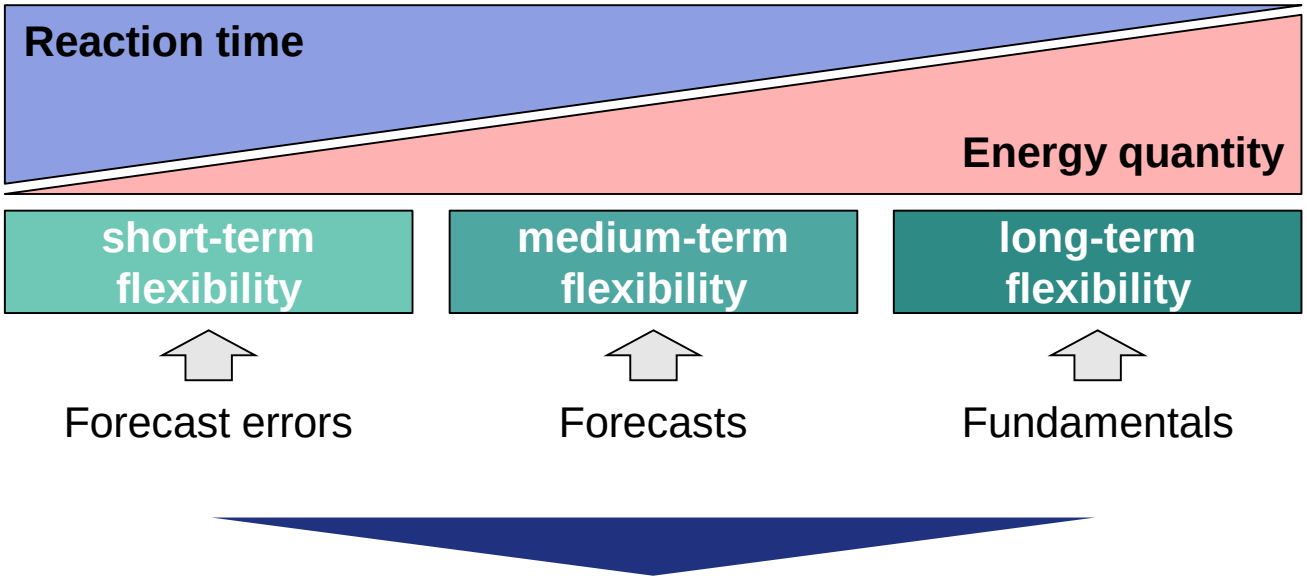
IAEE 2019 Ljubljana

Scenarios for Decarbonizing an Integrated European Energy System - First Results From a Top-down-bottom-up Modelling Approach

OSMOSE WP 1: Optimal Mix of Flexibilities

Definition

A power system's ability to cope with variability and uncertainty in demand and generation



- **Increasing the shares of variable renewables will also increase the need for flexibility**
- **Electrification of the heat and mobility sector provides new sources for flexibility**

Scenario assumptions (preliminary)

	Neglected climate action	Current goals	Accelerated transformation

Emission levels
▪ 2030 and 2050
	• Both the 2030 and 2050 target are missed by 5% and 10%
	  • **35%** until 2030
	  • **70%** until 2050
		• Goals currently set on a European level are achieved
		  • **40%** until 2030
		  • **80%** reduction by 2050
			• More ambitious goals are set and achieved
			  • **55%** in 2030
			  • **98%** for 2050

Final energy demand (excluding transport sector)	• Slight overall increase	• Constant final demand for electricity and high temperature heat • demand for **low temperature heat** decreases by **20%**	• Moderate efficiency gains in electricity and high temperature heat • demand for **low temperature heat** decreases by **25%**
Technologies	• Coal phase-out until **2045**	• Coal phase-out until **2040**	• Coal phase-out until **2035**

Applied model framework

Input assumptions

- yearly emission limits
- final demand for heat, mobility and electricity
- technology and cost data for renewable and conventional technologies

GENeSYS-MOD

cost efficient pathways to 2050 in 5-year-steps for the **energy system**

capacities and consumption

- CHP, heat pumps and electric boilers
- electro mobility
- methaniation and electrolysis

remaining potentials

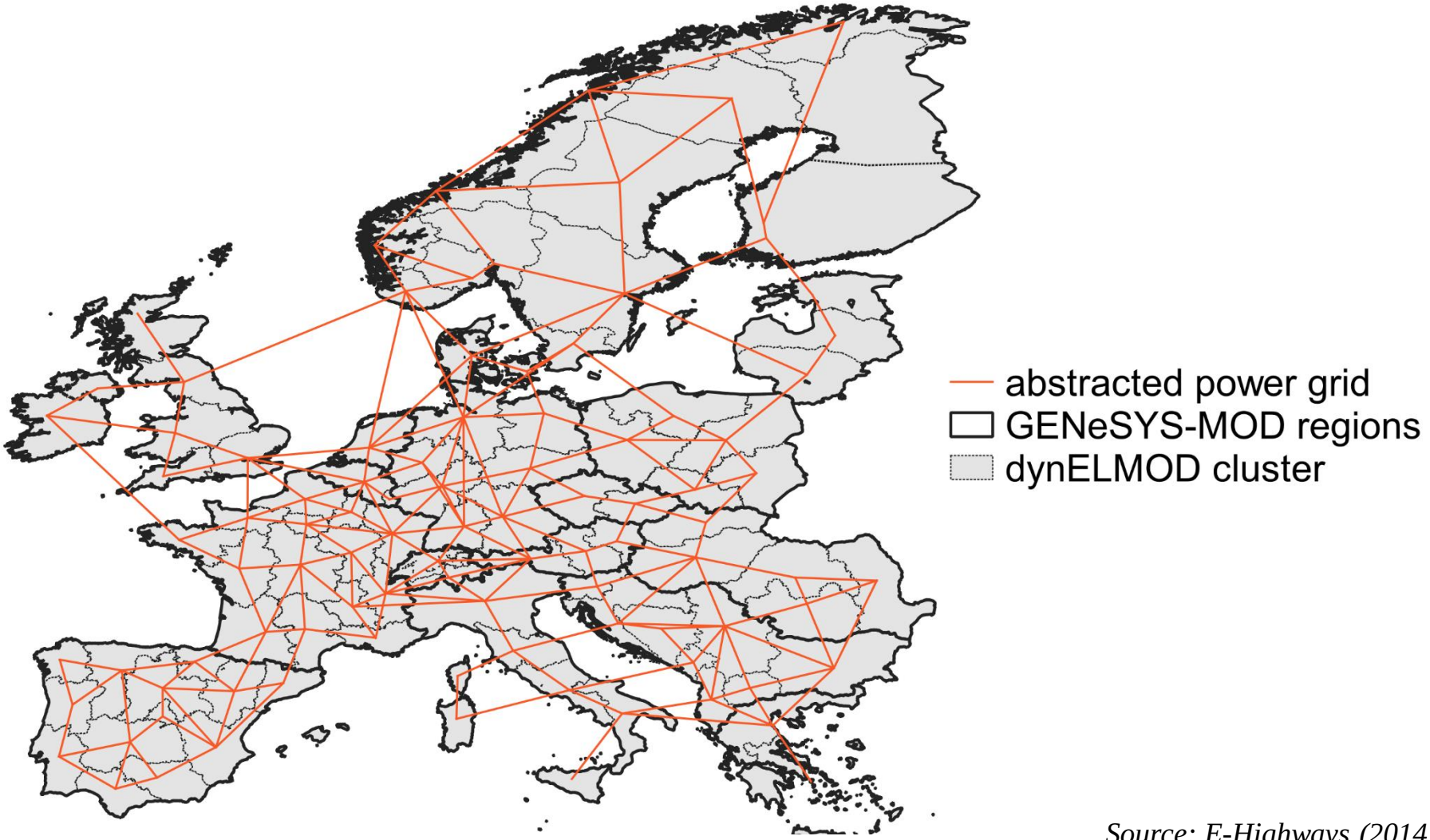
- emissions
- Biomass

dynELMOD

cost efficient pathways to 2050 in 10-year-steps for the **power system**

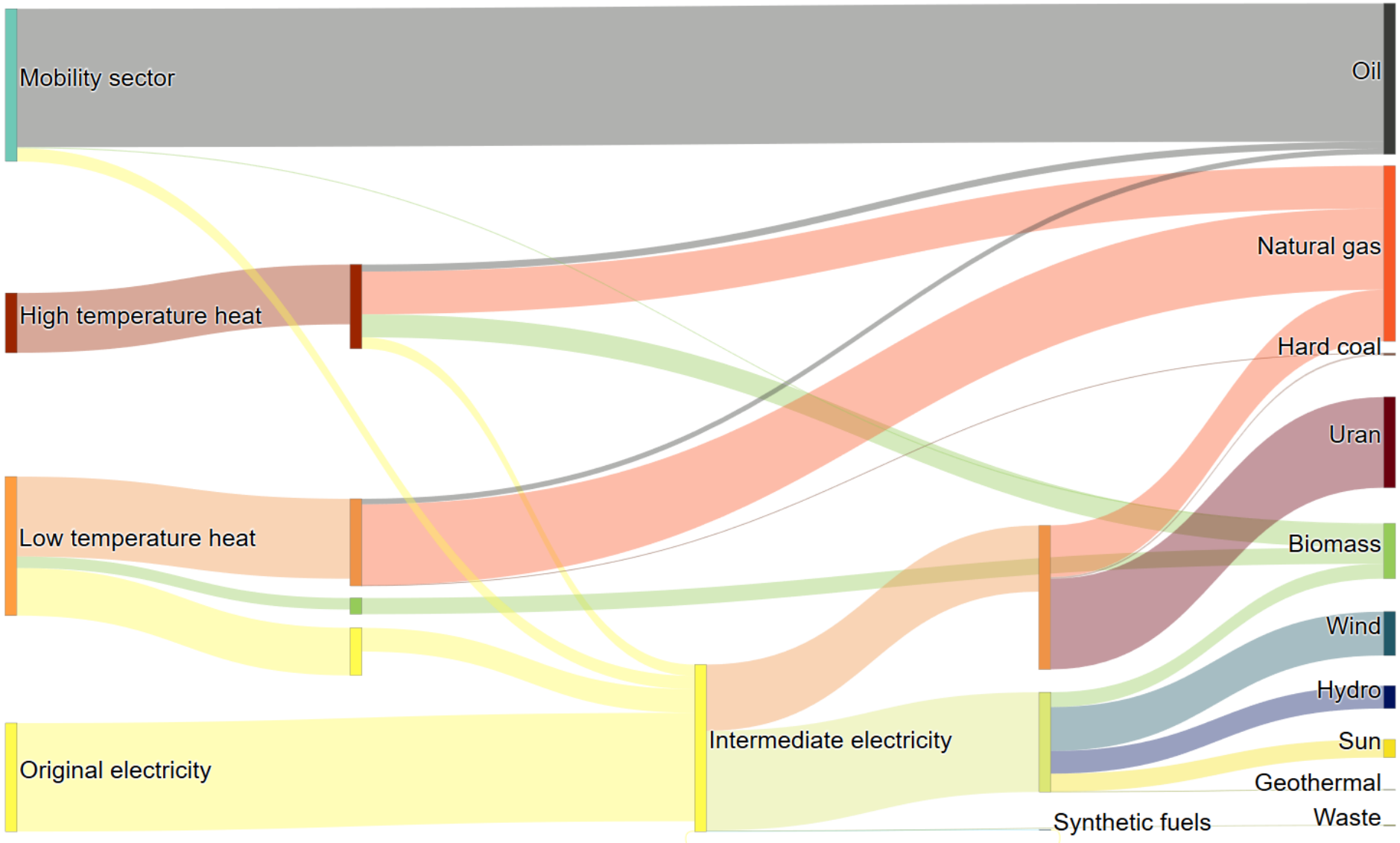
capacities | **generation** | **transmission**

Spatial resolution of applied models

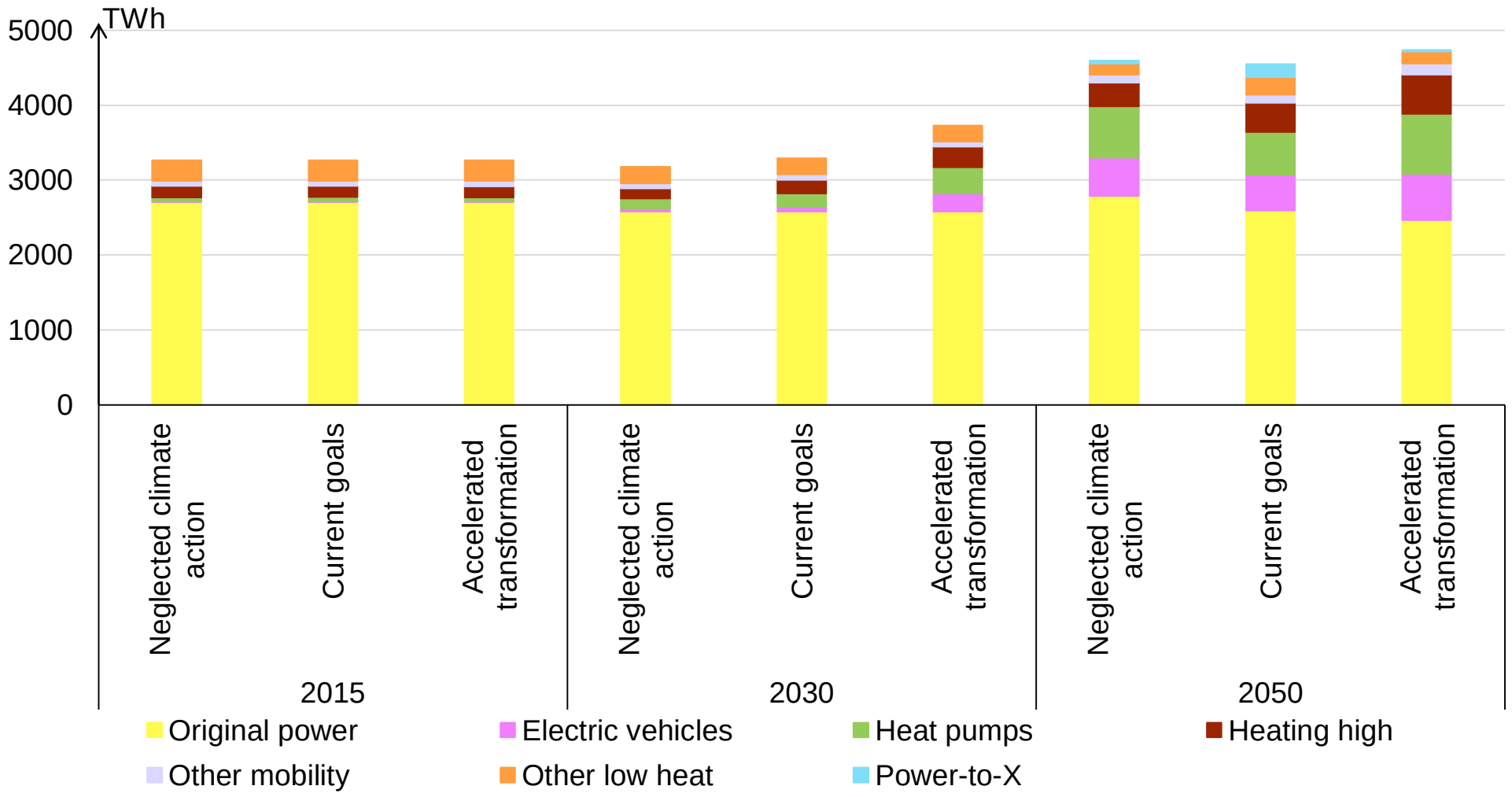


Source: E-Highways (2014)

Energy flow, Europe 2030 Accelerated transformation

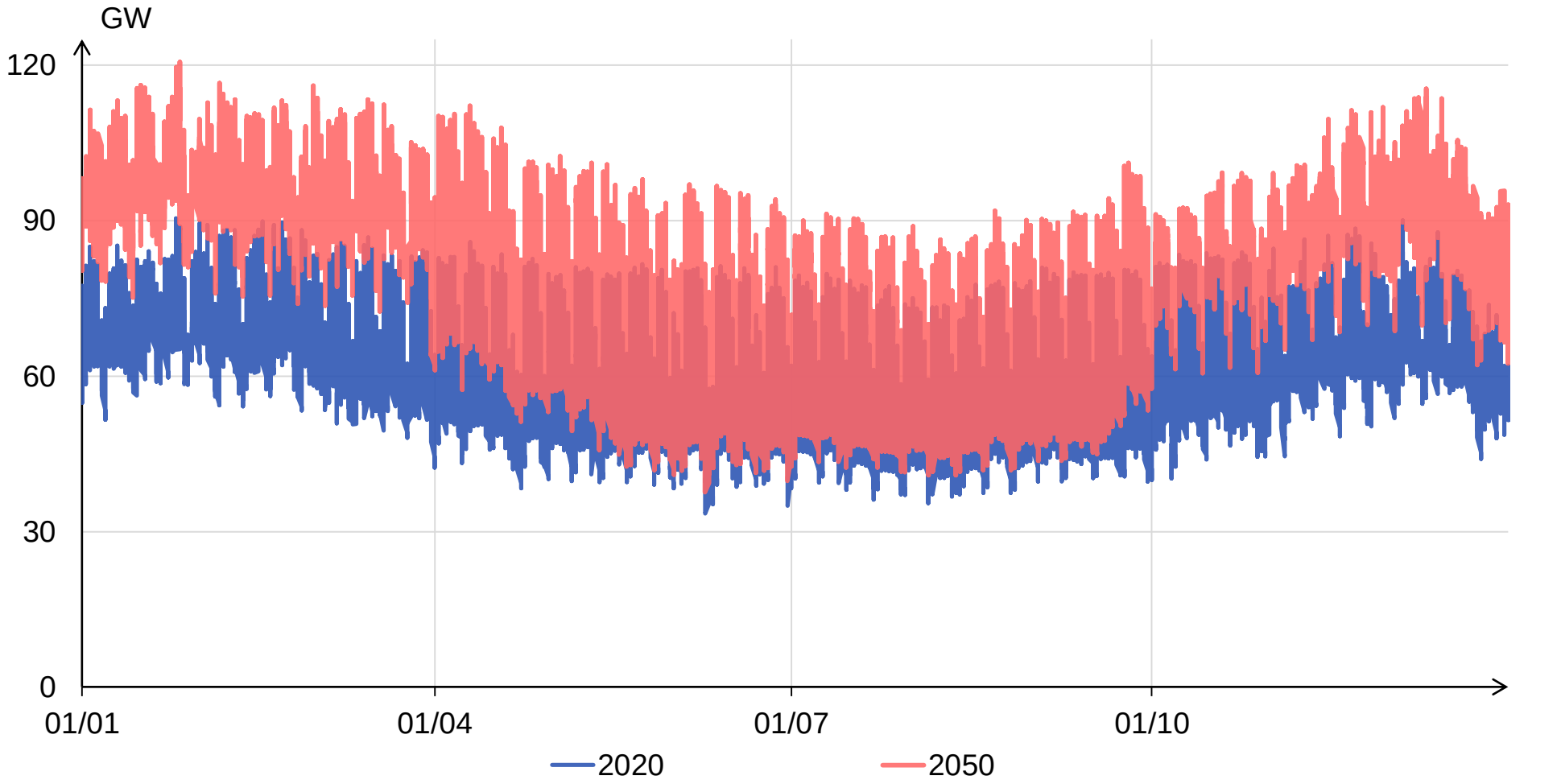


Final electricity demand



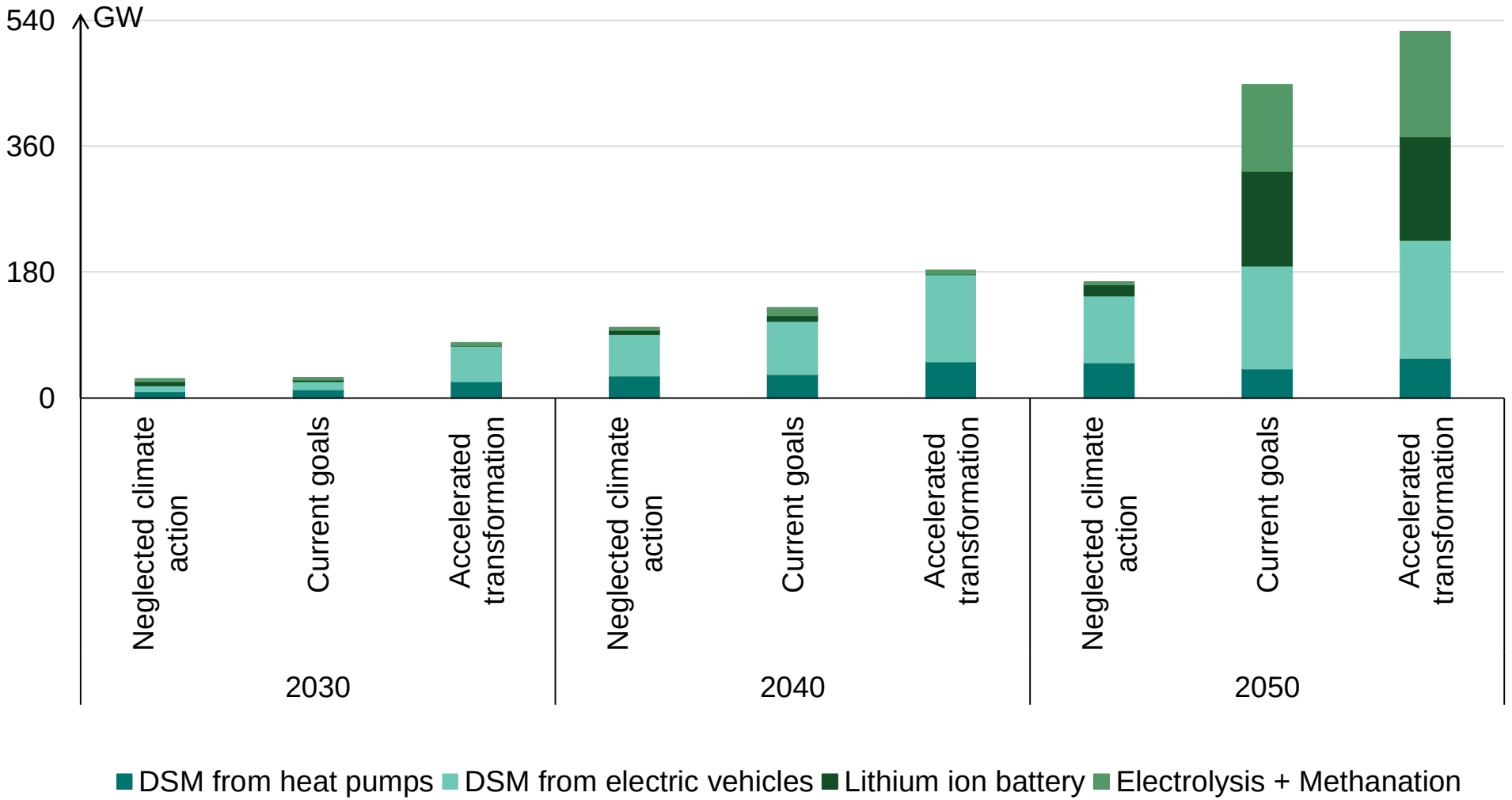
→ rising levels of electrification and gains in efficiency offset each other

Demand profiles for Germany, Accelerated transformation



→ electrification greatly increases the volatility of load

Installed flexibility technologies



Conclusion

Key findings

- Electricity demand from the heat and mobility sector create an additional demand for flexibility, but also provide additional medium-term (and short-term) flexibility

Methodological shortcomings

- Only temporal resolution of power system model is sufficient to model the need for long-term flexibility → limits options to provide this flexibility
- Reduced foresight in the power system model causes sunk investments

Research outlook

- Further integrate modelling of sectors, but maintain sufficient level of temporal detail
- Identify cross-sectoral synergies in the provision of flexibility (e.g. decentralized seasonal heat storage)

→ develop new modelling tools and apply advanced solution methods

Thank You for Your Attention!

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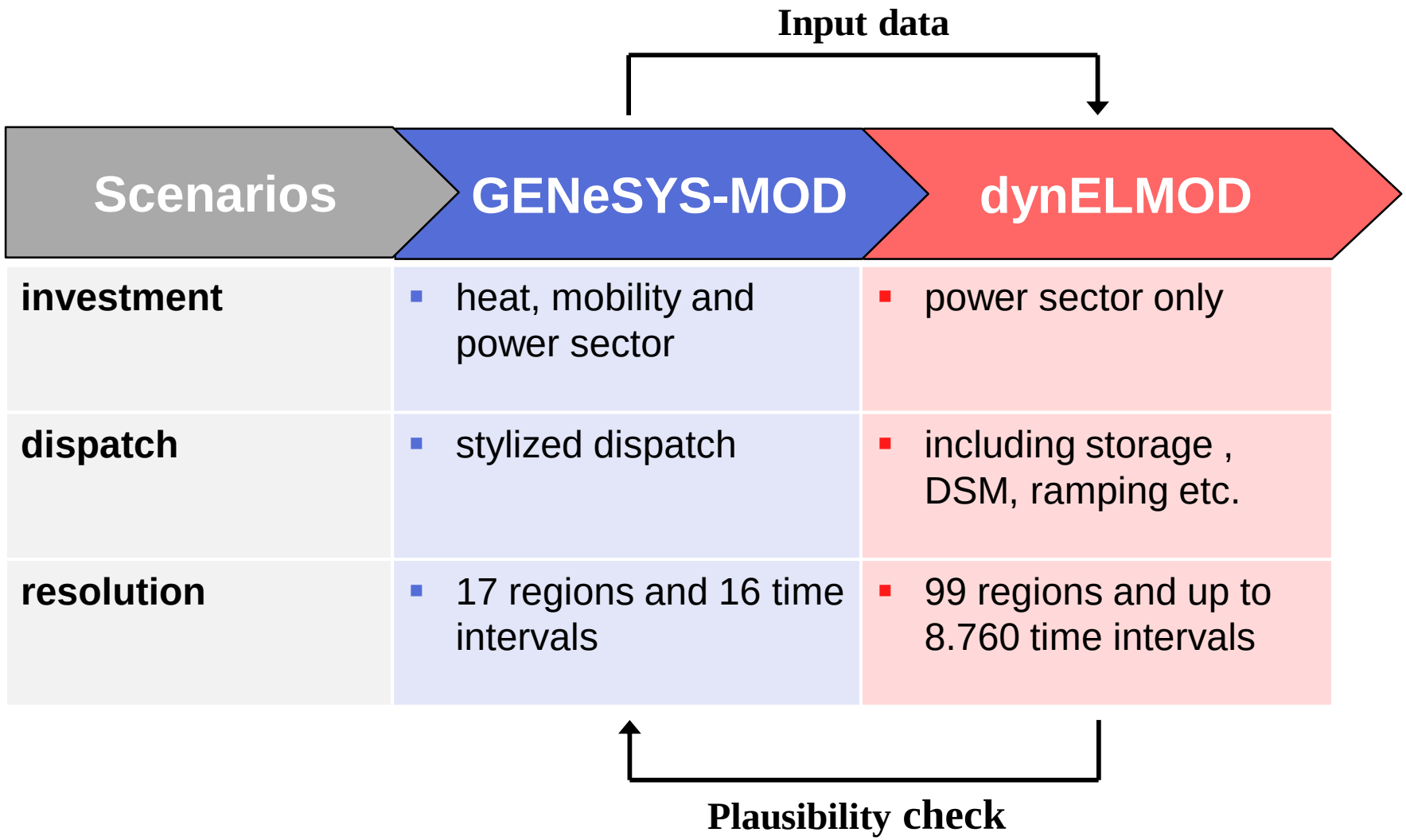
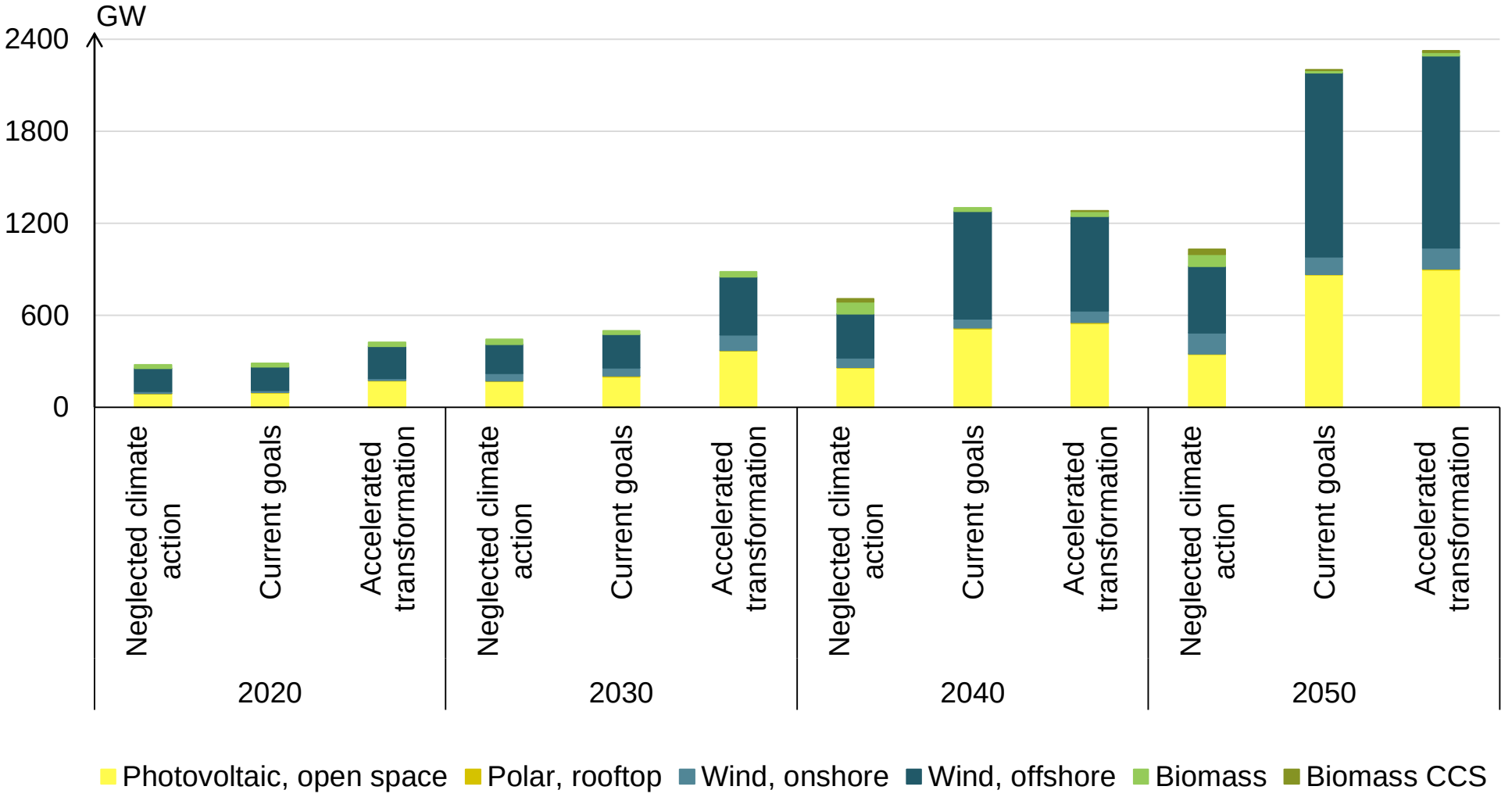
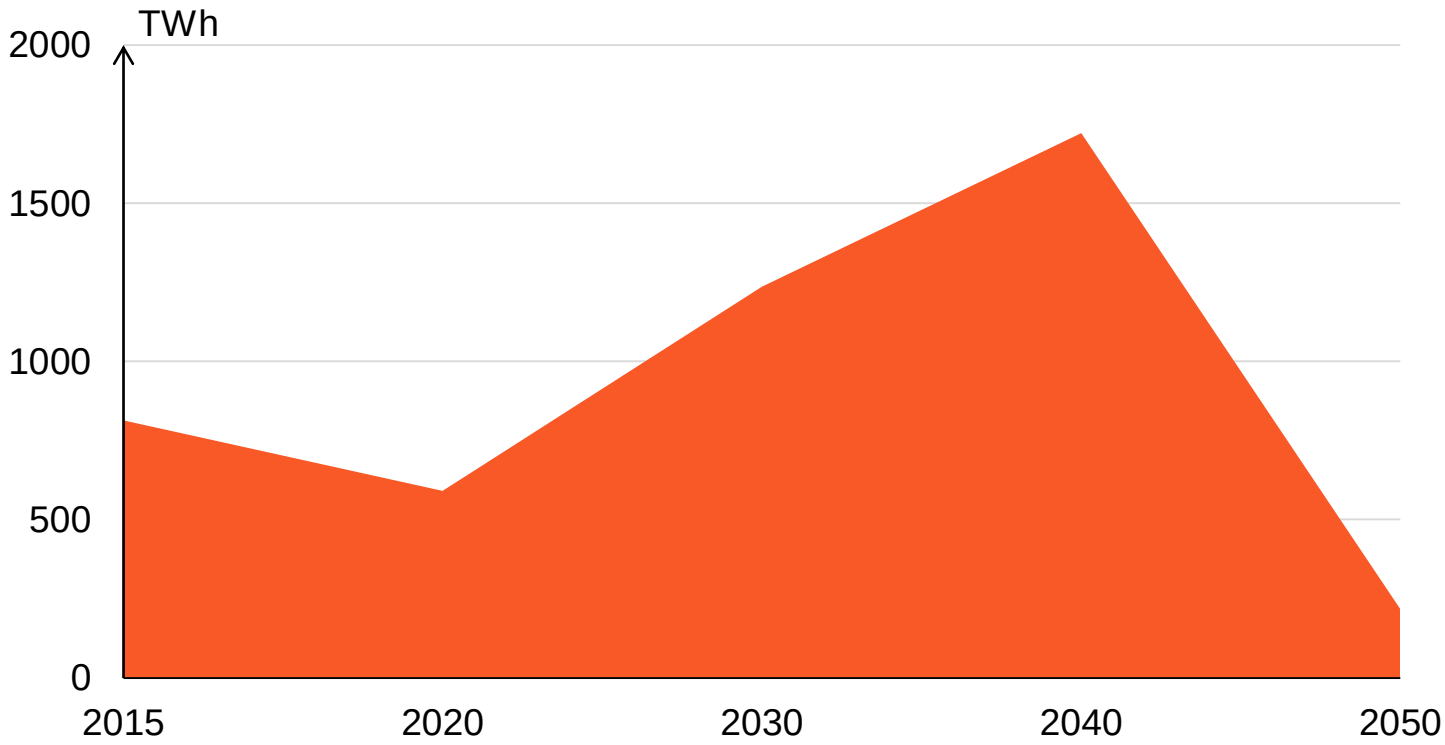
Utilisation of scenarios in the OSMOSE modelling process



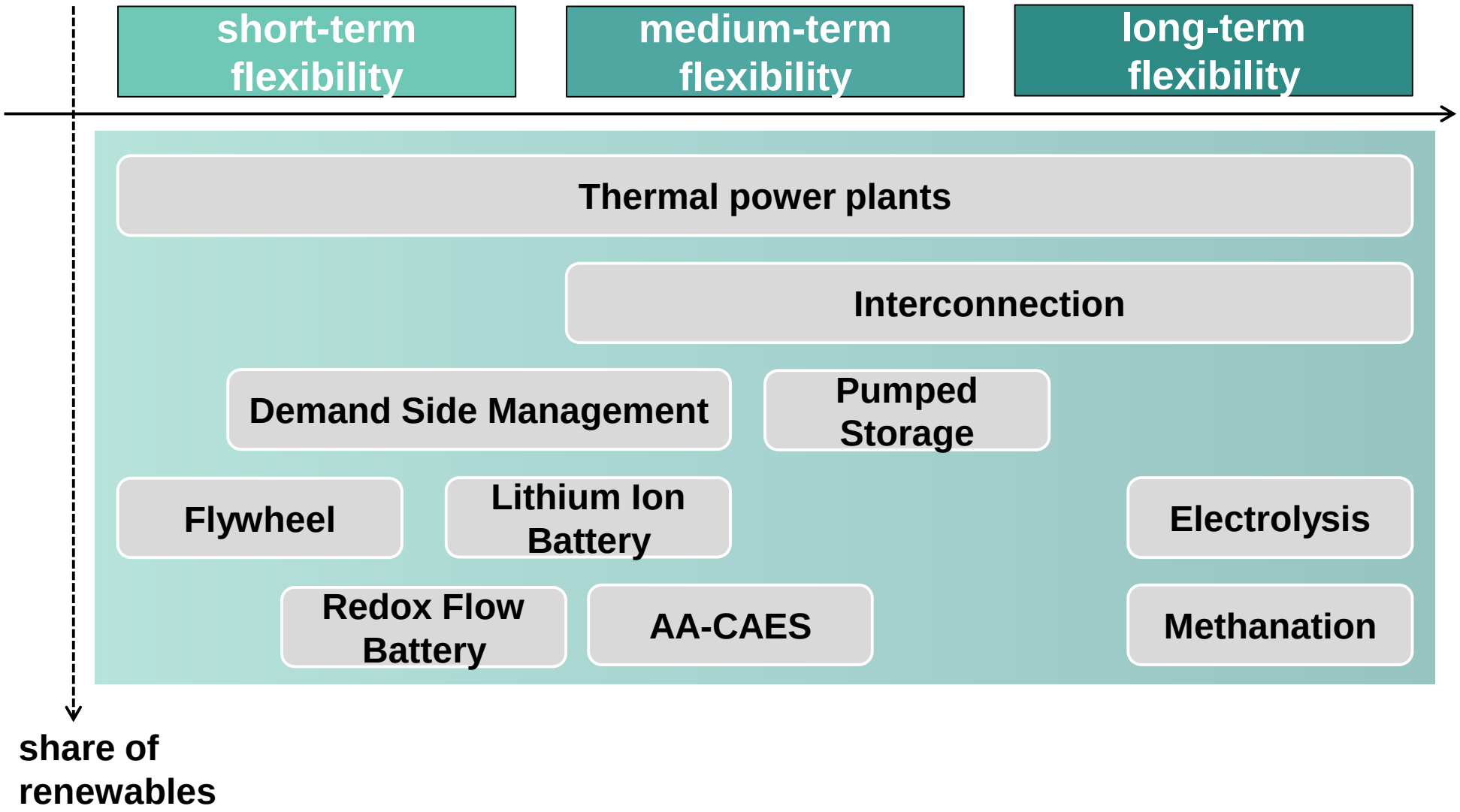
Installed renewable capacities



Gas use in the power sector



Overview of included technolgies



Frage: Angebot und Nachfrage Flexibilität durch Sektorkopplung, Synergien?

Grafiken: Lastprofil DE -> mehr Vola, mehr SL, mehr saisonale Speicherung

Energy flow diagram -> flexxen

Energy flow diagramm