Experience with modeling behavioral change in Integrated Assessment Models

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A few examples...

	implicit (part of a more general phenomenon)	**explicit** (discrete, identifiable processes)
exogenous (externally specified)		1. COVID recovery scenarios 2. Transport behavior
endogenous (internally generated)		3. iPETS model

1. Narratives for post-pandemic recovery

Scenario typology for post-COVID recovery:
main assumptions for activity changes (%Δ) in end-use demand between 2019 and 2025

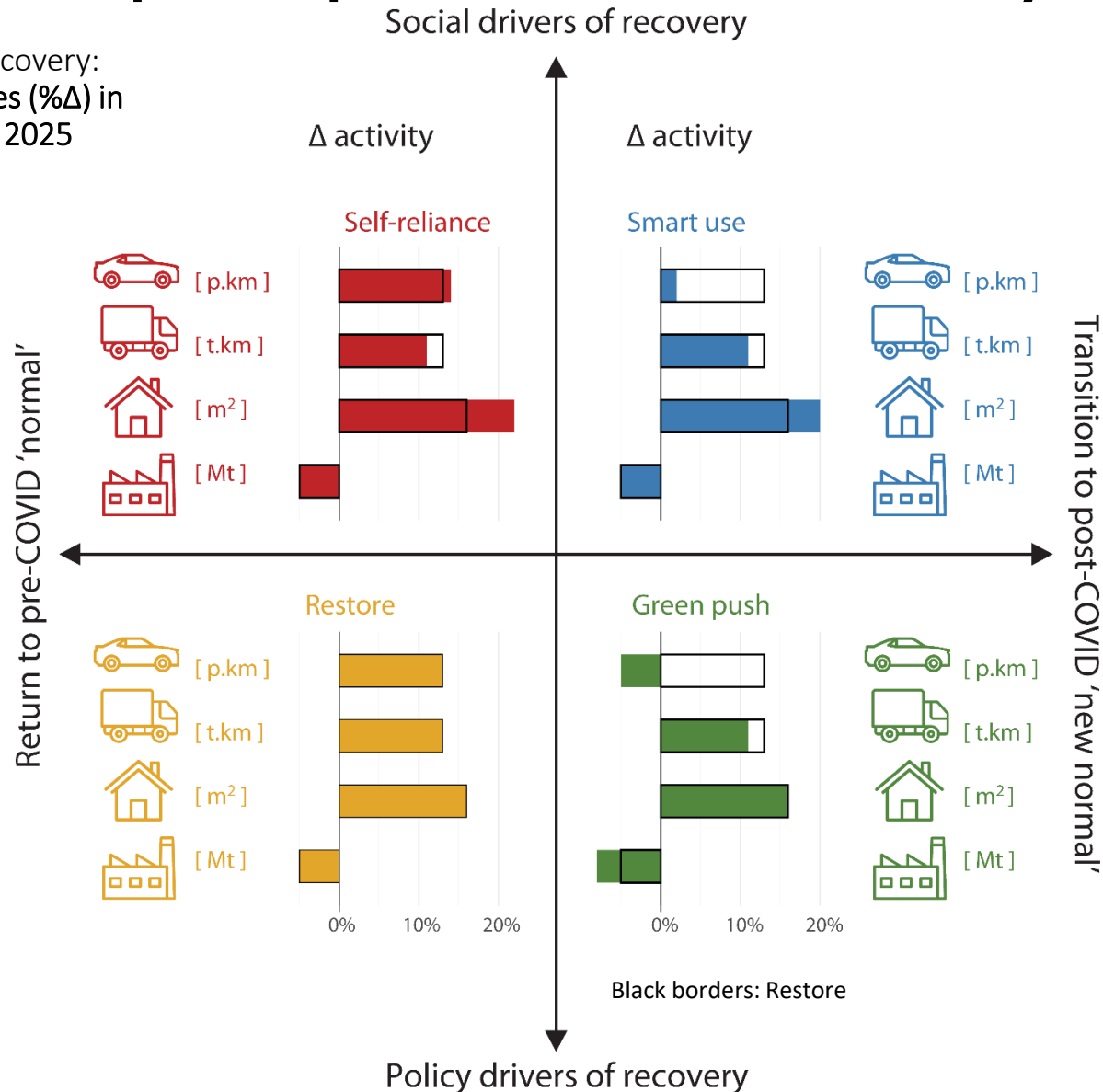*Teleworking and individual and longer trips, new age of tourism online retail*

More home-stay, while also larger/safer work spaces

Economic impact & glocalisation

Back to normal, trends in individualization

Back to technical improvements and historical demand trends

Economic impact on production

Some level of teleworking, reduced commuting, rediscovery of non-motorized trips, online retail

More home-stay, while no change to non-residential demand

Small reduction and restructuring in production

Large reduction in commuting and long-distance trips, promoted alternative transport

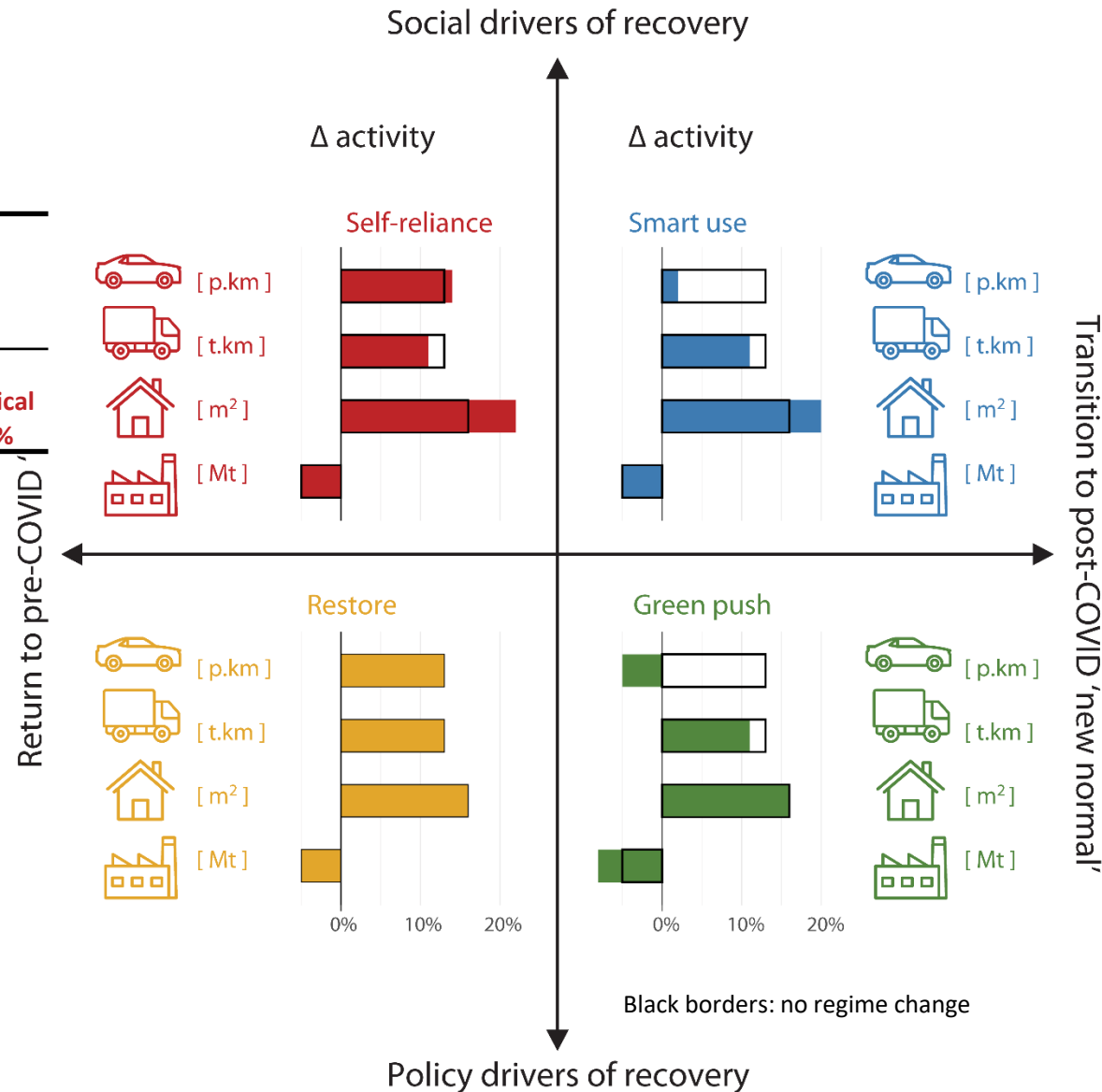*Intensification of teleworking, while reductions in work floor space*

Repurposing in production

Social drivers of recovery

Δ activity   Δ activity

Self-reliance   Smart use

Return to pre-COVID 'normal'   Transition to post-COVID 'new normal'

Restore   Green push

[p.km]   [t.km]   [m²]   [Mt]

0%   10%   20%

Black borders: Restore

Policy drivers of recovery

Kikstra, J., Vinca, A., Lovat, F., Boza-Kiss, B., Van Ruijven, B. J., Wilson, C., Rogelj, J., Zakeri, B., Fricko, O., & Riahi, K. (2021). *COVID-19 impacts on energy demand can help reduce long-term mitigation challenge*. In Review https://doi.org/10.21203/rs.3.rs-155224/v1

1. Quantification of structural change

Structural change

Rail	Cars	Public transport	Aviation
-5%	+10%	-5%	0%

Iron, steel	Aluminium	Cement	Pulp, paper	Chemical
-12%	-19%	-5%	+7%	+11%

No structural change compared to pre-covid

Structural change

Rail	Cars	Public transport	Aviation
-10%	-5%	-10%	-10%

Iron, steel	Aluminium	Cement	Pulp, paper	Chemical
-12%	-19%	-5%	+7%	+11%

Rail	Cars	Public transport	Aviation
25%	-15%	15%	-30%

Iron, steel	Aluminium	Cement	Pulp, paper	Chemical
-16%	-21%	-8%	+7%	+6%

Social drivers of recovery

Δ activity

Δ activity

Self-reliance

Smart use

Restore

Green push

Return to pre-COVID

Transition to post-COVID 'new normal'

Policy drivers of recovery

Black borders: no regime change

[p.km] [t.km] [m²] [Mt]

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1. Impacts on energy demand and CO$_2$ emissions
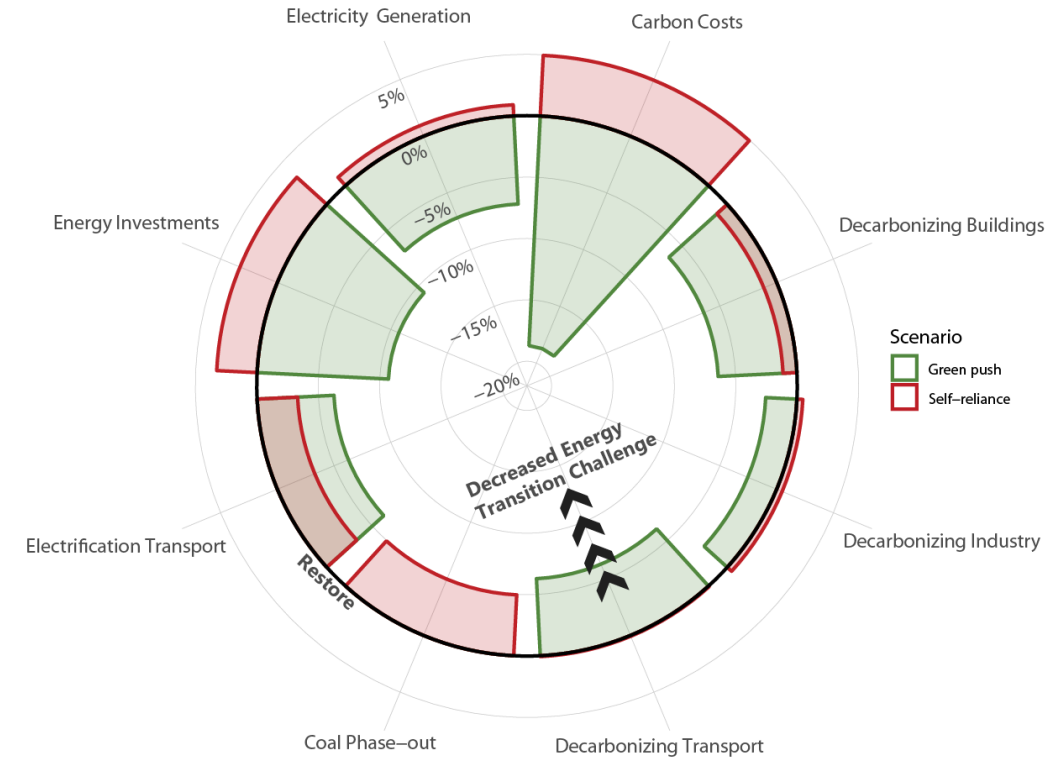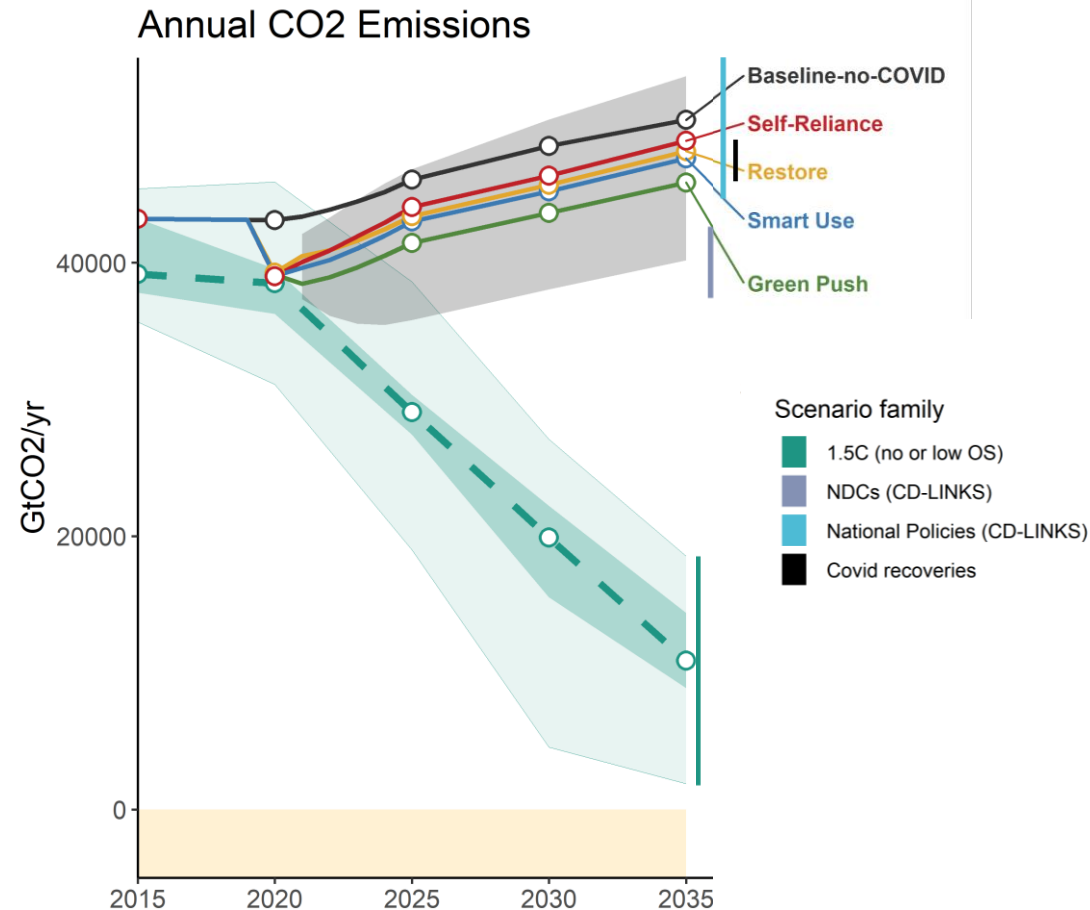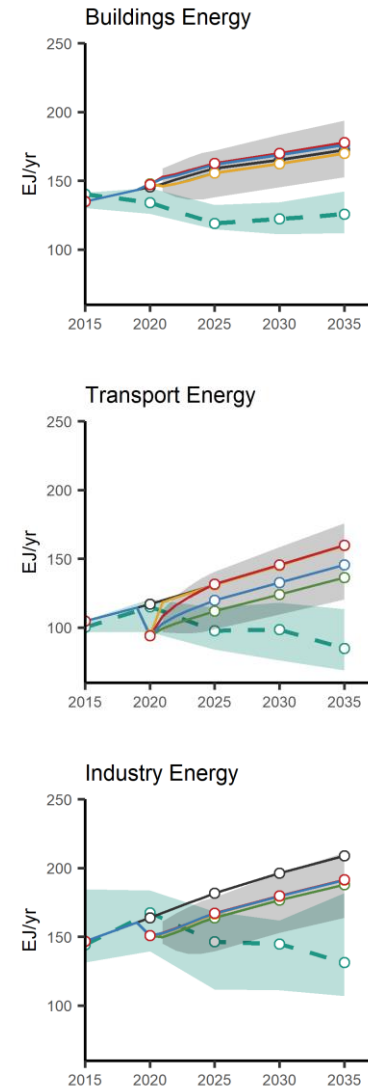
2. Behavior in MESSAGE-Transport

Disaggregation of LDV Mode/Demands

McCollum, D.L., Wilson, C., Pettifor, H., Ramea, K., Krey, V., Riahi, K., Bertram, C., Lin, Z., Edelenbosch, O.Y., Fujisawa, S., 2017. Improving the behavioral realism of global integrated assessment models: An application to consumers' vehicle choices. Transportation Research Part D: Transport and Environment 55, 322–342. doi:10.1016/j.trd.2016.04.003

Legend:
- Fossil_ICE_hist
- Fossil_ICE
- Fossil_HEV
- NGA_ICE
- NGA_HEV
- Biofuel_ICE
- Biofuel_HEV
- Synfuel_ICE
- Synfuel_HEV
- H2_FCV
- Electric
- PHEV

(Homog_NoBeh) Homogen. consumers No behavior

(Heterog_NoBeh) Heterogen. consumers No behavior

(Homog_LimBeh) Homogen. consumers Limited behavior

(Heterog_DivBeh) Heterogen. consumers Diverse behavior

Electric
Fossil Syn. ICE
Biofuel ICE
Nat. Gas ICE
Fossil ICE

2. Impact of behavior on abatement
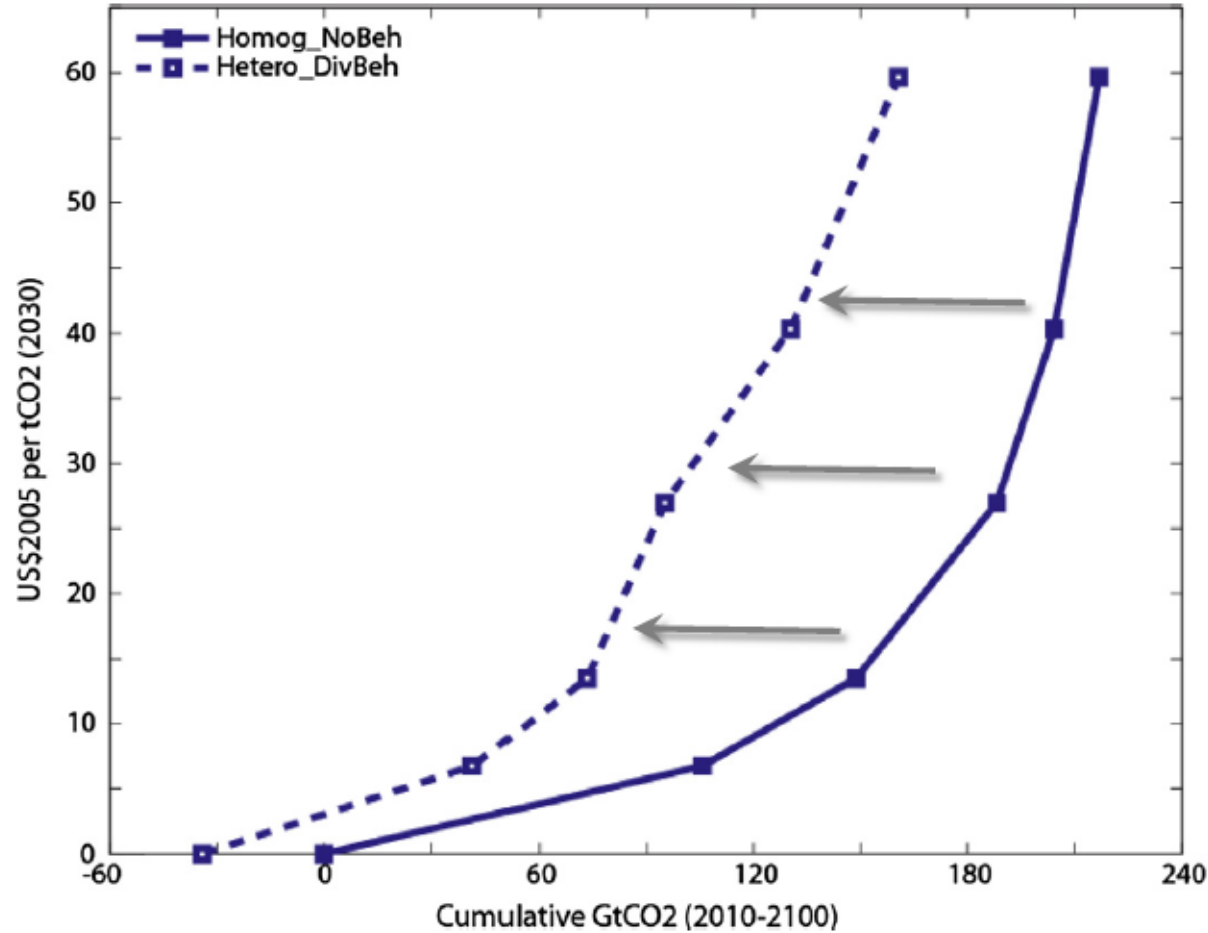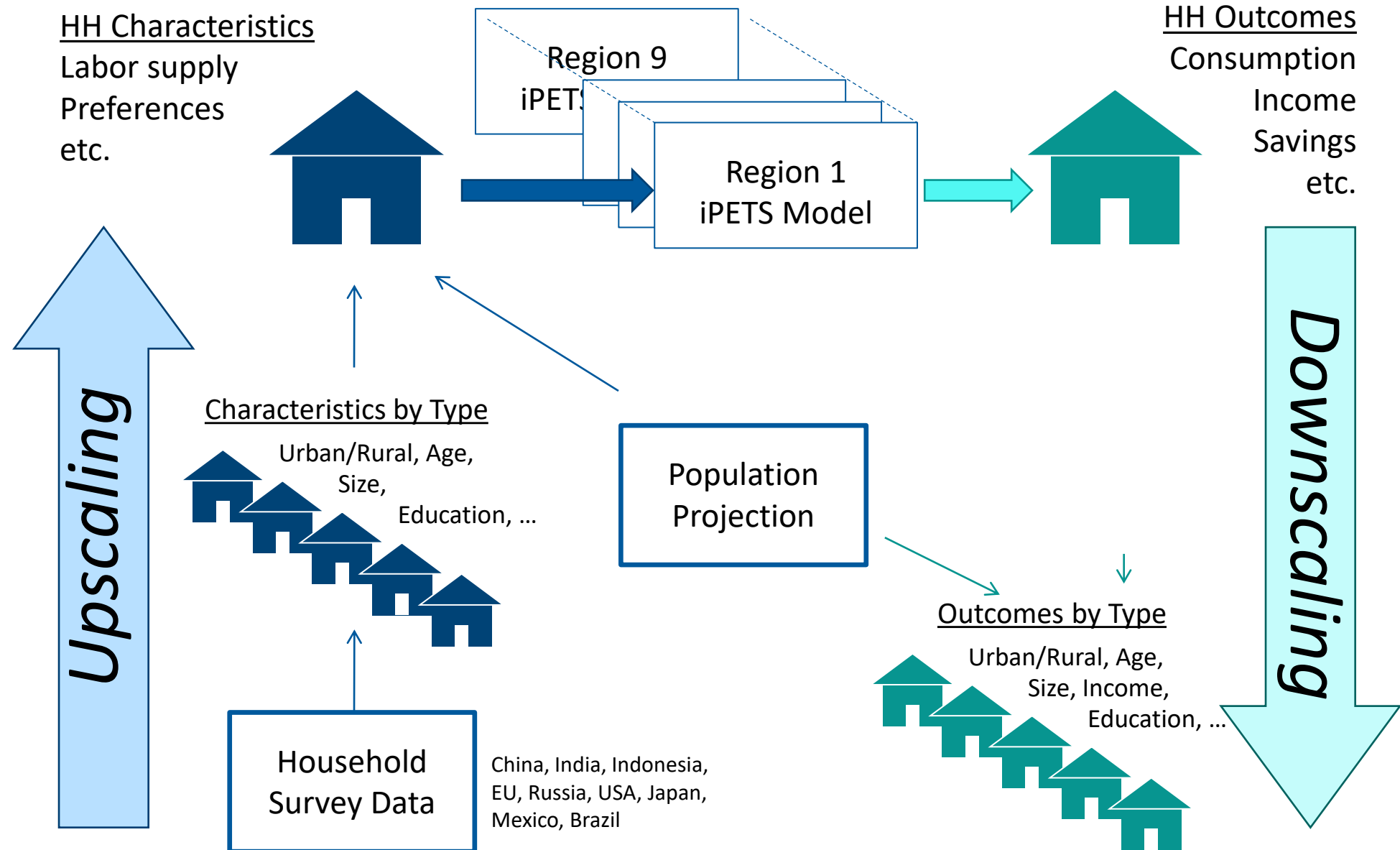
3. Demographic Effects on CO$_2$ Emissions

O'Neill BC, Dalton M, Fuchs R, Jiang L, Pachauri S, Zigova K. Global demographic trends and future carbon emissions. PNAS 2010
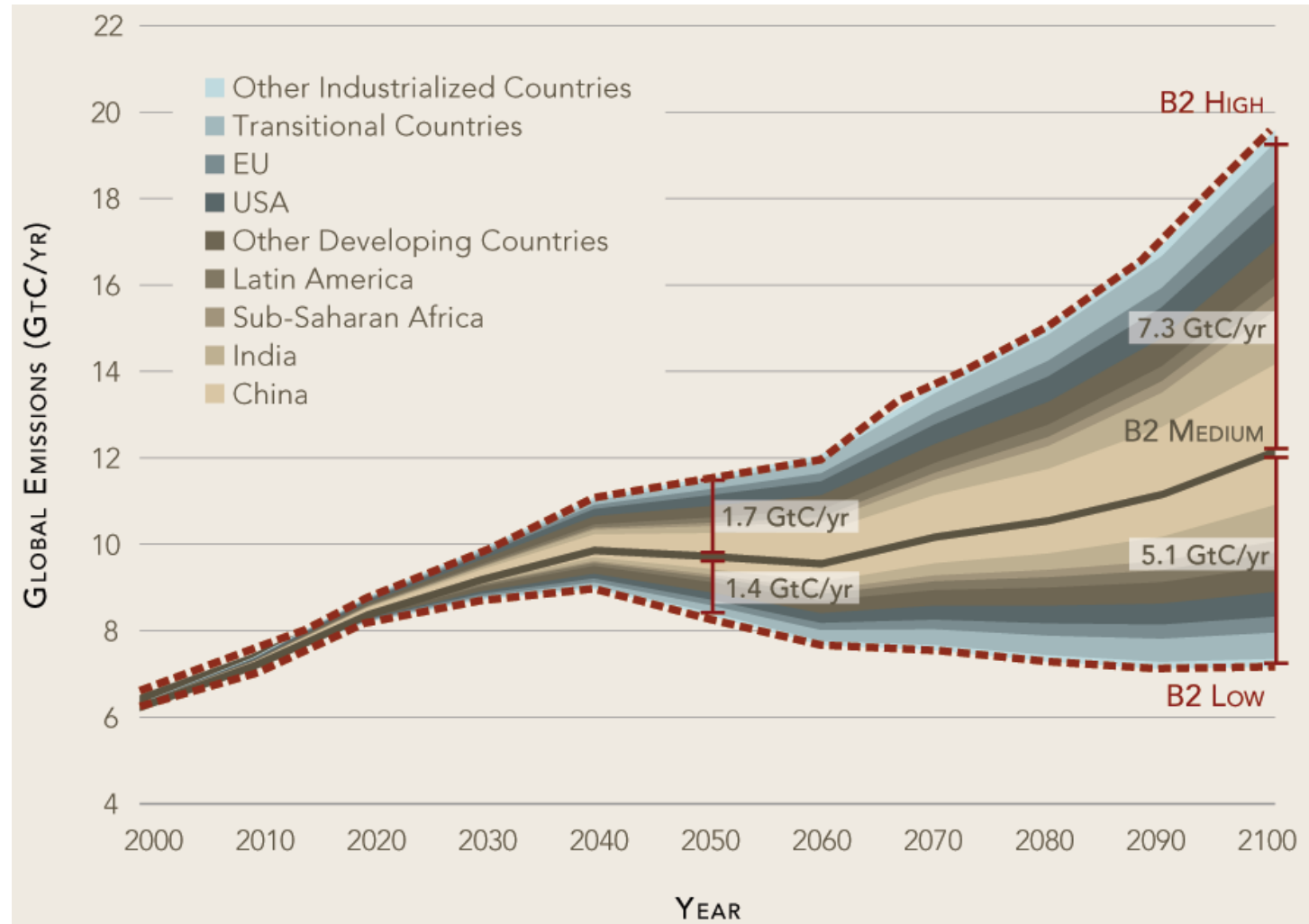
Taking things further: the EDITS project

- Energy Demand changes Induced by Technological and Social innovations (EDITS)
  - ⇒ Coordinated by RITE and IIASA

- Improve understanding of energy services and demand, modeling of behavioral change

- Development of demand transformation scenarios, like the Grubler et al., Low Energy Demand (LED) scenario
  - ⇒ At city, country, continent, sectoral, global levels.

Thank you very much for your attention!

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