ACHIEVABILITY OF THE PARIS AGREEMENTS' TARGETS IN THE EU – COMPARISON OF ENERGY + EMISSION INTENSITIES IN INTERNATIONAL + NATIONAL MITIGATION SCENARIOS*

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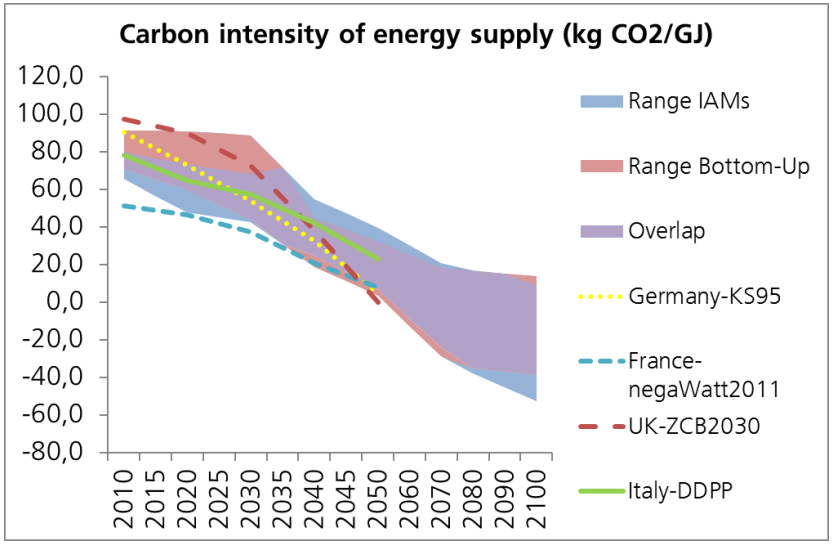

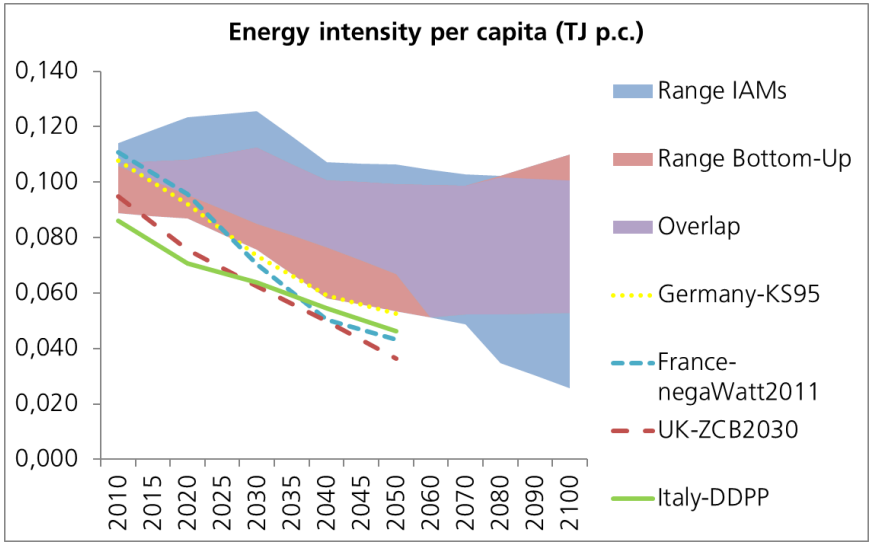

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Agenda

- Introduction
  - Question: Role of carbon and energy intensities for Paris targets
  - Approach: evaluation of international + national 2°C scenarios
  - Comparison of carbon and energy intensities
- Methodology: index decomposition of sectoral mitigation
- Decomposition results
  - transport
  - buildings
  - methodological remarks
- Conclusion and outlook

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Question: is it more crucial to reduce carbon than energy intensity to tackle Paris targets?

- **Paris agreement's targets**:
  - limit global warming to well below 2°C + efforts to limit warming to 1.5°C
  - net-zero emissions in the 21st century
- **Peters et al (NatureCC ´17) focus on CO2 intensity (CI)** for indicators of progress:
  - "The [AR5] scenarios indicate that most future mitigation is due to reductions in CO2/energy, [...]"
- **However: role of energy intensities in low-carbon scenarios is a different one**
  - aggregated modeling of demand in IAMs
  - lower CI rely on lower energy intensities

Source: Peters et al „Key indicators to track current progress and future ambition of the Paris Agreement" Nature Climate Change 2017

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Approach: comparison of global, EU and national 2°C scenarios

- For the global mitigation scenarios, we only consider scenarios with
  - **likelihood > 2/3 to limit temperature rise to 2 °C** and no overshoot of 2°C-target
  - special attention to scenarios with likelihood of 1/2 to limit temperature rise to 1.5 °C.

- Evaluated scenarios required to provide specific data for the EU + sectors:
  - **EU data in global mitigation scenarios** from the databases of the projects AME, AMPERE and LIMITS
  - **European mitigation scenarios** from the database of the project AMPERE
  - **National mitigation scenarios** with a GHG reduction of 80 – 100 % until 2050:
    - **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)*.

* 2030 pathways are interpreted as 2050 pathways here, as target levels are taken from a 2050 scenario

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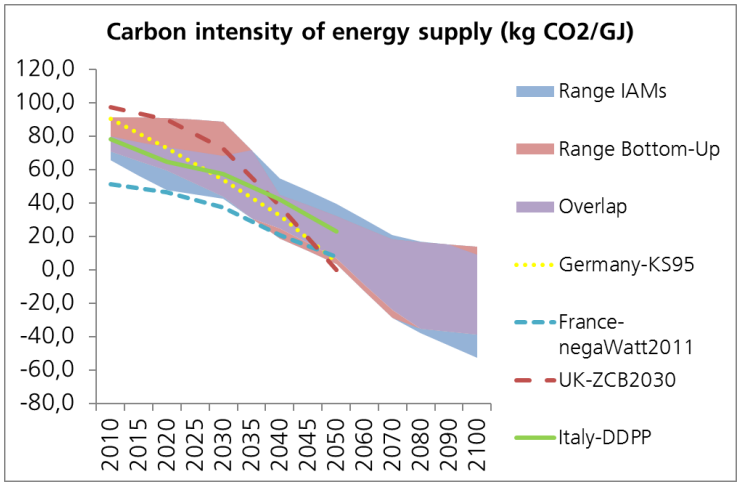
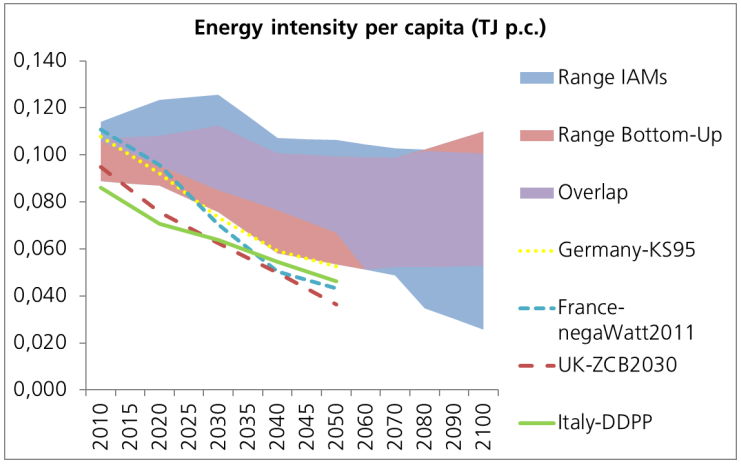
National scenarios: while CO2 intensities align with IAMs, energy intensities are lower

- **Comparison of carbon intensities**:
  - reduction of CO2 intensities are in-line
  - national intensities at start depend on individual local conditions
  - in international scenarios, CI depends more on scenario than on model type

- **Comparison of energy intensities:**
  - energy intensities in national scenarios mainly lower than the lower limit in the global + EU scenarios in 2050
  - in international scenarios, reduction of intensities in the EU starts later in IAMs





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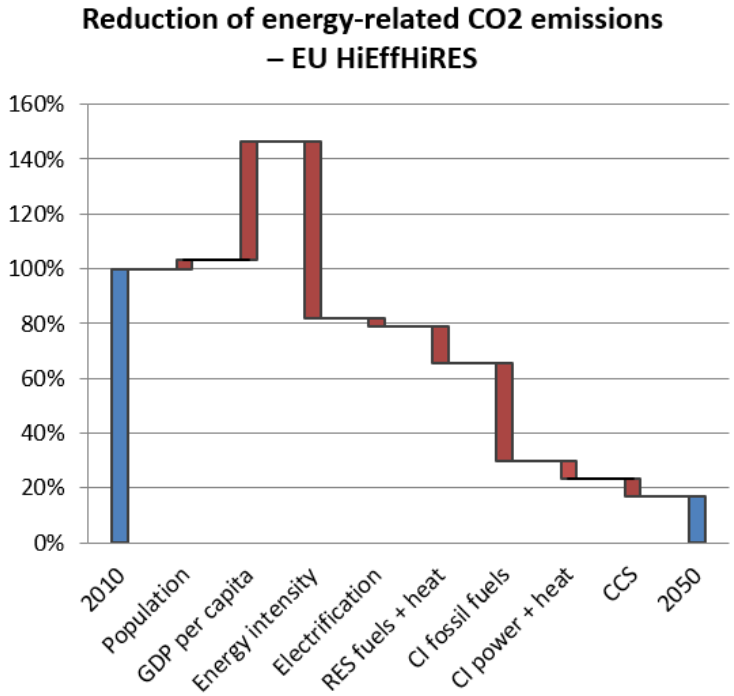
Methodology: time-step approach to index decomposition of sectoral mitigation

- **Index decomposition of energy-related CO2 emissions** based on Kaya identities
  - $CO2_{i,t} = Population_{i,t} \cdot Activity_{i,t} \cdot Energy\ intensity_{i,t} \cdot Carbon\ intensity_{i,t} - CCS_{i,t}$
  - $Carbon\ intensity_{i,t} = CI\ fossil\ fuels_{i,t} \cdot fossil\ share_{i,t} + CI\ electricity_{i,t} \cdot electricity\ share_{i,t}$

- **Focus: sectoral emissions + final energy**
  - industry, buildings, transport, overall
  - avoids mixing of RES + EE in primary energy

- **Additive LMDI with time-steps included**
  - LMDI (e.g. Xu & Ang 2013) has no residual
  - time-steps reflect pathways:

$$\Delta CO2_{i,2050,2010} = \sum_{t=2020}^{2050} \Delta CO2_{i,t,t-10}$$



Source: own representation

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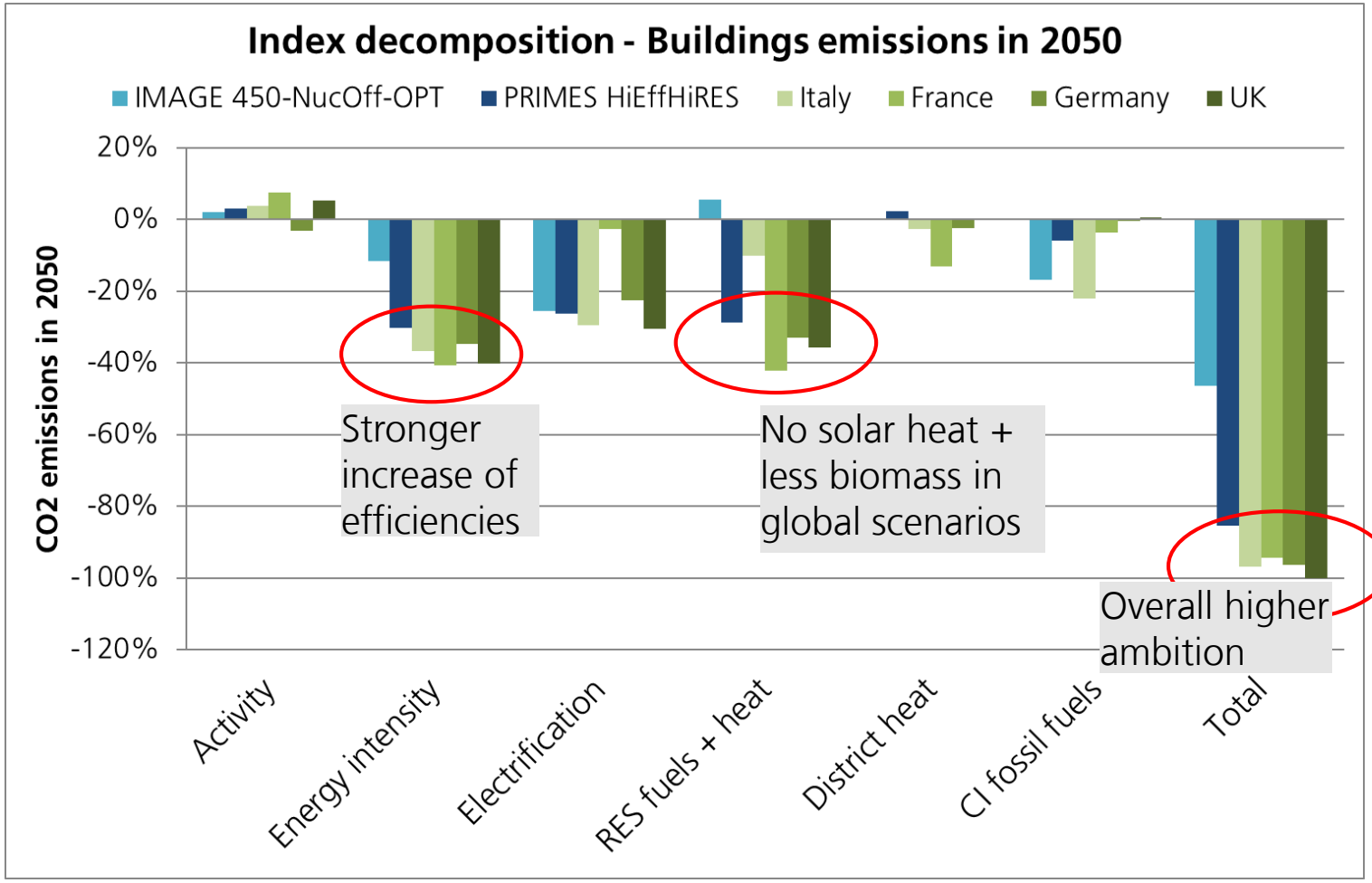
Buildings: much higher ambition in national + EU scenarios via more EE + RES heat



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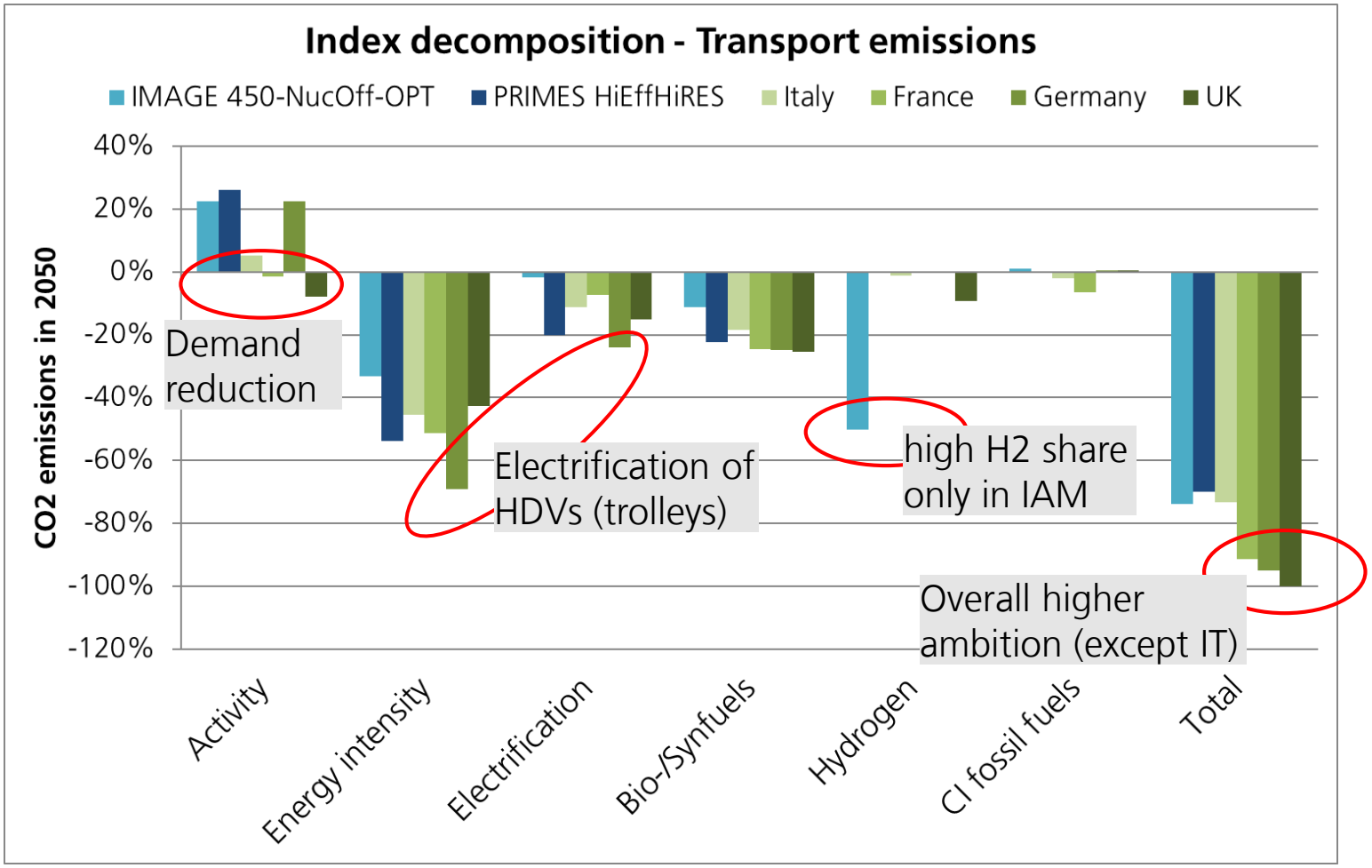
Transport: higher ambition in some national scenarios by sufficiency / trolley HDVs



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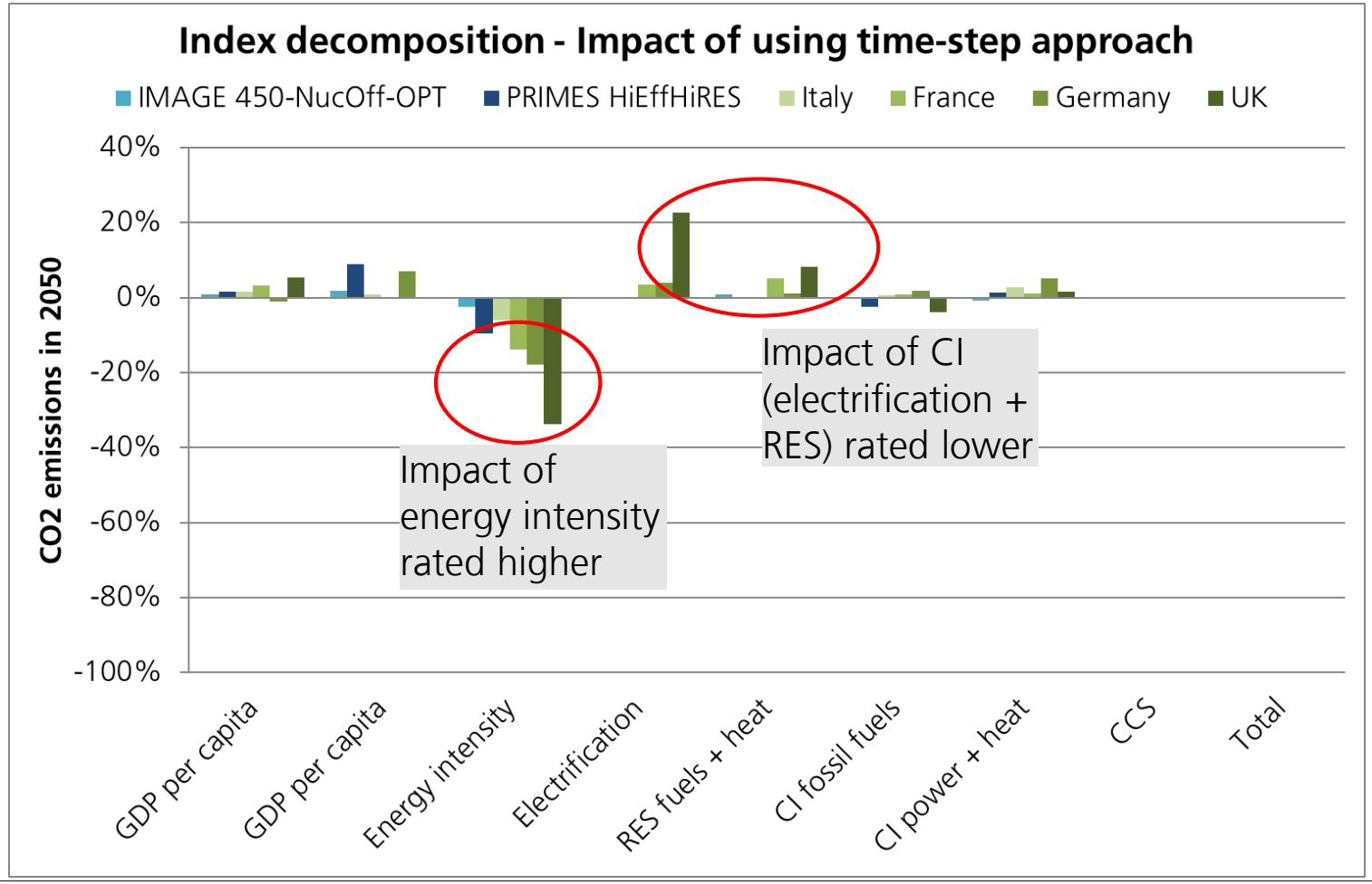
Method: Index decomposition without time-steps underrates impact of energy intensity



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Conclusion: additional reduction of sectoral energy intensities crucial for Paris targets

- **KEY MESSAGE 1: Index decomposition underrates the contribution of reductions of energy intensities.**
  - assumed independence of carbon + energy intensities not given in many cases
  - adding intermediate time steps reduces but does not fully remove the problem

- **KEY MESSAGE 2: More ambitious reductions of sectoral energy intensities found in national scenarios may reduce the need for negative emissions after 2050.**
  - lower level of CCS due to lack of acceptance and avoidance of overshoots
  - additional technological options included (trolley HDVs, solar heat grids)
  - sufficiency and demand reductions considered in more detail

- **OUTLOOK: Results for cumulated emissions + role of CCS in a companion paper**
  - **Session 3A, A. Denishchenkova:** „Achievability of the Paris agreements' targets in the EU - Implications from a combined bottom-up modelling and budget approach"

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Thank you for your attention!

- Xu, X.Y., Ang, B.W. (2013): Index decomposition analysis applied to CO2 emission studies. Ecol. Econ. 93, 313–329.
- Peters, G.P. et al. (2017): Key indicators to track current progress and future ambition of the Paris Agreement. Nature Climate Change. DOI: 10.1038/NCLIMATE3202
- **Wachsmuth, J., Duscha V. (to be submitted): Achievability of the Paris agreements' targets in the EU – Comparison of the Role of Demand-Side Driven Mitigation in Scenarios Compatible with the Paris Agreement.** Special Issue of *Energy Efficiency* on "Demand-side policies, governance and socio-technical mitigation pathways of limiting global warming to 1.5°C"

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