



ENhanced understanding of Trade Impacts
on Climate, industries, and the Environment

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**Climate policy, steel
decarbonisation, and trade
fragmentation: a coupled energy-
macroeconomic analysis for
Europe**

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EU climate policies

Fit-for-55 package



Trade policies

USA tariffs on steel



RQ: How do international trade policies and **geopolitical fragmentation** interact with **climate policies** and energy system transition?

Policy literature

Climate policy assessment



Decarbonisation pathways and economic impacts

Löffler et al. 2019; Victoria et al. 2020; Seck et al. 2022; Bernard & Vielle 2009; Orecchia et al. 2023; Weitzel et al. 2022

Trade and climate policies



Trade measures, competitiveness and decarbonisation

Böhringer et al. 2022; Perdana & Vielle 2022; Clausing & Wolfram 2023; Farrokhi & Lashkaripour 2023

Methodological literature

Modelling challenges

ESMs: technological detail

CGEs: economy-wide feedbacks

Pfenniger et al. 2014; Babatunde et al. 2017; Süsser et al. 2022



Model coupling

Integrating technological detail and macroeconomic feedbacks

Gong et al. 2023; Fattahi et al. 2023; Odenweller et al. 2025

Research gap: Integrated assessment of climate policy and trade fragmentation

PyPSA-Eur

- **European energy system model** with electricity, heating, transport, industry, agriculture¹
- **Open-source**, one node per country, 3h time resolution
- Added **steel endogenous** productions choices²

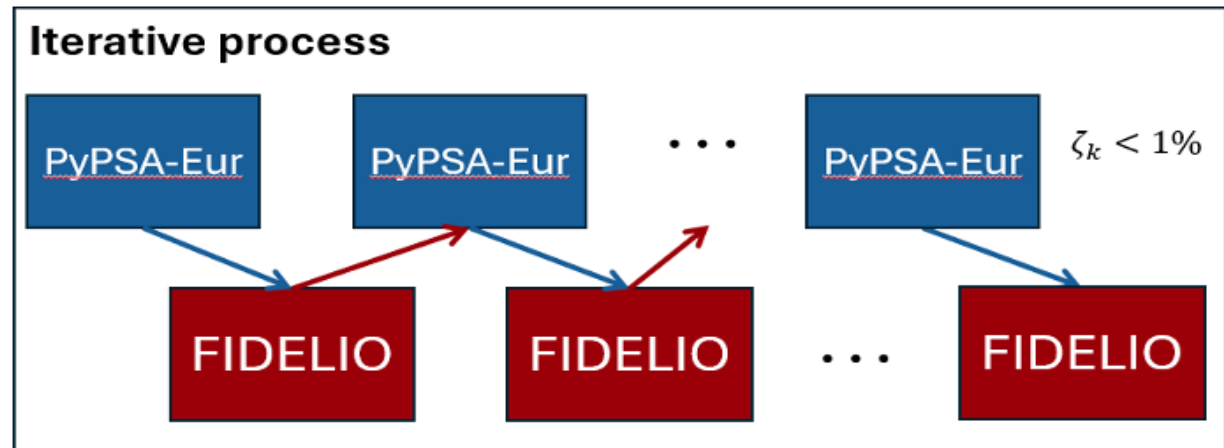
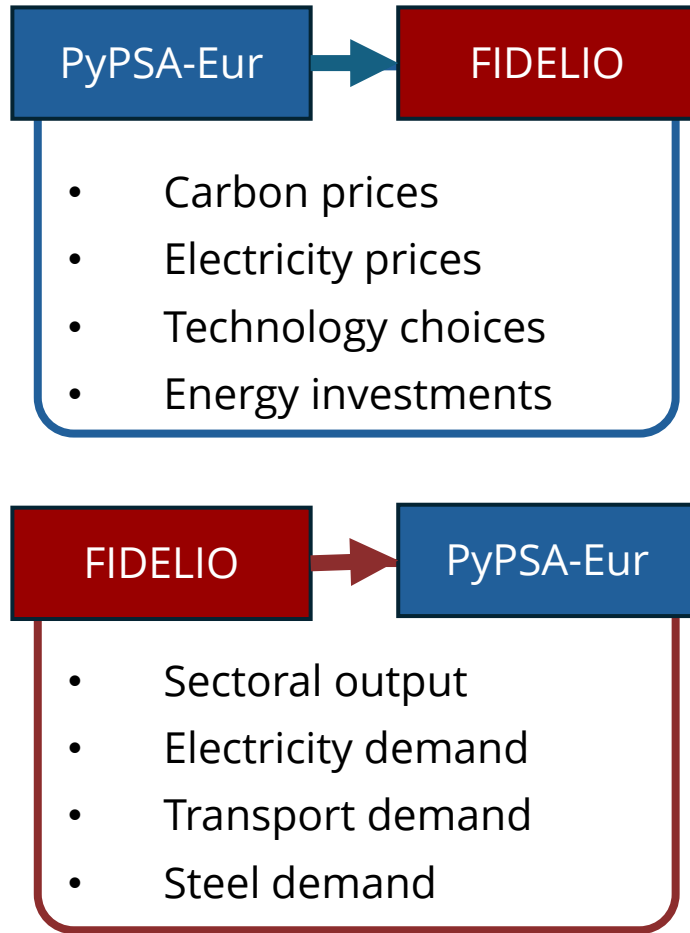
¹ Hörsch et al., [link](#)

² Di Bella et al., [link](#)

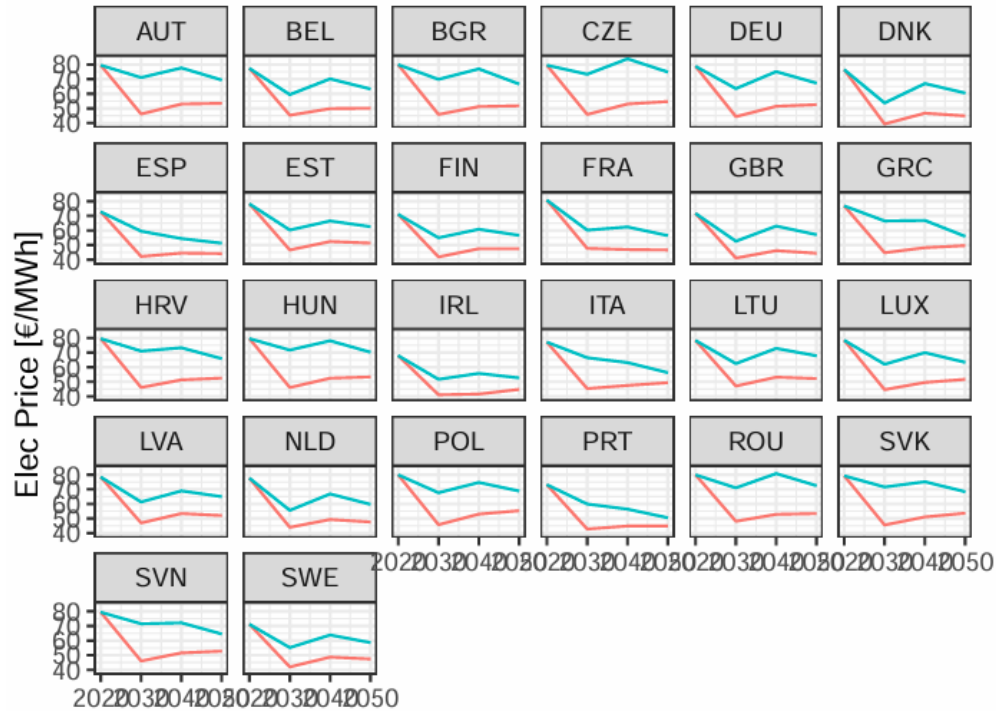
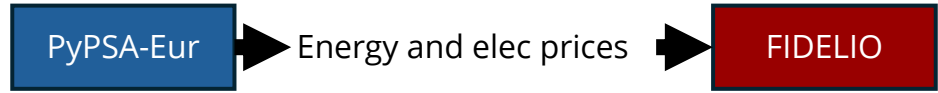
FIDELIO

- New-Keynesian recursive dynamic multi-regional multi-sectorial general equilibrium model³
- Calibrated on **Figaro** and Figaro-e data (2015)
- **46** regions, **64** sectors/ commodities
- Bilateral trade flows (Armington elasticities)

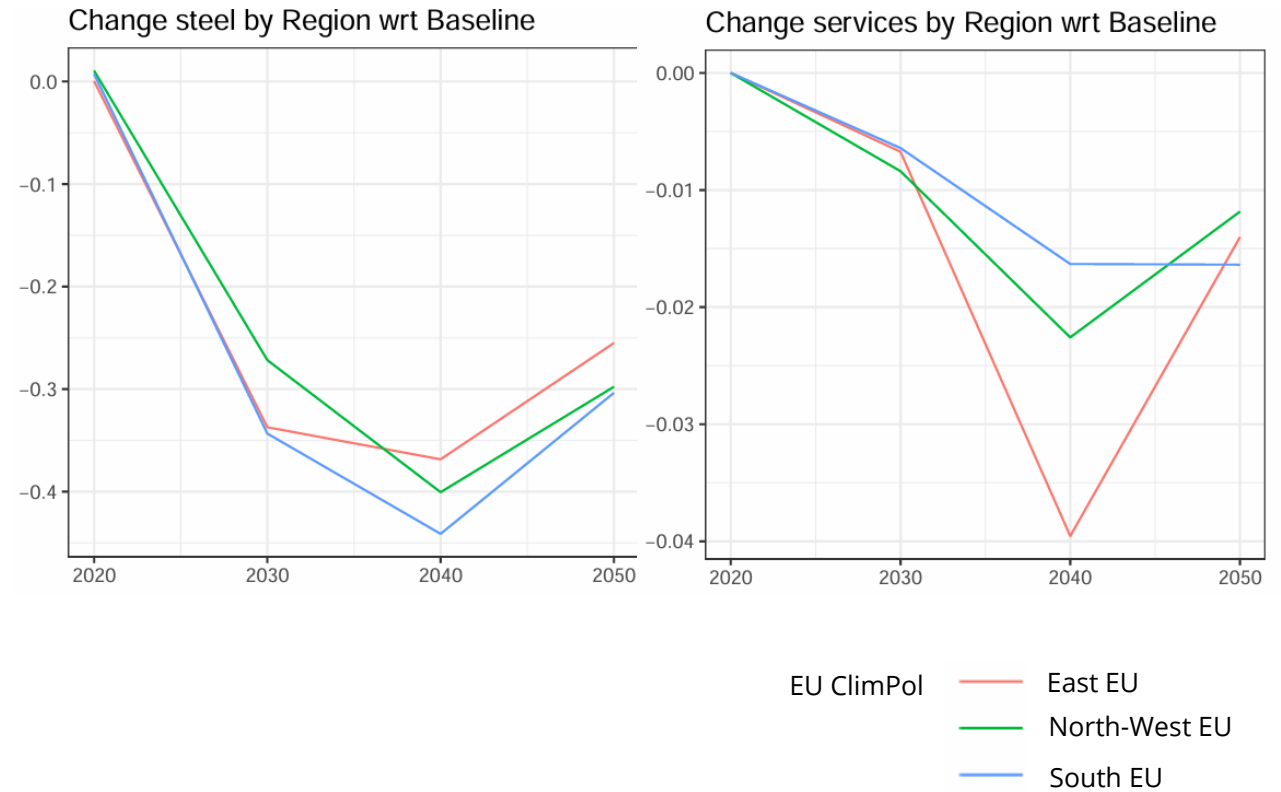
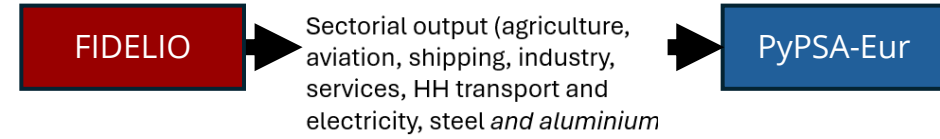
³ Rocchi et al., [link](#)



Convergence through Gauss-Seidel method¹



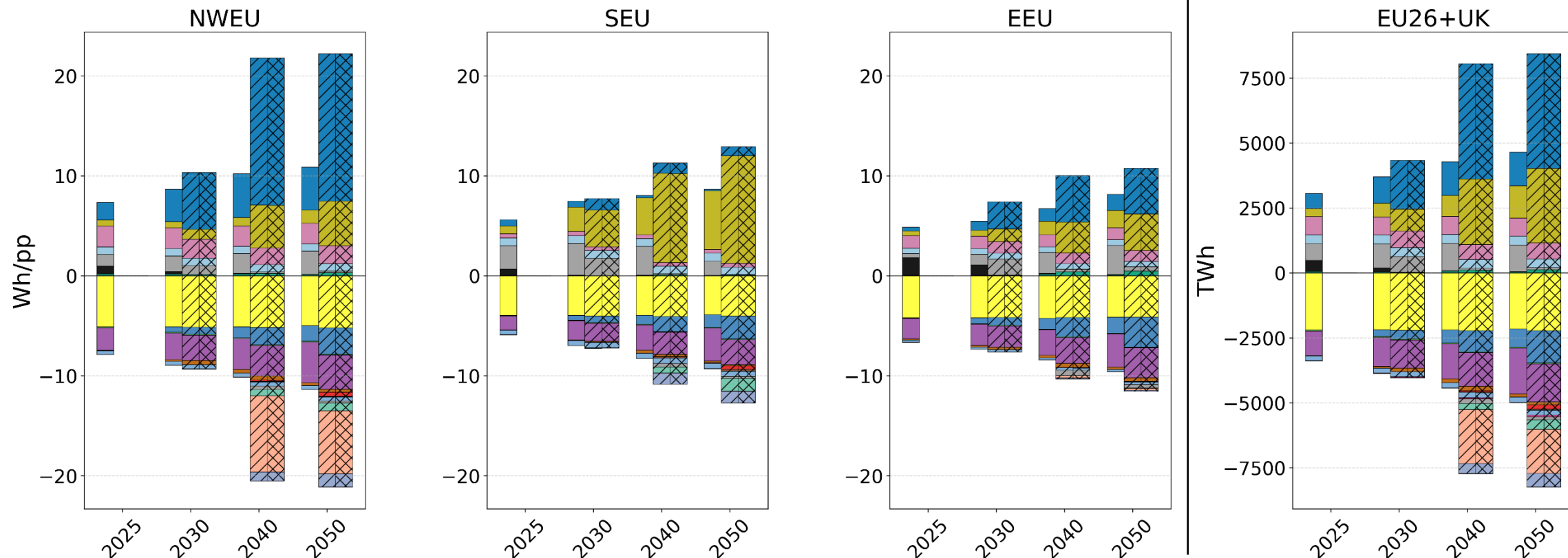
Scenario — Baseline
— EU ClimPol



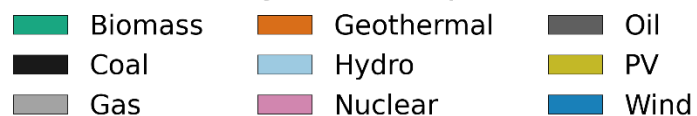
Baseline	No climate policy, no USA tariffs on steel
EU ClimPol	EU Climate Policies*
EU ClimPol + Tariffs	EU Climate Policies* + USA tariffs on steel (+50% for all)

* Main measures	Implementation - Model
ETS revision, free allowance phase-out	Sectoral GHG emission caps generating endogenous carbon prices: PyPSA-Eur
ETS2	Emission caps for buildings and road transport, with ETS2 price ceilin: PyPSA-Eur
CBAM	Carbon-based import tariff linked to EU ETS price and exporter carbon intensity: FIDELIO
EPBD, ETS2	Building energy demand reduction and electrification of heating: PyPSA-Eur
ICE phase-out	Endogenous EV fleet shares consistent with CO ₂ standards: PyPSA-Eur
ReFuelEU Aviation	SAF and e-fuel blending mandates in aviation fuel mix: PyPSA-Eur
FuelEU Maritime	Maritime fuel carbon-intensity constraints and fuel switching: PyPSA-Eur
RED, REPowerEU	Renewable deployment and electricity system optimisation under climate constraints: PyPSA-Eur
Hydrogen and gas package	Hydrogen network expansion and utilisation: PyPSA-Eur
Social Climate Fund	Recycling of ETS revenues to households and vulnerable users: FIDELIO

Results: high electrification by fuel



Electricity sources (positive)



Electricity uses (negative)



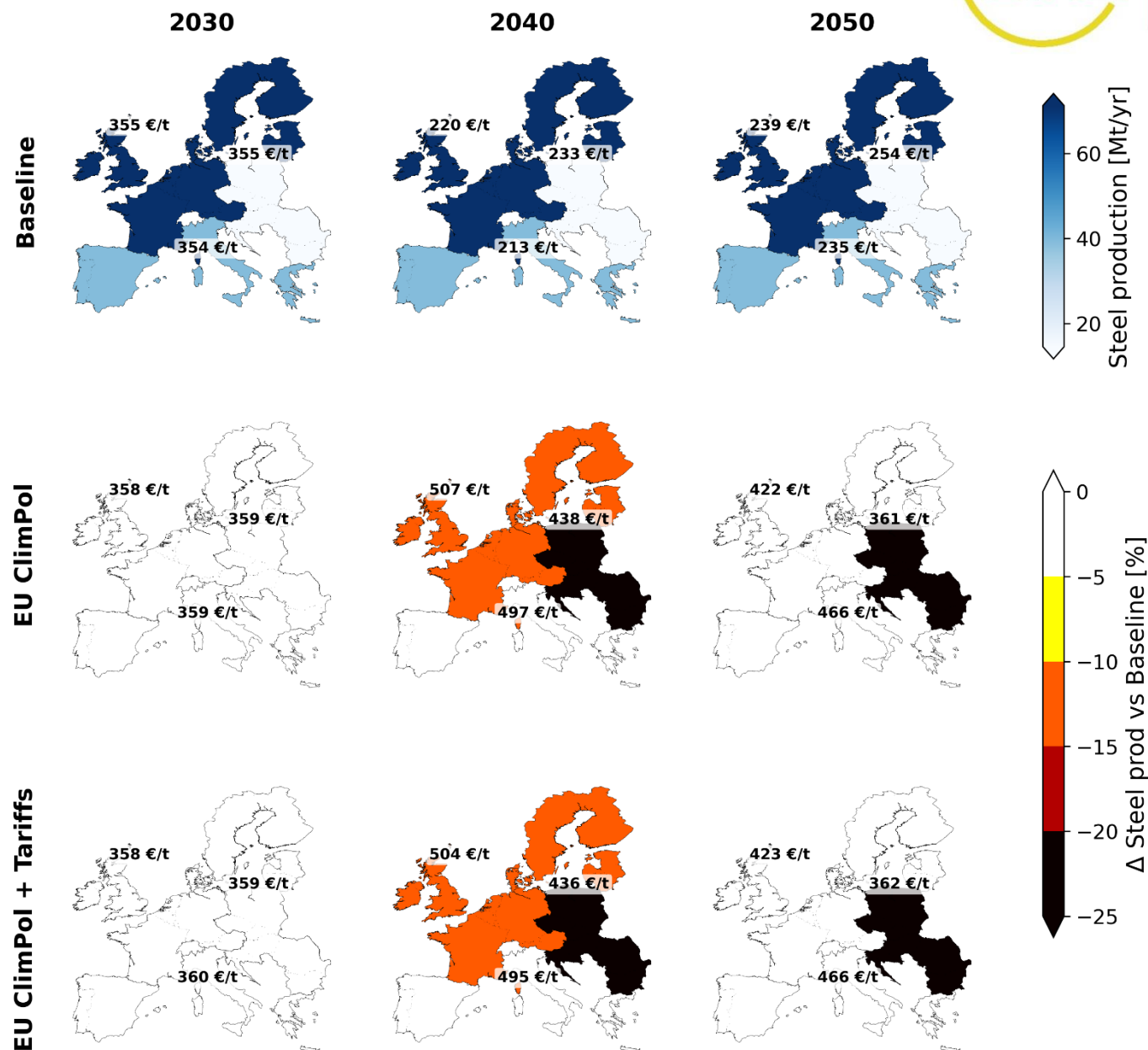
Scenario



Results: Steel production and price changes

Overall steel output reduction	2040	2050
EU ClimPol	-11.7%	-5.0%
EU ClimPol + Tariffs	-10.3%	-3.8%

Production-weighted average steel price for EU25+UK in 2040, EU ClimPol
Uncoupled PyPSA-Eur: 587EUR/t
Coupled PyPSA-Eur: 501EUR/t

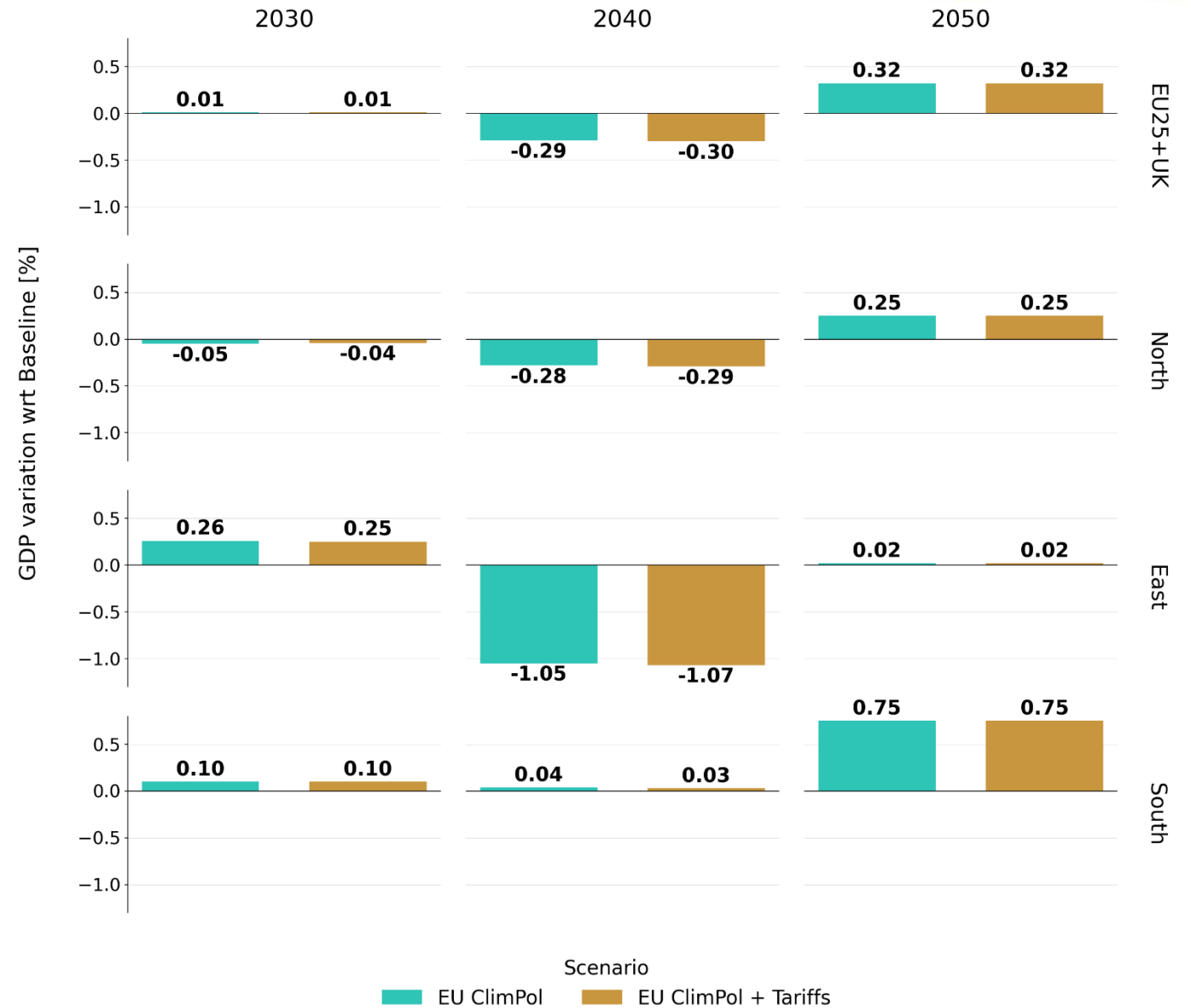


GDP variation

- GDP impacts remain **modest** (<0.5% EU-wide)
- Regional heterogeneity
- The largest effects occur in **2040**, during the **peak transition phase**
- **US steel tariffs** have **negligible** additional effects relative to climate policy alone
 - Steel production represents **1.3% of EU GDP**¹
 - Steel-intensive products exported to the USA account for 11% of total EU production in these sectors²

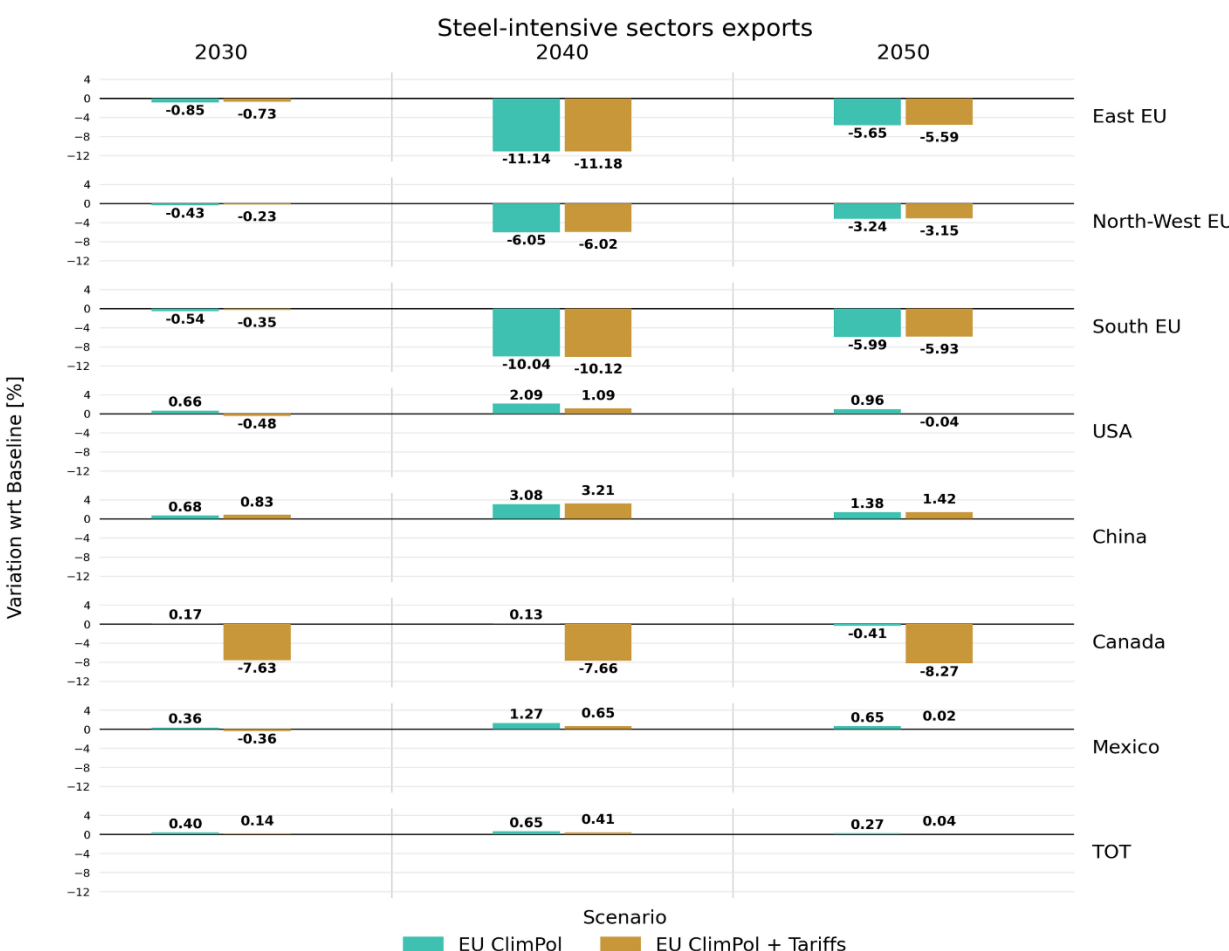
¹European Commission, [link](#)

²FIGARO tables, [link](#)



Trade variation EU export contraction and imports rise for steel-intensive goods, driven by **energy transition** and not by USA steel tariffs.

Steel-intensive sectors include primary steel production, fabricated metal products, machinery and equipment, motor vehicles, and other transport equipment



Methodology

- Strong **price channel**
 - Macroeconomic feedbacks substantially **reduce** projected energy and steel prices
 - Energy-system price signals are the main transmission channel shaping macroeconomic outcomes
- **Demand feedbacks** have **limited** effects on long-term energy-system outcomes
- Coupling mainly affects prices and economic outcomes, with limited effects on long-term technology deployment

Policies

- EU climate policies affect **regions unevenly**, with Eastern Europe experiencing the largest GDP losses
- Domestic **climate policy**, rather than US steel tariffs, is the **dominant force** shaping economic and industrial outcomes
- Steel decarbonisation proceeds through **rapid electrification and adoption of low-carbon production routes**, but at the cost of lower steel output and competitiveness



Thank you! Any question?

For more details or comments:

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