ACHIEVABILITY OF THE PARIS AGREEMENTS' TARGETS IN THE EU – IMPLICATIONS FROM A COMBINED BOTTOM-UP MODELLING AND BUDGET APPROACH*

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Introduction

- **Paris agreement:**
  - limit global warming to “well below 2°C” and
  - “pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels”
  - reach net-zero emissions in the second half of the century

- **Global carbon budget** between 2017-2100:
  - 2°C limit: between 940 and 390 GtCO2 (medium estimate **760 GtCO2**)
  - 1.5°C limit: 167 and -48 GtCO2 (medium estimate **59 GtCO2**)

- **Overarching question:**
  - What kind of transformation is necessary to stay within those budgets?

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Different approaches to determine transformation pathways from a modelling perspective

- **Climate Models**
  - lack a sufficient level of detail of the energy and non-energy systems but provide insight on the impacts of emissions

- **Integrated Assessment Models (IAMs)**
  - include a certain level of detail of the energy and non-energy systems while still able to model the impacts of emissions

- **Techno-economic bottom-up models or macroeconomic models**
  - applied to analyze transformation pathways but lack the information to make projections on the associated climate impact

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Approach: Compare decarbonization ambitions of global and national 2°C scenarios

- **Focus on Europe**
- **Global** and **European mitigation scenarios**
- **National mitigation scenarios** with a GHG reduction of 80 – 100 %

- **Looking from a carbon budget perspective:**
  - are the **national mitigation scenarios** in line with CO2-emission projections of the **global** and **European scenarios**?

- **Burden sharing:** do the selected scenarios have the potential to reach a **fair share carbon budget**
  - calculations provided by Gignac and Matthews (2015)
  - budget approach applies contraction & convergence framework for allocation of emission allowances by Meyer (2000)

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Methods: selection of national decarbonisation scenarios

- **Selection criteria**
  - level of ambition compatible with the 2°C target or 80-100% GHG reduction by 2050
  - four european biggest emitters that together cover about 50% of GHG emissions

- **Scenario selection: national mitigation scenarios :**
  - Italy: 83 %, Deep Decarbonisation Pathways Project (SDSN/IDDRI 2015)
  - France: 83 %, Scenario négaWatt, (négaWatt 2014)
  - Germany: 95 %, Climate Protection Scenario KS 95 (BMUB 2015)
  - UK: 100%, Zero-Carbon Britain 2030 (CAT 2013)

  - Country's figures are applied to construct rough estimates for reduction pathways for the EU as a whole

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Methods: Scenario selection from AR5 Scenario Database

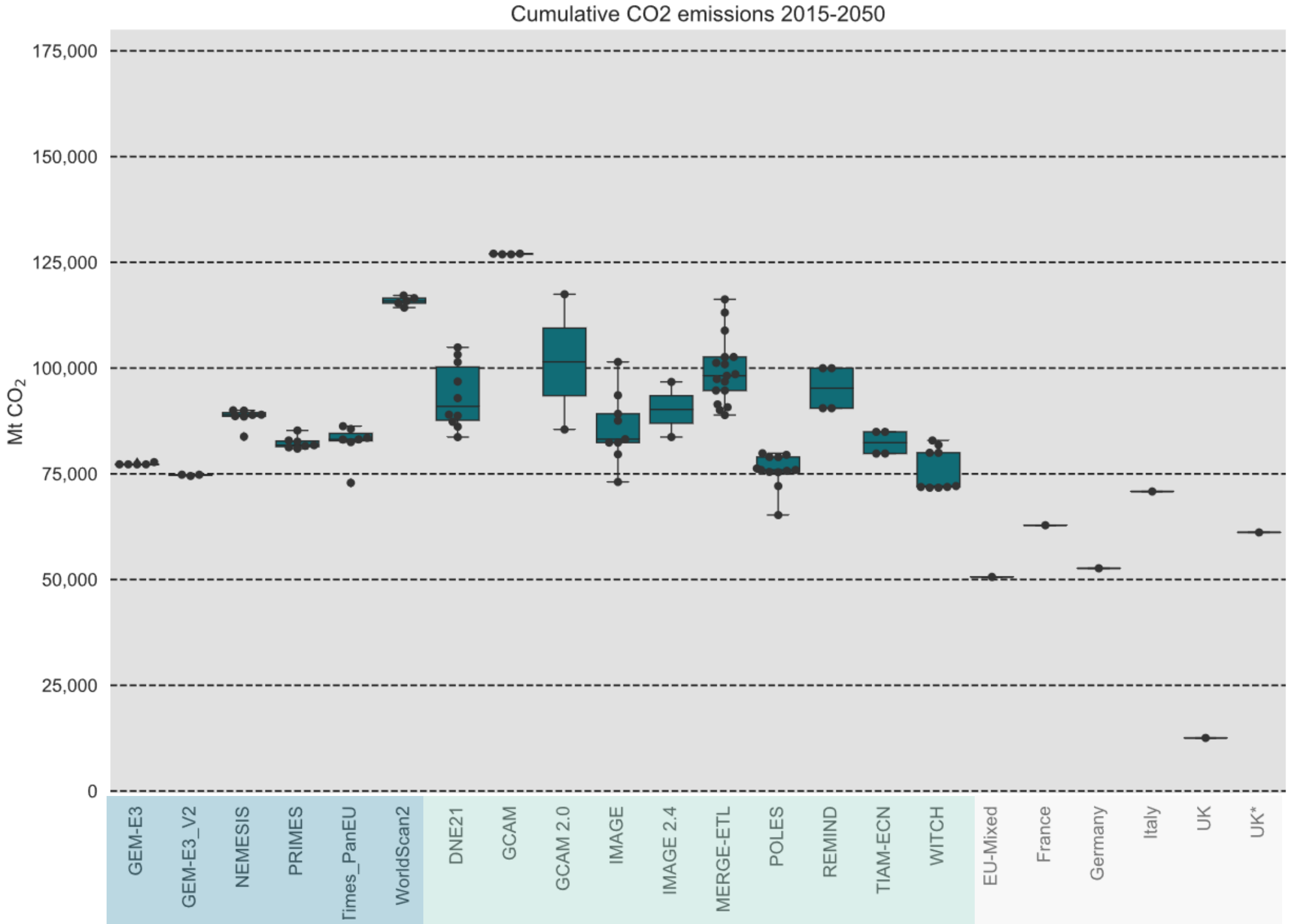
- Selection criteria:
  - likelihood of at least 2/3 to meet the 2°C target or ½ to meet the 1.5°C target

- **Global mitigation scenarios (EU data) (projects AME, AMPERE and LIMITS)**
- **data for CO2-emissions 2005-2100**
  - GCAM
  - GCAM 2.0
  - REMIND
  - MERGE-ETL
  - WITCH
  - IMAGE
  - IMAGE 2.4
  - POLES
  - TIAM-ECN
  - DNE21*

- **European mitigation scenarios (project AMPERE)**
- **data for CO2-emissions 2005-2050**
  - WorldScan2
  - GEM-E3
  - GEM-E3 V2
  - NEMESIS
  - PRIMES
  - Times_PanEU
- **assumption for CO2-emission projections 2015-2100:**
  - linear decrease of CO2-emissions from year 2050 to zero at the year 2070

* data availability for DNE21 until year 2050: same underlying assumption for projections until 2100 as for european mitigation scenarios

Results: comparison of cumulative CO2-emissions from european + global + national 2°C scenarios **2015-2050** for the EU



- For 2015-2050: EU scen. on the lower range of global scen.; less dispersed
- National mitigation scenarios are rather ambitious
- Especially UK - Zero Carbon Britain 2030

UK*: available data from „Zero Carbon Britain 2030“ extended to 2050

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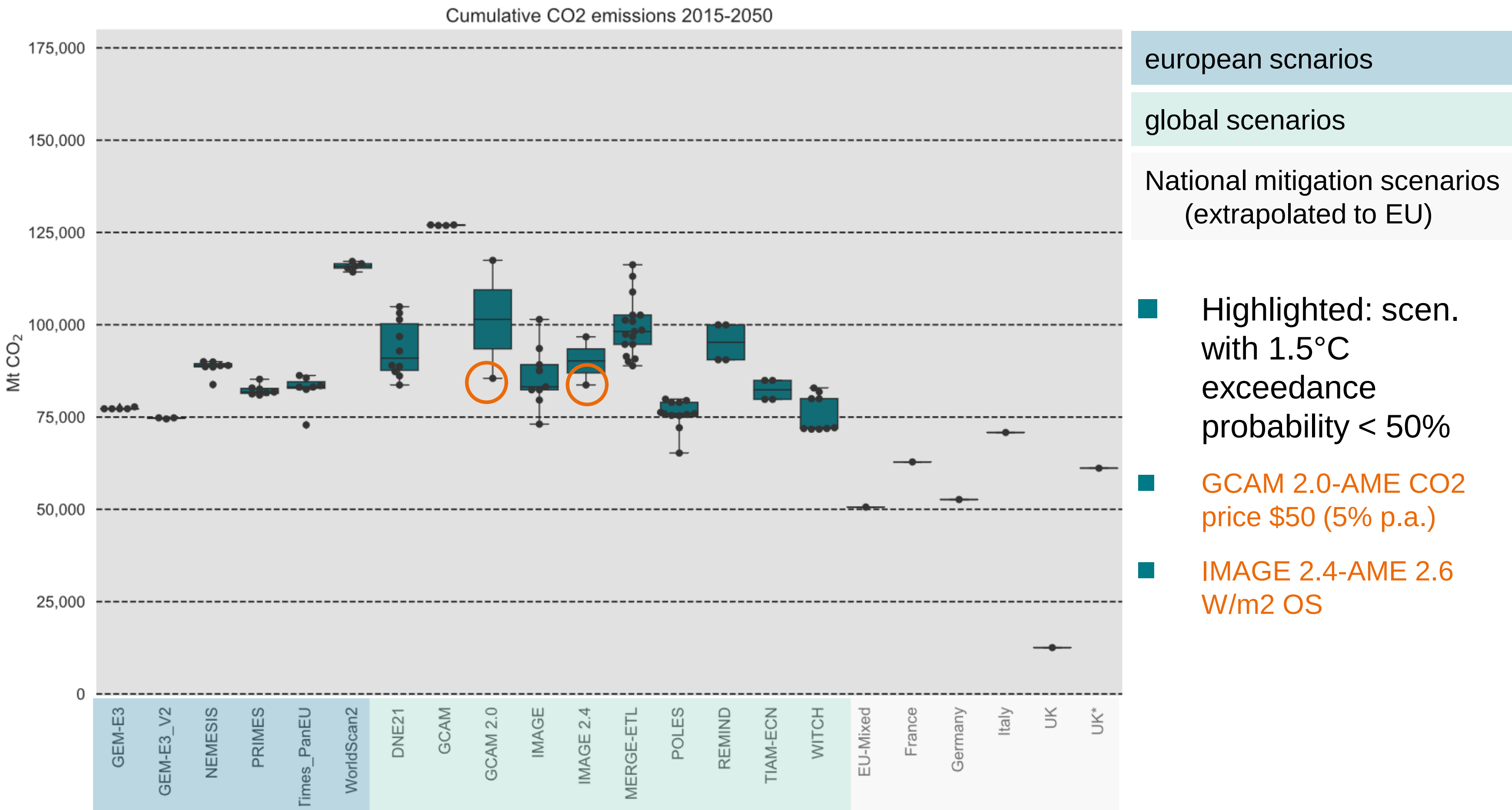

UK*: available data from „Zero Carbon Britain 2030“ extended to 2050

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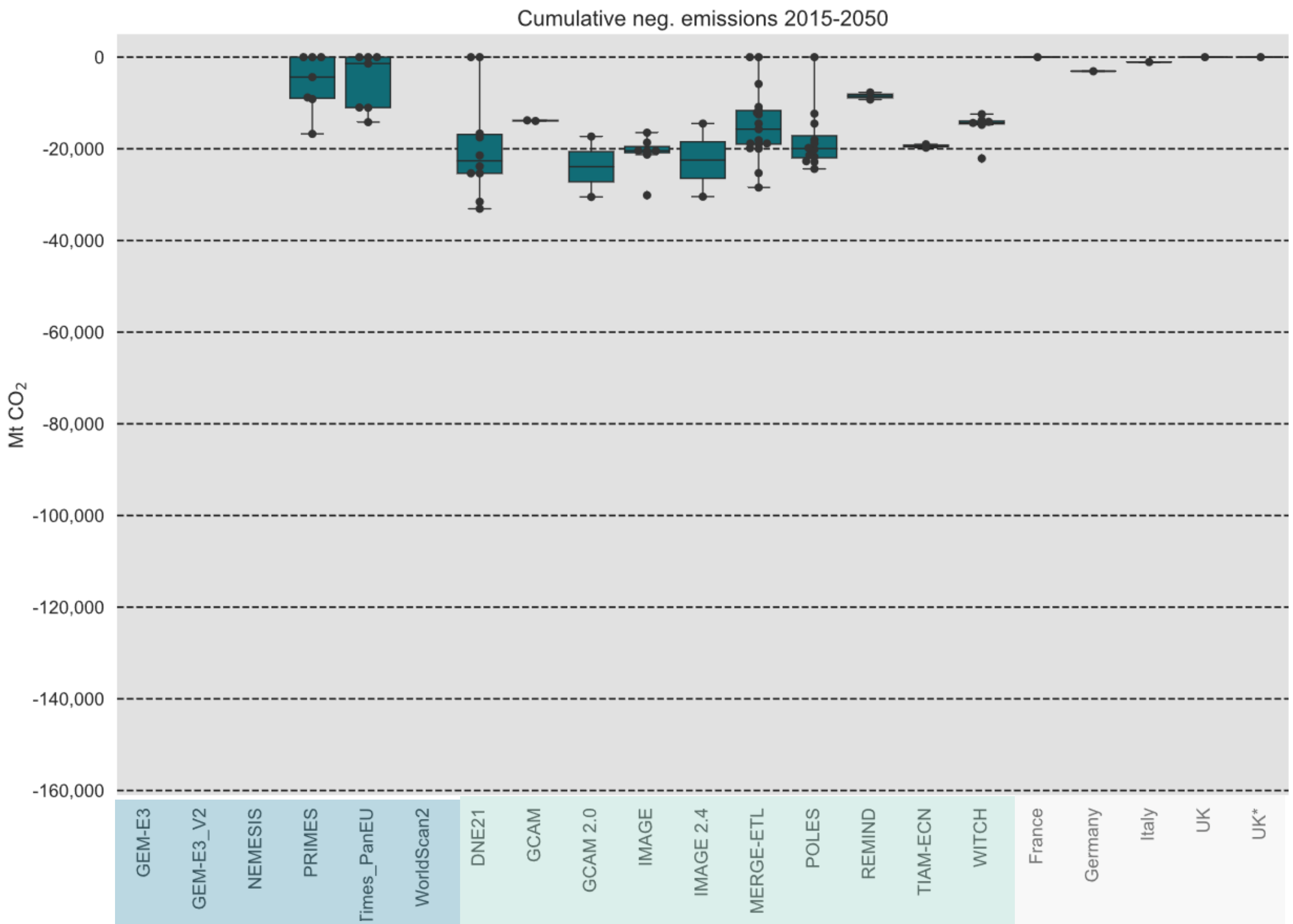
Results: comparison of cumulative **neg. CO2-emissions** from **CCS/BECCS** of european + global + national 2°C scenarios **2015-2050** for the EU



european scnarios

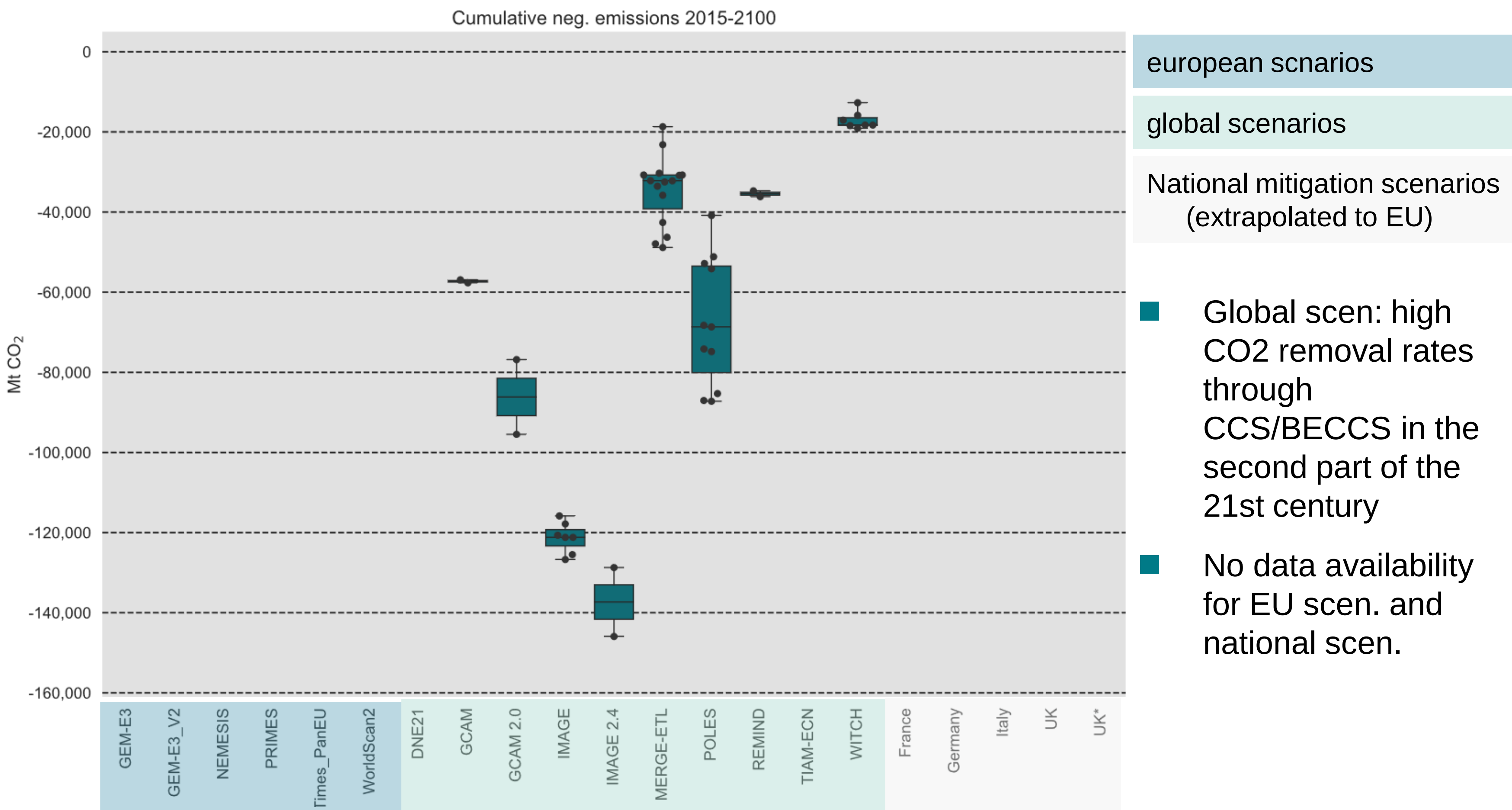
global scenarios

National mitigation scenarios (extrapolated to EU)

- EU scen: 2 models include CCS/BECCS
- Global scen: high level of CCS/BECCS included
- National scen: no or restricted use uf CCS/BECCS

UK*: available data from „Zero Carbon Britain 2030“ extended to 2050

Results: comparison of cumulative **neg. CO2-emissions** from **CCS/BECCS** of global (+european + national 2°C scenarios) **2015-2100** for the EU



- Global scen: high CO2 removal rates through CCS/BECCS in the second part of the 21st century
- No data availability for EU scen. and national scen.

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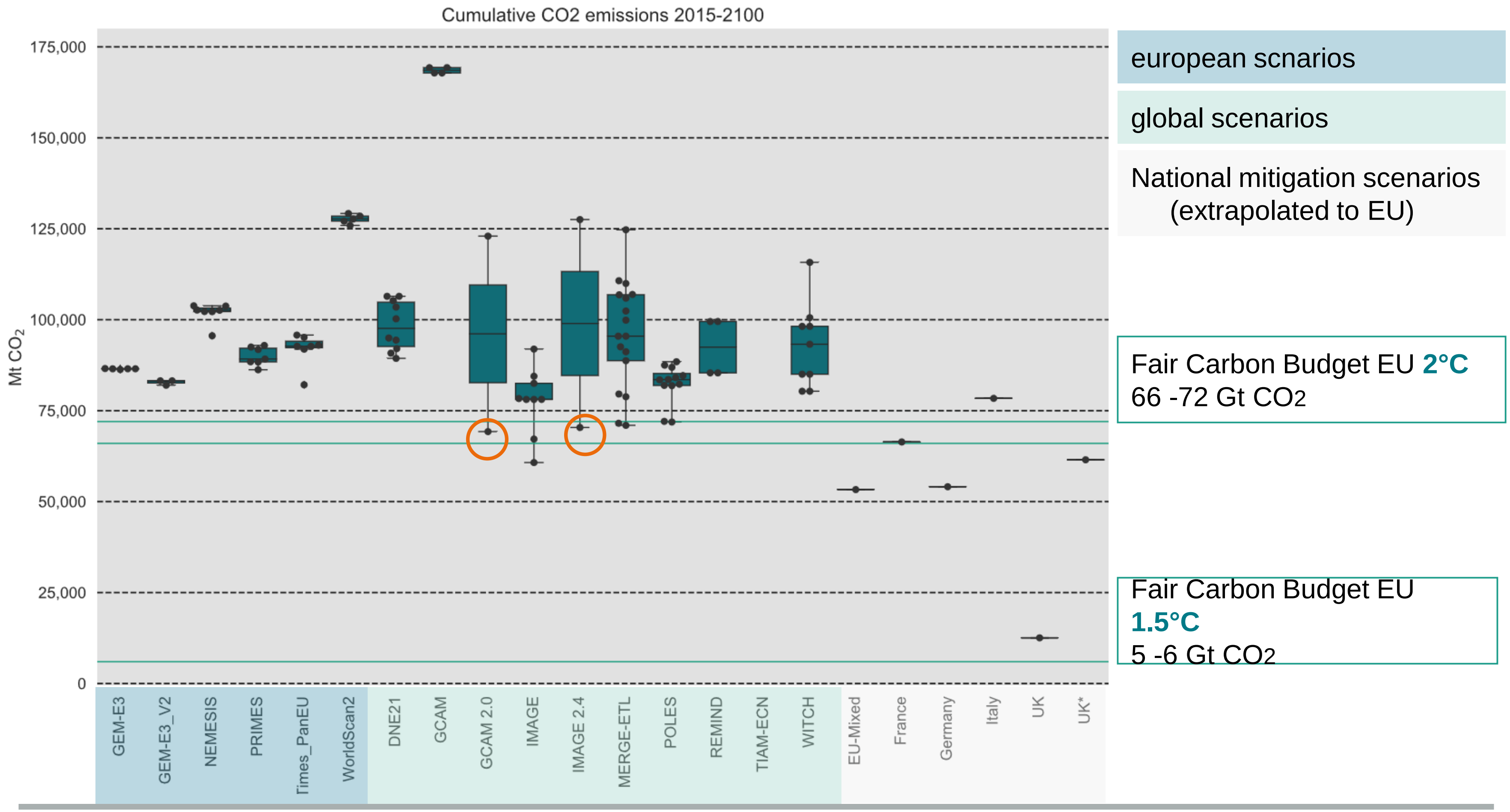
Results: comparison of cumulative CO2-emissions from european + global + national 2°C scenarios **2015-2100** for the EU



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Conclusions:

- **National mitigation scenarios** are more ambitious than the most ambitious global scenarios or european scenarios in the first half of the 21st century.
- **Global** and **european scenarios** include a high level of negative emissions through **CCS/BECCS** while national mitigation scenarios have no specific focus or only very restricted use.
- The **fair carbon budget** calculated for the 2°C EU target is achieved by some ambitious global scenarios but national mitigation scenarios even are below the EU benchmark
- **National mitigation scenarios** achieve emission reduction by ambitious reductions of **sectoral energy intensities** (Wachsmuth, Duscha 2017)*
- **Outlook:**
  - Next to information on target points**, transformation pathways** and **reduction speed** should be taken into account
  - Further development and analyses of **non-linear reduction pathways** and determine their effects on the EU‘s carbon budget

*"Achievability of the Paris Agreements' targets in the EU – Comparison of Energy and Emission Intensities in International and National Mitigation Scenarios" by Jacob Wachsmuth and Vicki Duscha (Fraunhofer ISI)

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References

- BMUB (2015): Climate Protection Scenario 2050, 2nd rnd. https://www.oeko.de/oekodoc/2451/2015-608-de.pdf
- Center for Alternative Technology (CAT) (2013): Zero Carbon Britain – Rethinking the Future. http://zerocarbonbritain.com/images/pdfs/ZCBrtflo-res.pdf
- M. Collins et al. (2013): Long-term climate change: projections, commitments and irreversibility. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (ed. T.F. Stocker, ...). Cambridge, UK; Cambridge University Press.
- R. Gignac and H. D. Matthews (2015): Allocating a 2°C cumulative carbon budget to countries. Environmental Research Letters, Volume 10, Number 7.
- MCC (2017): Remaining CO2 budget. https://www.mcc-berlin.net/en/research/co2-budget.html
- A. Meyer (2000): Contraction and Convergence: The Global Solution to Climate Change. Foxhole, Devon: Green Books.
- NegaWatt (2014): Scenario negaWatt 2011-2050.
- Wachsmuth, J. and Duscha, V. (2017): Achievability of the Paris agreements' targets in the EU - Comparison of Energy and emission intensities in interantional and national mitigation scenarios

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