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Decarbonising the demand side

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Introduction

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- IPCC: Demand-side reductions could lead to sectoral GHG emission reductions of **40-70% by 2050**

  → Large uncertainty concerning demand-side contributions

  - How much can each sector contribute to emissions reductions?
  - What is the most optimal emission reduction strategy?
  - Interactions between different strategies?
  - Interaction across different sectors?

Scenarios

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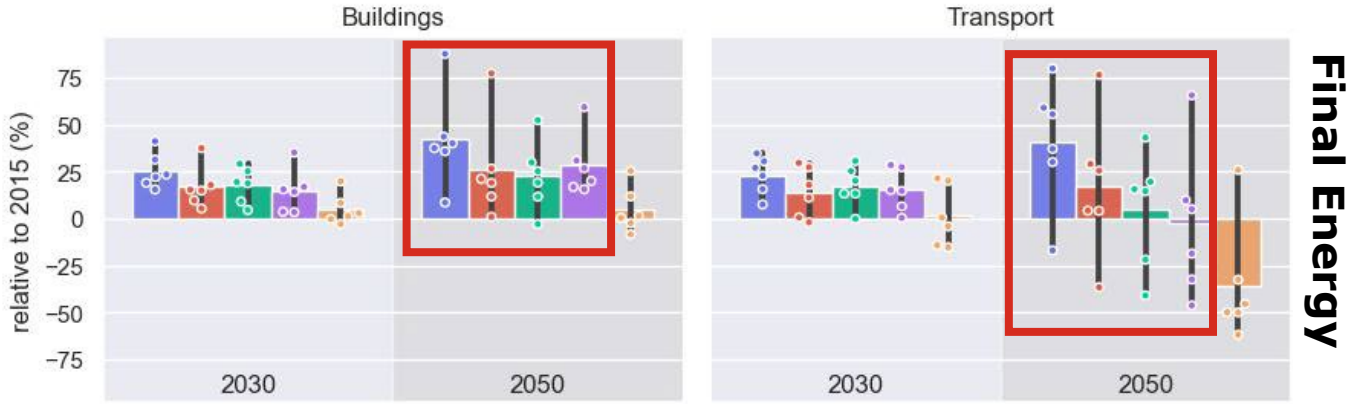
- Activity-focused strategy **(ACT)**
  - Redesigning of service-provisioning services to either reduce or shift consumption
  - *Flexible workspaces in buildings, smaller houses, lower heating/cooling demand, use of public transport, etc.*
- Technology- focused strategy **(TEC)**
  - Technological innovations and improvements in efficiency
  - *Increased renovation, thermal insulation, efficiency HVAC, standard for road vehicles etc.*
- Electrification-focused strategy **(ELE)**
  - Switching to electricity based energy service provision
  - *Electricity based heating (including heat pumps), electrification of transport (direct and electro-fuels)*

Results: Energy & Emissions

- Reductions compared to 2015 (global)
  - **ACT**, **TEC** and **ELE** reduce energy demand *compared to reference*
    - But increase with respect to 2015 (i.e. interventions mitigate demand increases)
  - **ALL** scenario has largest effect
- Large variation
  - Across models and regions



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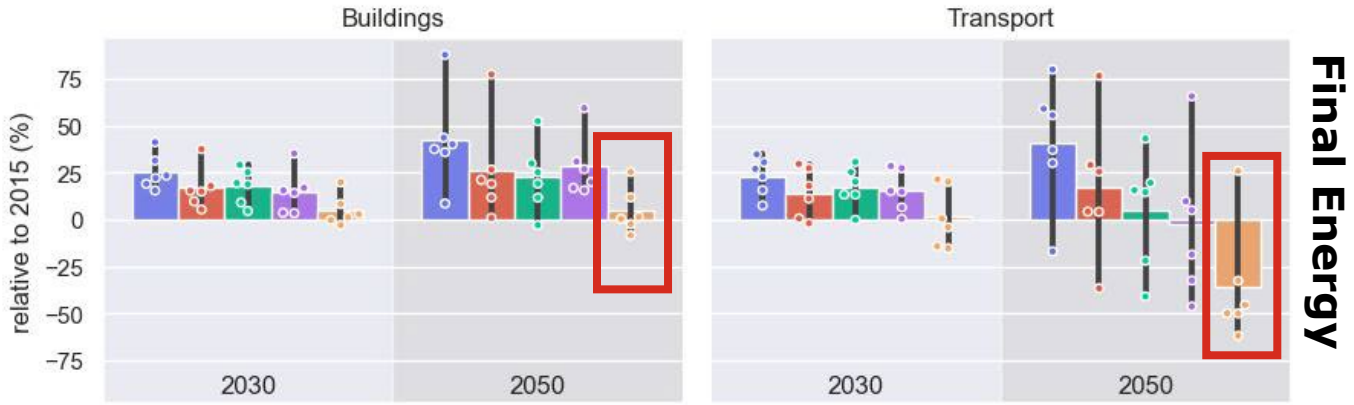

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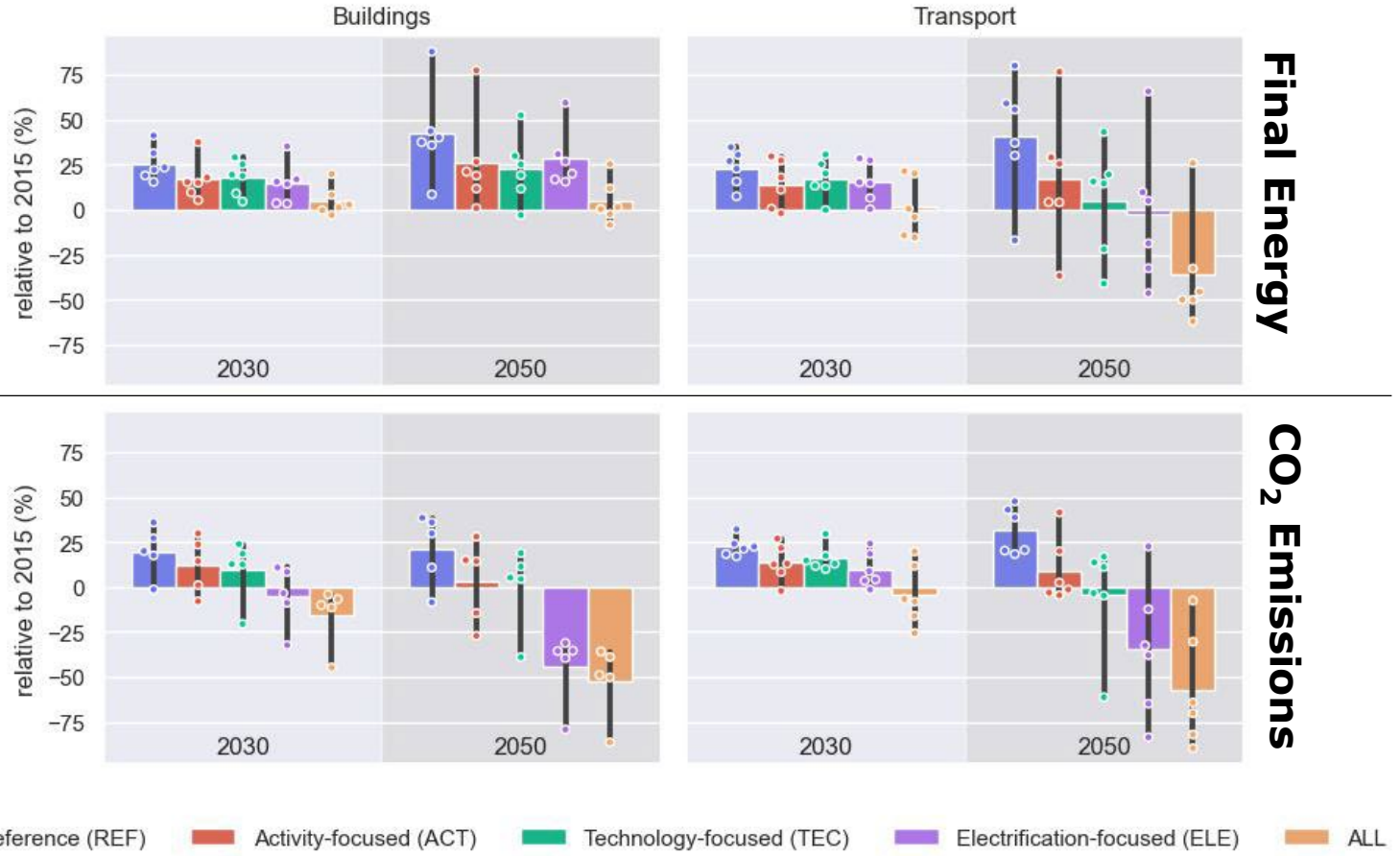
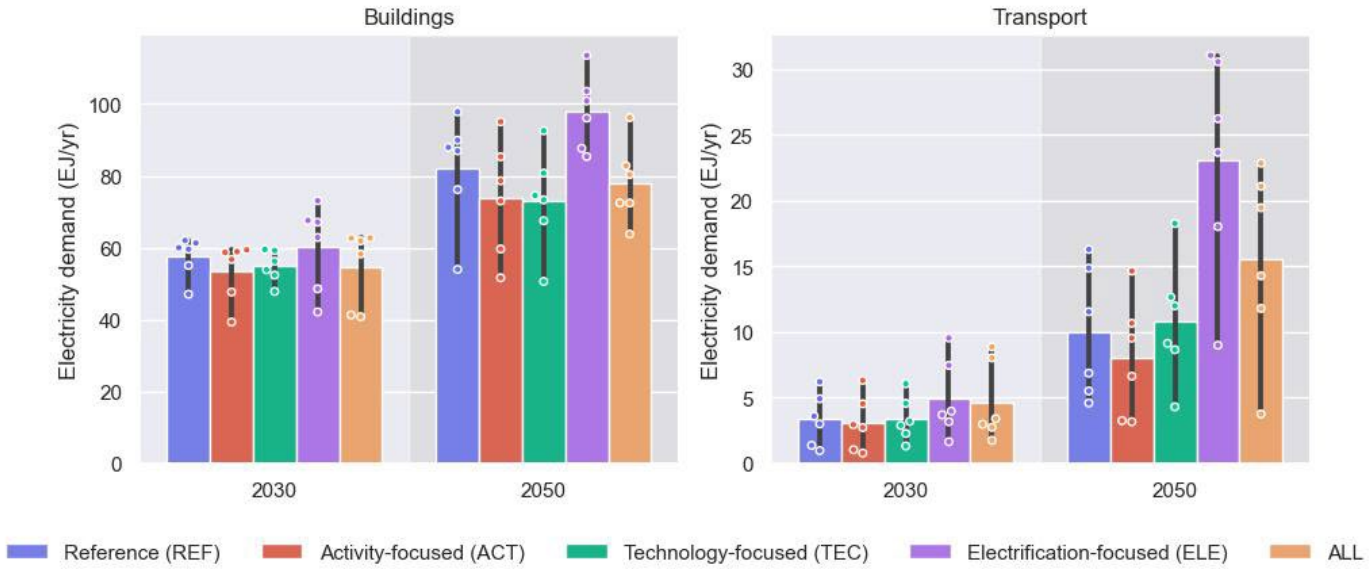


- CO_2 emissions similar pattern
  - Greater reduction in emissions

Results: Electricity Demand

- Overall, a large increase
  - 70% by 2030 → up to 3× by 2050
  - **ACT** & **TEC** have slightly lower electricity demand than **REF,** since they lower overall demand
  - **ELE** shows a sharp increase in electricity demand
    - transport!
  - …partly mitigated in **ALL** scenario



Insights

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- Demand-side changes can facilitate the achievement of climate targets
  - Reduce the need for other mitigation measures (e.g. carbon pricing)
- Combination of strategies reduced emissions in 2050 (compared to reference)
  - Transport: 66%
  - Buildings: 60%
- No single ideal strategy!
  - Electrification has the largest impact on energy demand and emissions

    → increases stresses on electricity supply (increased generation, storage, grids, etc.)
  - *Combining* different approaches

    → greatest reduction in energy use & emissions

    → alleviates stress on the energy system
- Wide variation in model results → high level of uncertainty in actual mitigation potential

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Thanks!

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Scenarios

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Scenario	Description and assumptions
Current policies	Considers the current climate- energy- and land-use policies and accounts for only those that are secured in legislative decisions, executive orders or equivalent (Averchenkova et al., 2017; UNEP, 2019). No additional measures or plans are considered.
Activity reduction / shifts	**Buildings** Flexible use of buildings, shared building spaces (e.g. co-housing and working) and policies limiting floorspace in new constructions, reduce the floorspace used per capita in both the residential and commercial sector. A shift in household preferences and policies limiting new construction of single-family housing will lead to a higher share of multi-family houses. Stimulated by information campaigns and restrictive policies, the setpoint temperatures in buildings shift to 20 °C (heating) and 25 °C (cooling). **Transport** Demand for private vehicles driving within cities is lowered (e.g. by congestion charges and increased remote working). Improvements in road freight logistics reduce road freight activity. More bike lanes and pedestrian zones increase the adoption of active modes (bicycles, e scooters and walking). Improvements in public transport infrastructure, last-mile services and free/lower public transport fares increase the adoption of public transport and car-sharing/pooling is actively promoted. **International transport** In the aviation sector, passenger transport is reduced by fuel taxes (abolishment of tax exemptions), movement taxes (e.g. a frequent flyer levy) and development of increased virtual connectivity. Fuel taxes and movement taxes also affect freight transport. Policies encourage development of local manufacturing and storage. Worldwide speed restrictions are introduced in maritime transport (slow steaming shipping) and short-haul air travel is phased out by 2030.

Scenarios

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Scenario	Description and assumptions
Technological improvements	**Buildings** Building codes and standards, energy performance certification and subsidies result in increased useful energy intensity per surface area and improved insulation levels. There is more efficient heating, ventilation and air conditioning and the current retrofit rate doubles in the global North. **Land-based transport** Efficiency standards result in efficiency improvements for passenger vehicles and trucks. **International transport** Efficiency standards result in efficiency improvements for new airplanes and ships. On top of that, environmental certification for using airports and ports stimulates efficiency improvements for the entire aviation and shipping fleet.
Electrification and fuel shift	**Buildings** Fuel mandates accelerate electrification and heating fuel switching. All new buildings adopt heat pumps by 2030. We assume that 70% of space and water heating is electricity-based by 2050. Building regulations and neighborhood-based approaches stimulate deployment of on-site and building-integrated renewables. Renewable energy (PV and thermal solar) covers 50% of heating/cooling demand in the Global North by 2050. New natural gas connections for heating are banned in the Global North by 2030. Non-clean heating fuels are phased out by 2050. **Transport** Fuel/technology mandates ensure full electrification (BEV and/or FCEV) of passenger vehicles and light-duty trucks by 2040. Phase-out of diesel engines in the fleet of heavy-duty vehicles by 2040. Electric short-haul planes become available after 2050. Full electrification of ports (and a reduction of auxiliary engines needed in ships) by 2030. Vessels are adapted to zero-emission berth standards by 2040. Fuels standards/mandates, infrastructure development and removing blending restrictions increase the use of alternative fuels (biofuels/electrofuels).

Regional Variation

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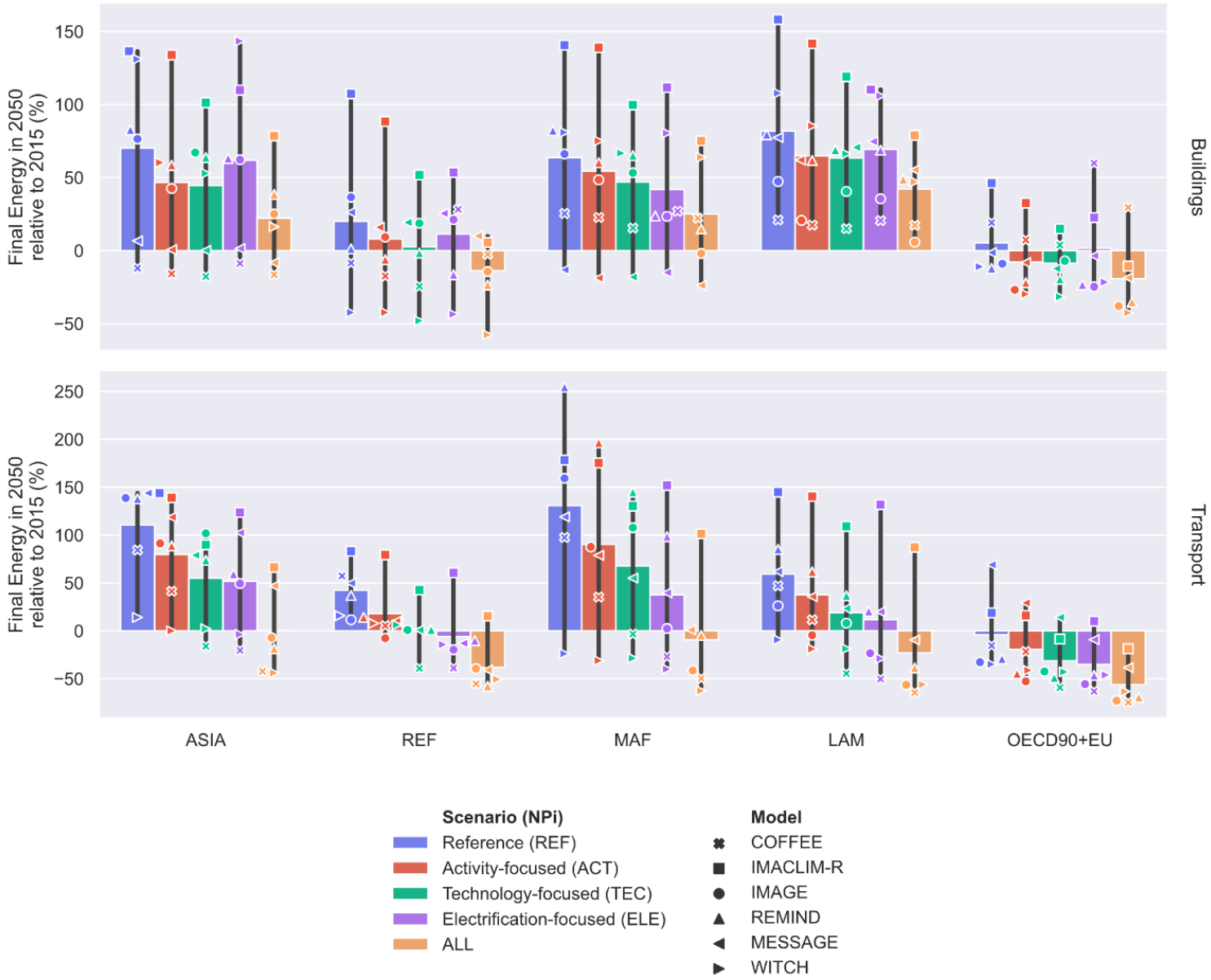

Decomposition

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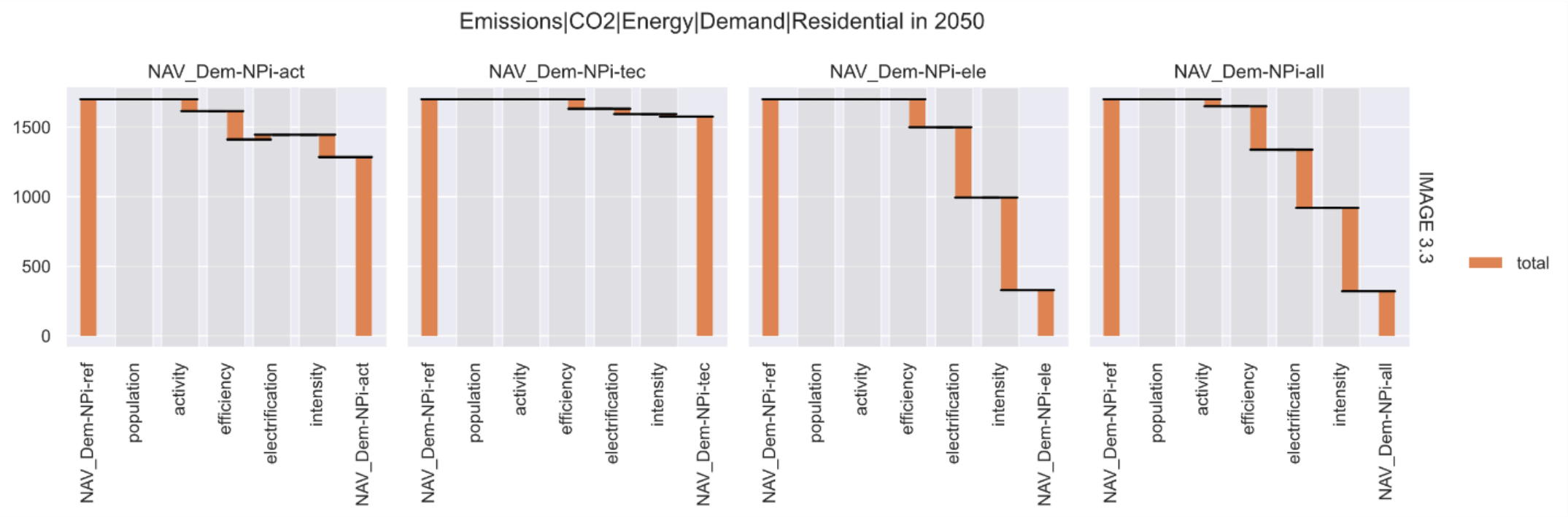
- Buildings
  - Combining approaches lowers the need for electrification and intensity reductions to



Decomposition

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- Transport:
  - Activity reductions and modal shifts have a less pronounced impact when combined with electrification and technological improvements
  - Activity shifts and efficiency improvements contribute to further emissions reductions in the transport sector.