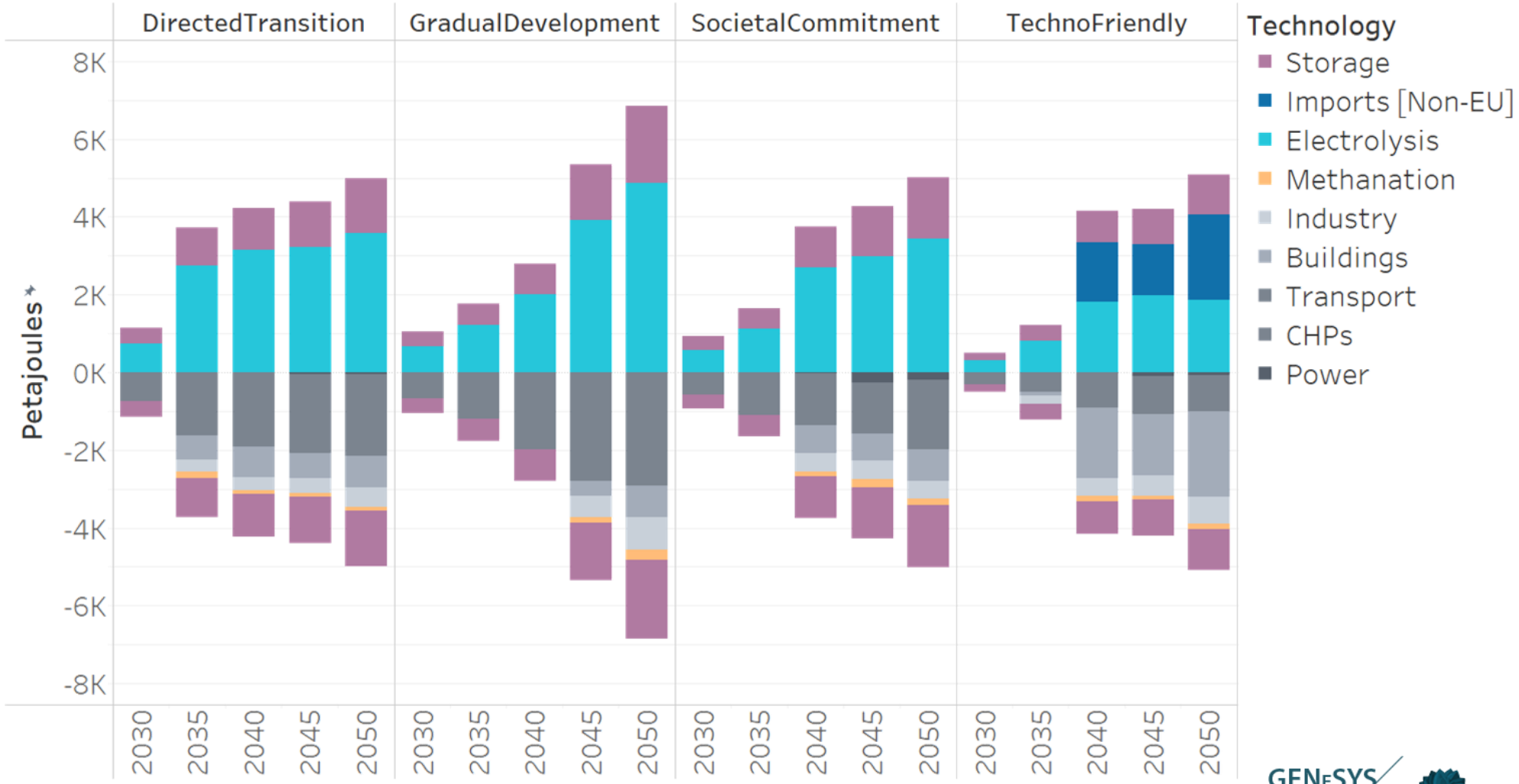
Results: Installed (power) capacity



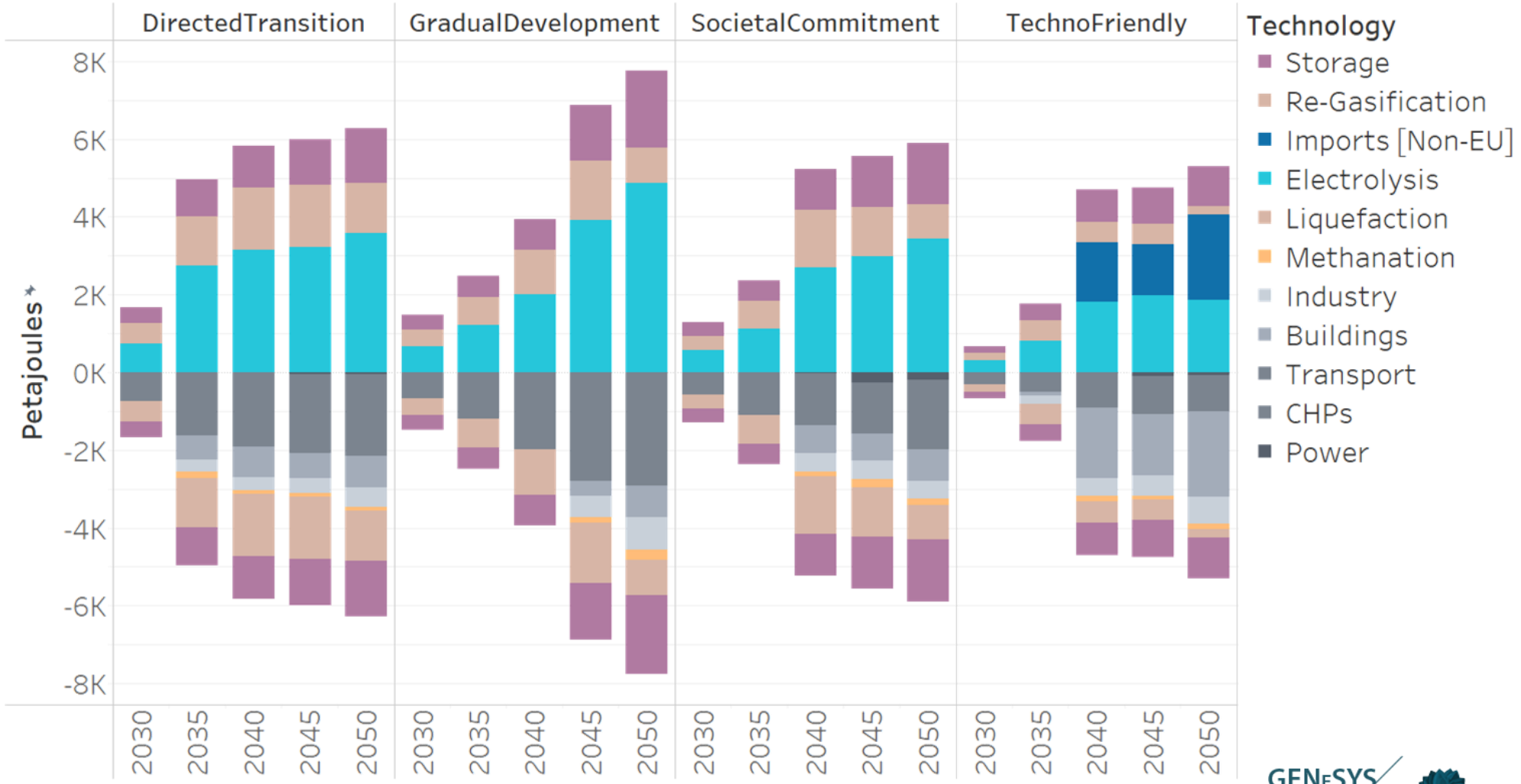
Pathway results – Hydrogen [excl. Storage & Liquefaction]



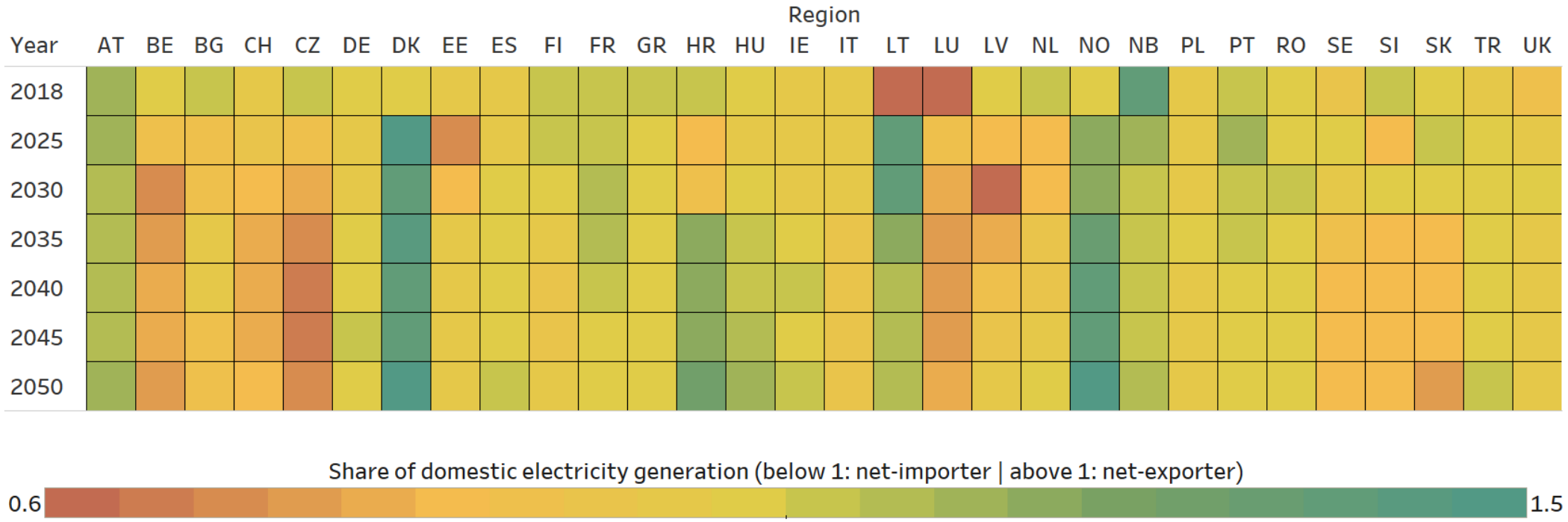
Pathway results – Hydrogen [incl. Storage]



Pathway results – Hydrogen [incl. Storage & Liquefaction]



Results: Country-level share of domestic electricity



Results: Electrification Rate