

Behavioral Climate Change Mitigation

from individual energy choices to demand-side potential

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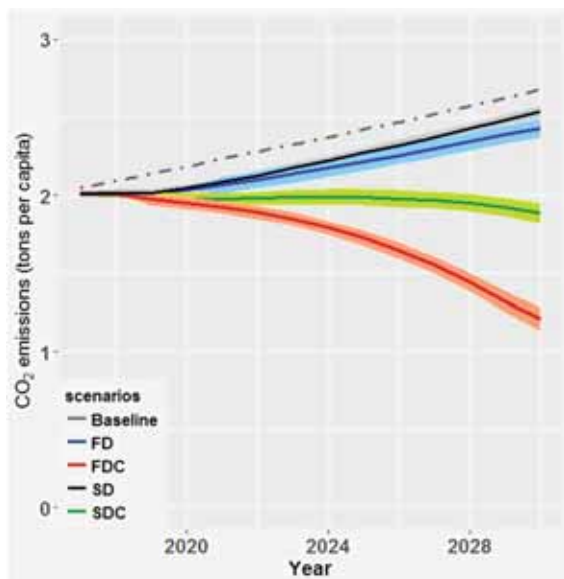
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Research questions

- What are the **main factors** influencing **individual energy behavioral changes** in the transition to a low-carbon economy?
- What are the **macroeconomic impacts** of individuals' behavioral changes on **carbon emissions**?
- What is a systematic way of **upscaling behavioral aspects** of individual decision-making to assess macroeconomic impacts for climate change mitigation over time and space?

Methodology

- **Comprehensive household survey:** Two provinces in The Netherlands and Spain
- **Agent-based models:** heterogeneity, interactions and learning, out-of-equilibrium dynamics
- **Systematic upscaling** individual heterogeneity and social dynamics



End-user scenarios

Baseline: based on the **SSP2 scenario** (input from CGE model).

Reference scenario: introduce the **heterogeneity** to the household socio-economic and housing attributes, e.g. income, education, electricity consumption, and dwelling conditions.

5% reduction

Bottom-up approach scenario: examine the effects of social interactions.

9% reduction

Top-up approach scenario: introduce the carbon price (25 euro per ton by 2030).

30% reduction

Social dynamics and carbon price scenario: combination of bottom-up and top-down.

55% reduction

*“The **BENCH agent-based model** can serve as a simulation platform to support the engagement of stakeholders.*

*It offers **policy**makers ways to explore various **policy mixes** combining **price instruments** with various **infrastructure, social and soft policies** to amplify the positive effect of **individual behavioral changes** regarding energy use.”*

Behavior matters: The understanding of how bottom-up processes can impact climate mitigation guides us to effective development and implementation of policies.

Heterogeneity is the key: Effective policymaking requires decision-supporting tools that can explore the interplay between economic decision-making and behavioral heterogeneity in individuals' energy choices when testing climate mitigation policies.

Social norms are essential: Individuals are not making decisions in isolation, as they are prone to being influenced by peers in their social networks and local communities.

Innovation

Bridge the gap between a **stylized representation** of human decision-making in **current energy-economy models** and the rich evidence on **pro-environmental behavior** that **social sciences** provide.

- **The unique micro-level dataset on behavior**

Empirical testing of theoretical concepts
Heterogeneity
Comparative research

- **Empirical agent-based models**

From equilibrium to out-of-equilibrium model
Theoretically and empirically grounded models
From learning to behavioral scenarios

- **Novel systematic upscaling method**

BENCH agent-based model

Heterogeneous household

- socioeconomic: income, education, age, ...
- dwelling: type, size, energy label, insulation level, ...
- energy consumption: source, consumption, ...
- psychological factors: awareness, personal norms, ...
- social factors: social norms and social networks

Various **energy behaviors:** investments, conservation, switching providers

Spatially explicit and behavioral rules of agents calibrated based on the survey data

Upscaling



Percentage change in electricity consumption in 2050 from the base 2015, calculated as a result of scaling up the outcomes of the ABM model with population changes in the “Fast dynamics” scenario.

To investigate the feasibility and importance of **introducing heterogeneity and behavioral-rich dynamics** in assessing climate change mitigation policies, a transparent **soft-linkage step-wise process** is developed to integrate an empirical **behaviorally-rich ABM** and a **spatial CGE model**.

Some regions lag behind while others are pioneers, due to the heterogeneity in individuals' socio-demographics, structural characteristics, behavioral and social traits, and spatial characteristics.

