Coupling TIMES-PanEU and NEWAGE:

Energy and macroeconomic impacts of decentralization trends in the European electricity sector

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ETSAP-UCC Workshop:

Methodologies linking energy systems models and economic models

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Outline

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4. Summary and outlook

Decentralisation trends in the European electricity sector

- Increased use of renewable energies for electricity generation
- Renewable energy systems operate at a lower scale than conventional plants
- Large power plant projects face acceptance problems in the society
  - → There is a decentralization trend in the European electricity sector

- What consequences does this trend trigger?
  - Impacts on fossil fuels usage and CO_2-emissions
  - Impacts on electricity prices
  - Macroeconomic impacts of electricity price increases

- Coupling an European energy system model (TIMES-PanEU) with a global CGE model (NEWAGE) makes it possible to assess these issues

TIMES-PanEU

- **30 region model (EU 28, No, CH, IS)**
- **Energy system model**

  SUPPLY: reserves, resources, exploration and conversion Country specific renewable potential and availability (onshore wind, offshore wind, ocean, geothermal, biomass, biogas, hydro)

  Electricity: public electricity plants, CHP plants and heating plants

  Residential and Commercial: End use technologies (space heating, water heating, space cooling and others)

  Industry: Energy intensive industry (Iron and steel, aluminium copper ammonia and chlorine, cement, glass, lime, pulp and paper), food, other industries , autoproducer and boilers

  Transport: Different transport modes (cars, buses, motorcycles, trucks, passenger trains, freight trains), aviation and navigation
- **Country specific differences for characterisation of new conversion and end-use technologies**
- **Electricity Grid, Biofuel and biomass trade**
- **Time horizon 2010 - 2050**
- **GHG: CO_2, CH_4, N_2O, SF_6 /Others pollutants: SO_2, NO_x, CO, NMVOC, $PM_{2.5}$, PM_{10}**

NEWAGE: a global CGE model with hybrid features

Special / hybrid features:

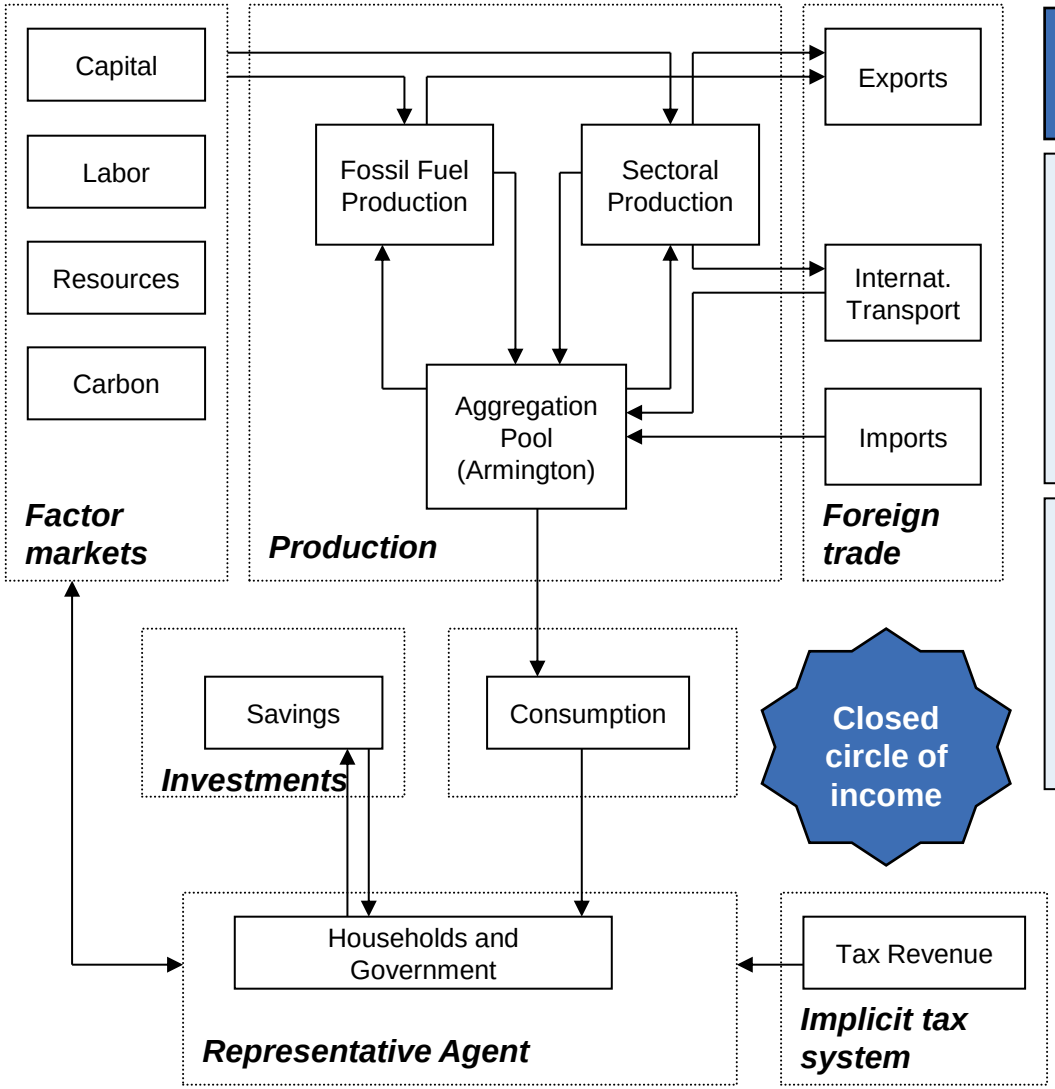
Imperfect Labor Market:
Rigid wages,
wage curve
Differentiation by qualification (skilled, unskilled)

Electricity Generation:
Technology based modeling: portfolio with 18 generation options

Main data sources:
GTAP8, IEA, et al.

Dynamics:
Recursive-dynamic, 2007-2030, 5-year steps

Technological Change:
Autonomous energy efficiency index (AEEI)

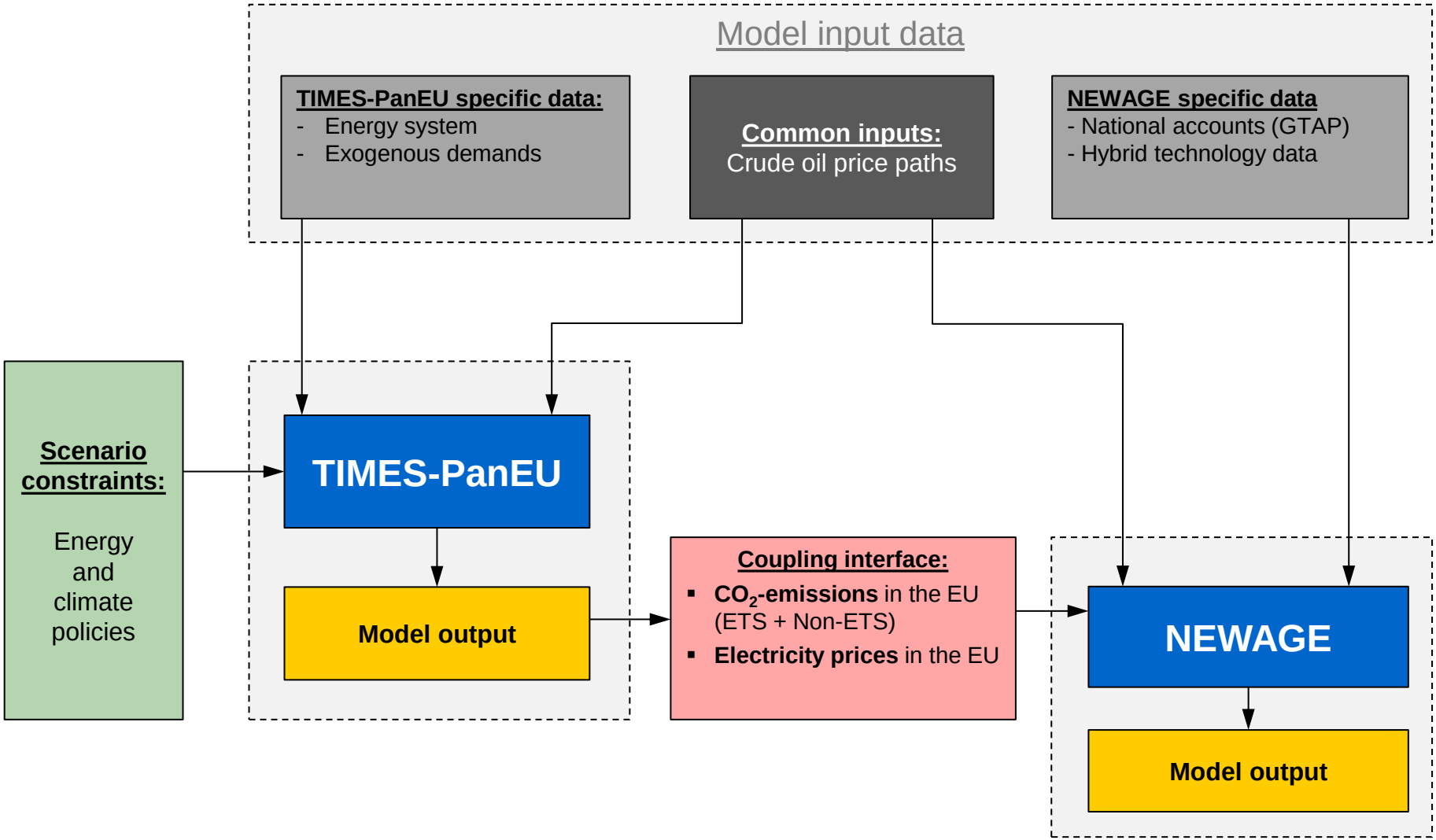


Flexible resolution of regions and sectors (current: 19x27)

19 sectors:
Agriculture
Energy production (5)
Energy intensive ind. (5)
Rest of industry (4)
Construction
Transport
Services

27 regions:
Germany (2)
EU-countries (8)
USA (1)
BRICS (5)
Other OECD (4)
Rest of world (7)

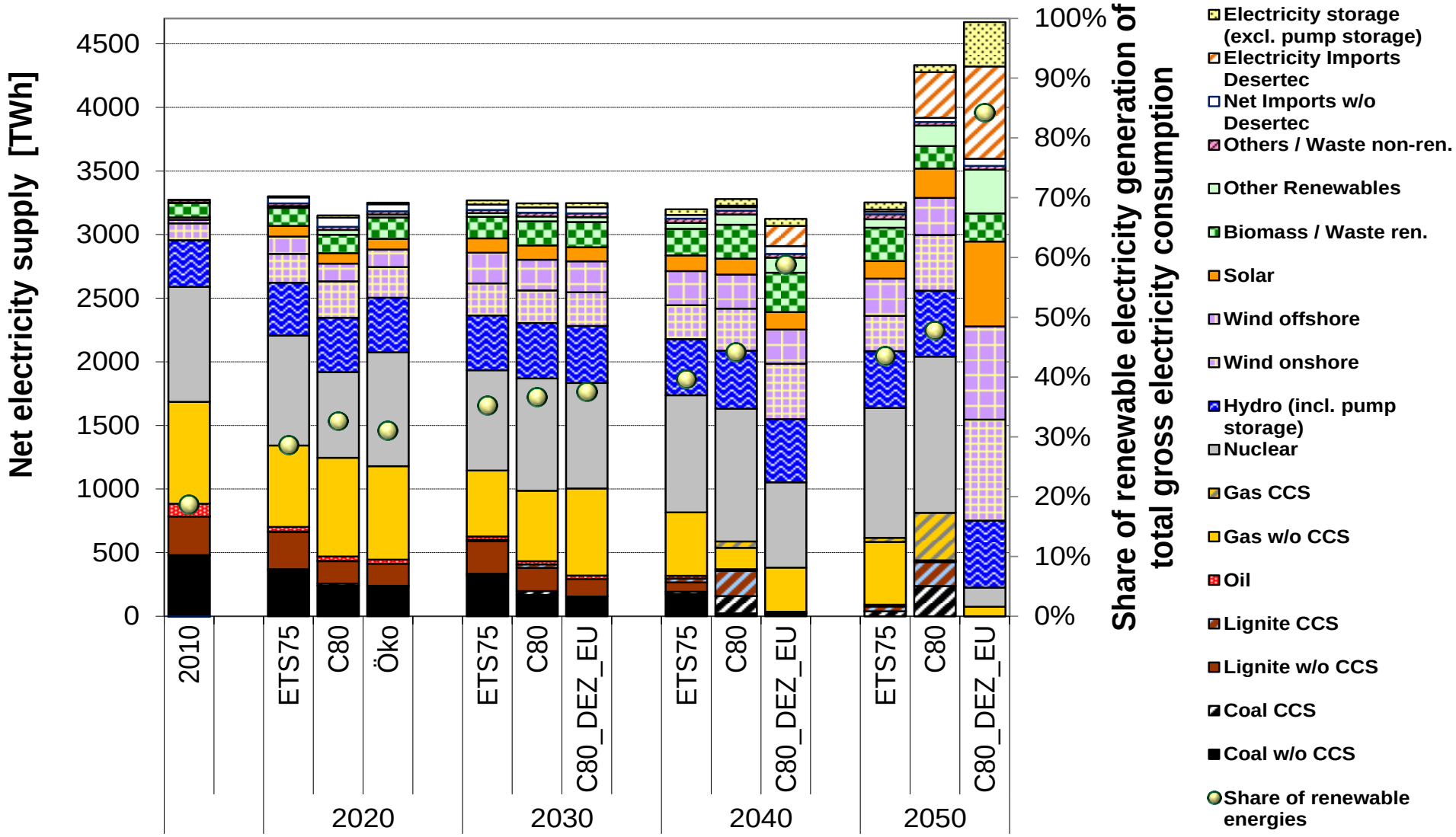
Model interface



Scenario definition

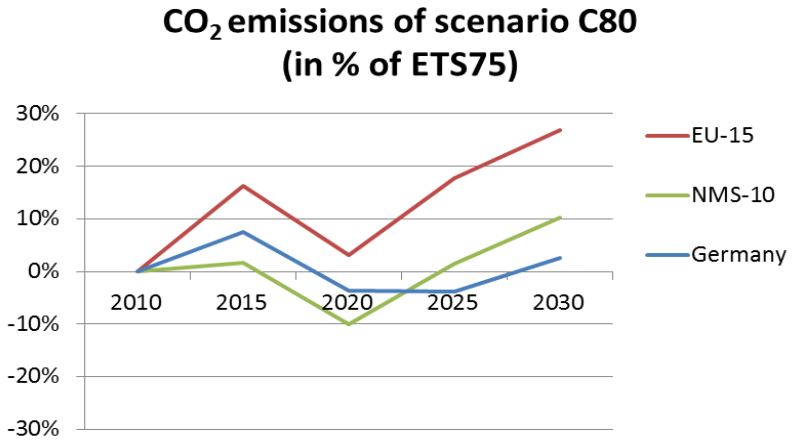
	ETS75	C80	C80_DEZ_EU
GHG reduction targets	▪ ETS: -34% until 2030 (w.r.t. 2005) ▪ ETS: -75% until 2050 (w.r.t. 2005)	▪ -80% until 2050	
Investments in large power plant and CCS	▪ Based on economic decisions		▪ Large power plant restriction in the EU from 2020

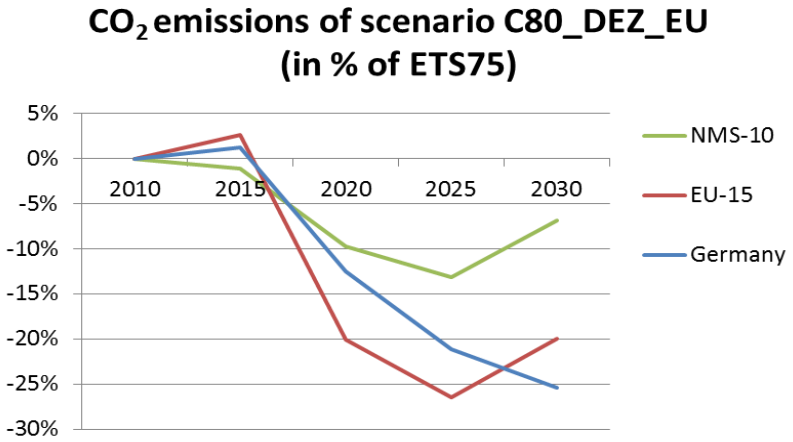
Electricity generation (TIMES-PanEU)

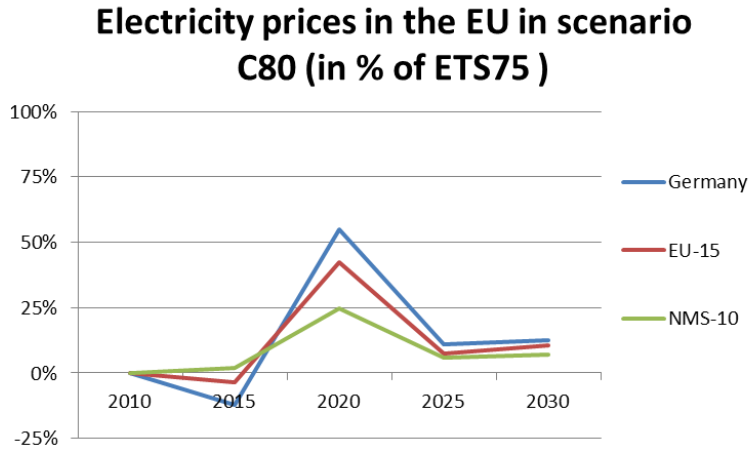


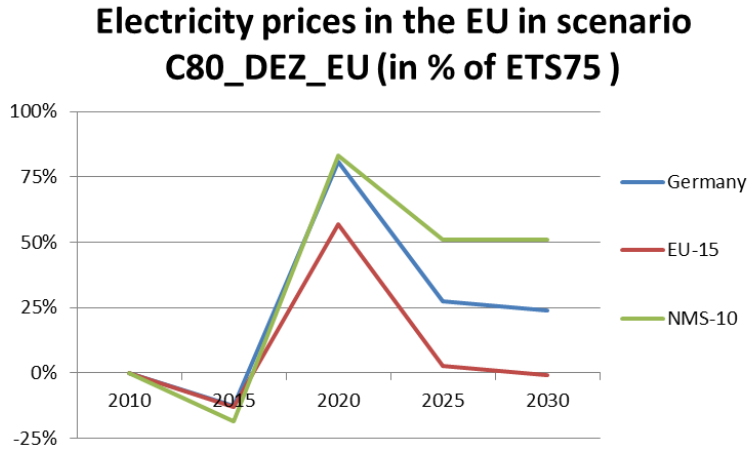
Model interface: results as inputs

- CO_2 emissions and electricity prices of the C80 and C80_DEZ_EU scenarios compared to the reference scenario ETS75

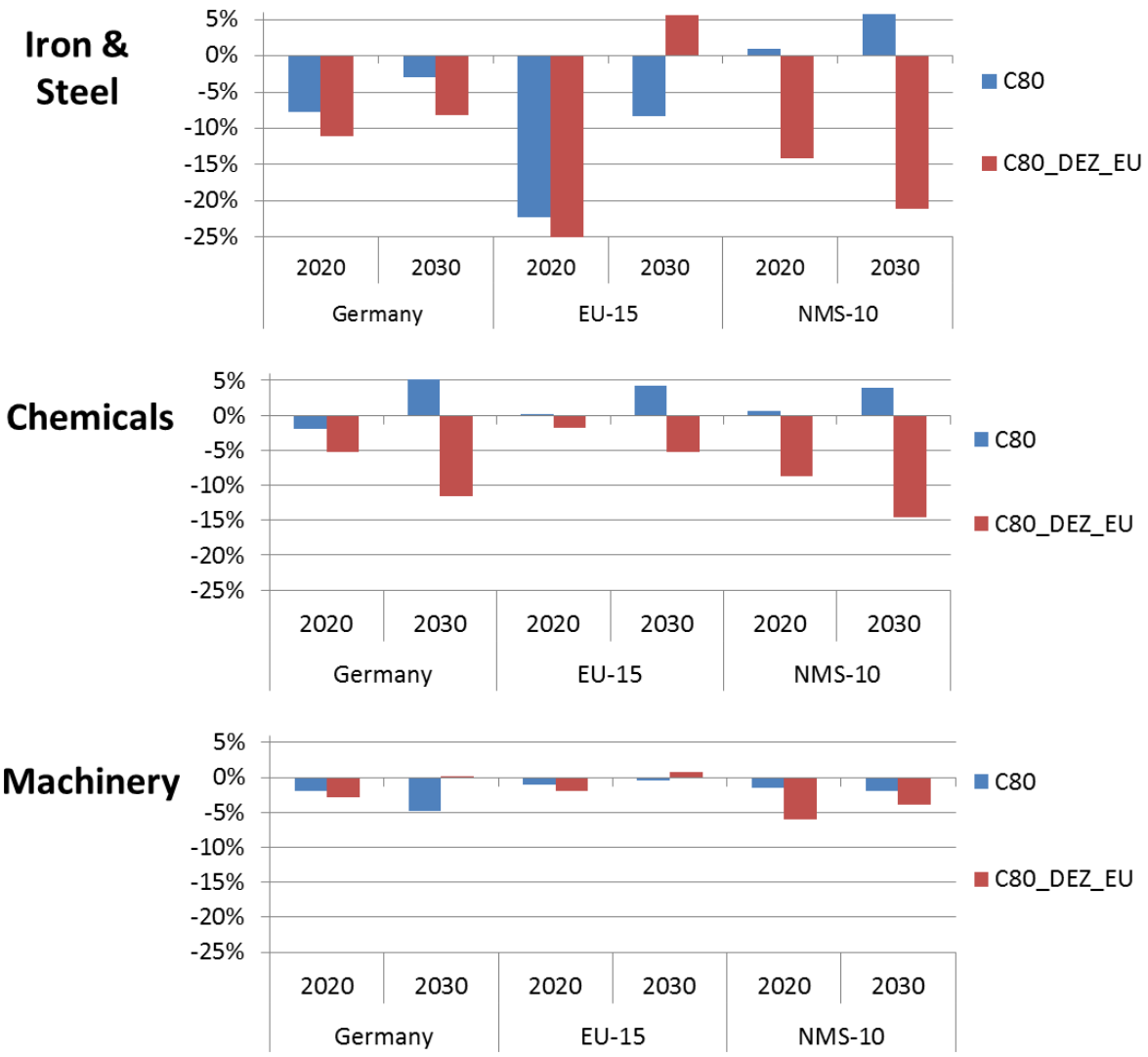




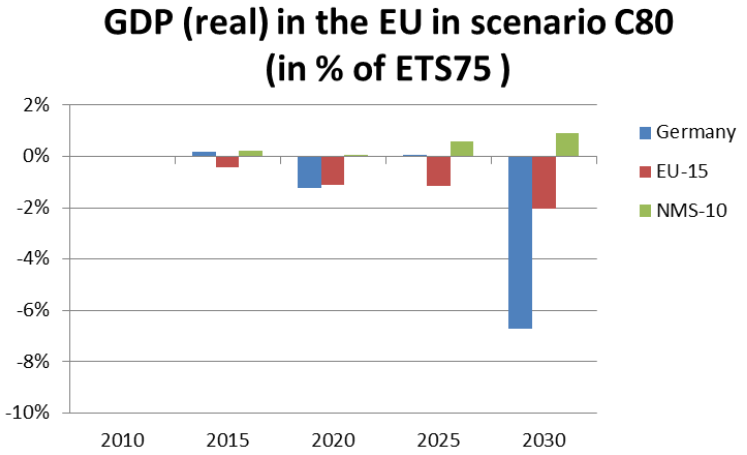


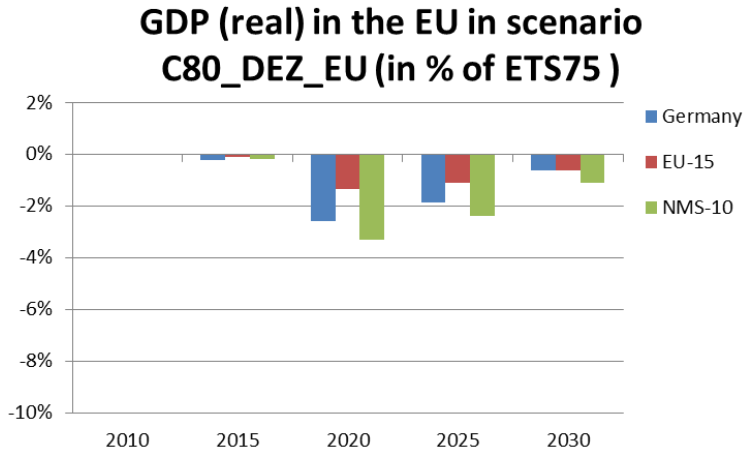


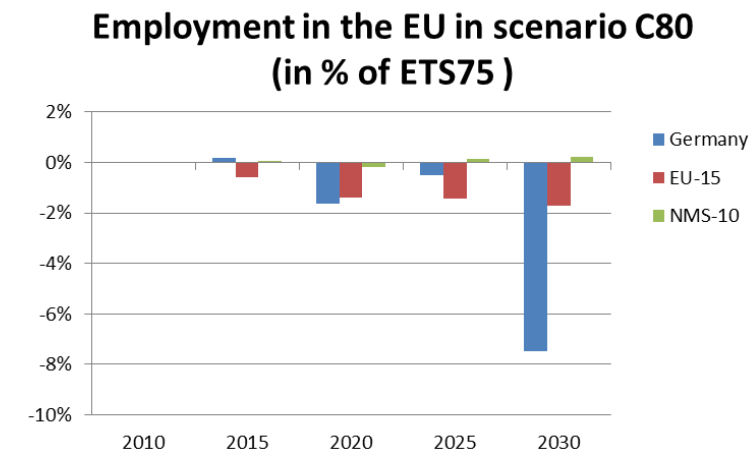
Output activity of different industries (NEWAGE)

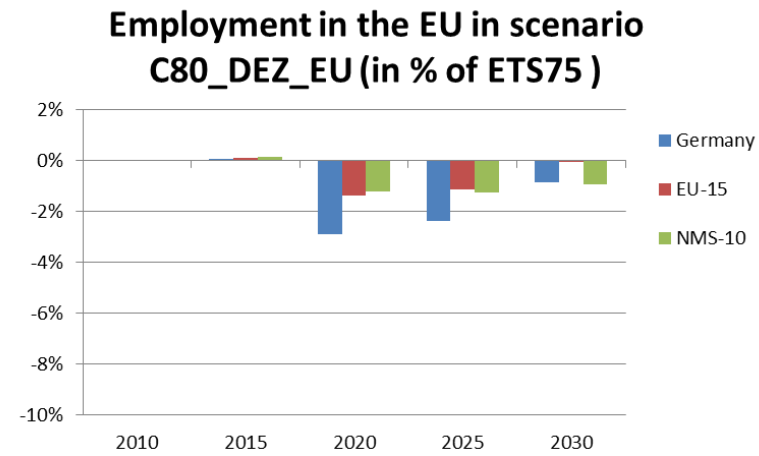


GDP and employment (NEWAGE)









Summary and Outlook

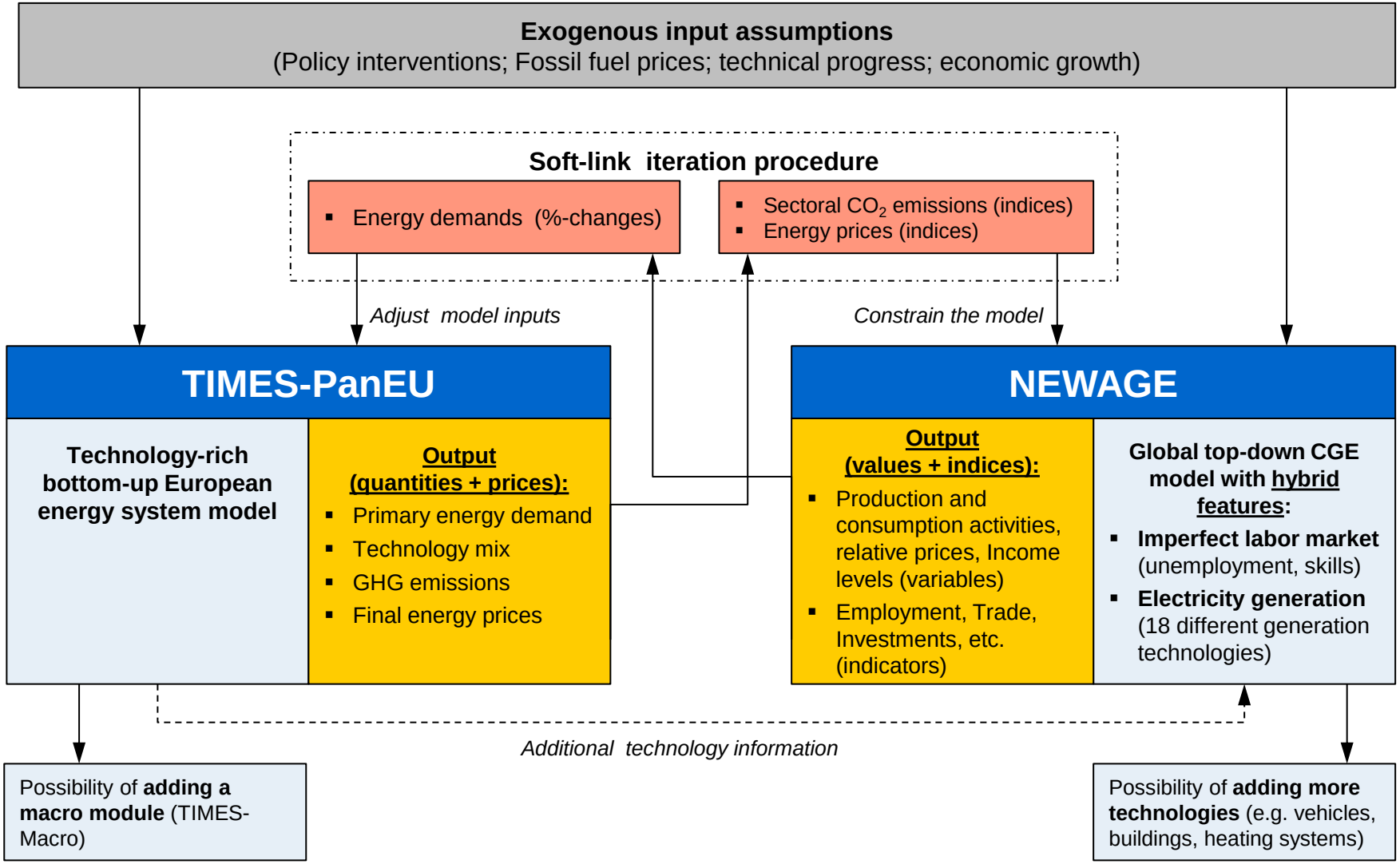
- Decentralisation is connected with an increase in renewable electricity generation and induces higher (net) electricity imports
  - This leads to a decreased use of fossil fuels (incl. CCS) and lower CO_2-emissions
- Decentralisation leads to electricity price increases, especially in Eastern Europe
  - Energy intensive industries reduce their output activity, especially in the iron & steel sector
  - This leads to negative GDP and employment impacts, especially in Eastern Europe with minor changes in the rest of the EU

- Further research with TIMES-PanEU an NEWAGE
  - Further improvement of the interface (iterative procedures)
  - Technologically disaggregated modelling of household energy demand in NEWAGE (implementation of cars & buildings)

Thank you for your attention!

Back up

General coupling of TIMES-PanEU and NEWAGE



CO_2 emissions