Implications of different mitigation pathways for household energy burdens

Mel George*[1,2,3], Shonali Pachauri[2], Narasimha Rao[2], Jihoon Min[2], Haewon McJeon[3], Leon Clarke[4], Anand Patwardhan[1]

1 School of Public Policy, University of Maryland, College Park MD, USA
2 International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
3 Joint Global Change Research Institute (JGCRI),. Pacific Northwest National Lab, College Park MD, USA
4 Bezos Earth Fund, Washington DC, USA

Important takeaways: 'Decarbonization as development' IS possible

- ✓ Demand side climate change mitigation options support **progressive outcomes**, compared to other approaches
- ✓ **Technology**-oriented pathways are **unable to deal with underlying inequities**, often even exacerbating them
- ✓ **Non-CO_2 reductions** related to affluence are an **important lever** to limit mitigation risks on the poorest households
- ✓ **Global** effort sharing matters for **local** Just Transitions

Distributional impacts of mitigation pathways are under-explored

- ❑ Energy networks are complex socio-technical systems; enhancing climate mitigation ambition for 1.5C goal could have dissimilar, and possibly disproportionate, consequences for diverse groups.
- ❑ For just, equitable, politically "smooth" decarbonization, we need to know who will be impacted most & ideally deliver good outcomes for the most disadvantaged
- ❑ Distributional Impacts: What works? For whom? In what contexts?

How can we best deliver on societal + climate goals?

- ❑ We examine the case of household energy burden under mitigation scenarios – the share of household income spent on all residential energy services.
- ❑ Research question: What is the impact of different 1.5°C pathways on household energy burdens across different income tiers?

$$Household\ energy\ burden = \frac{(Expenditure\ on\ energy\ needs)}{\left(\frac{GDP}{cap}\right) - (expenditure\ on\ food)}$$

Still, what's new?

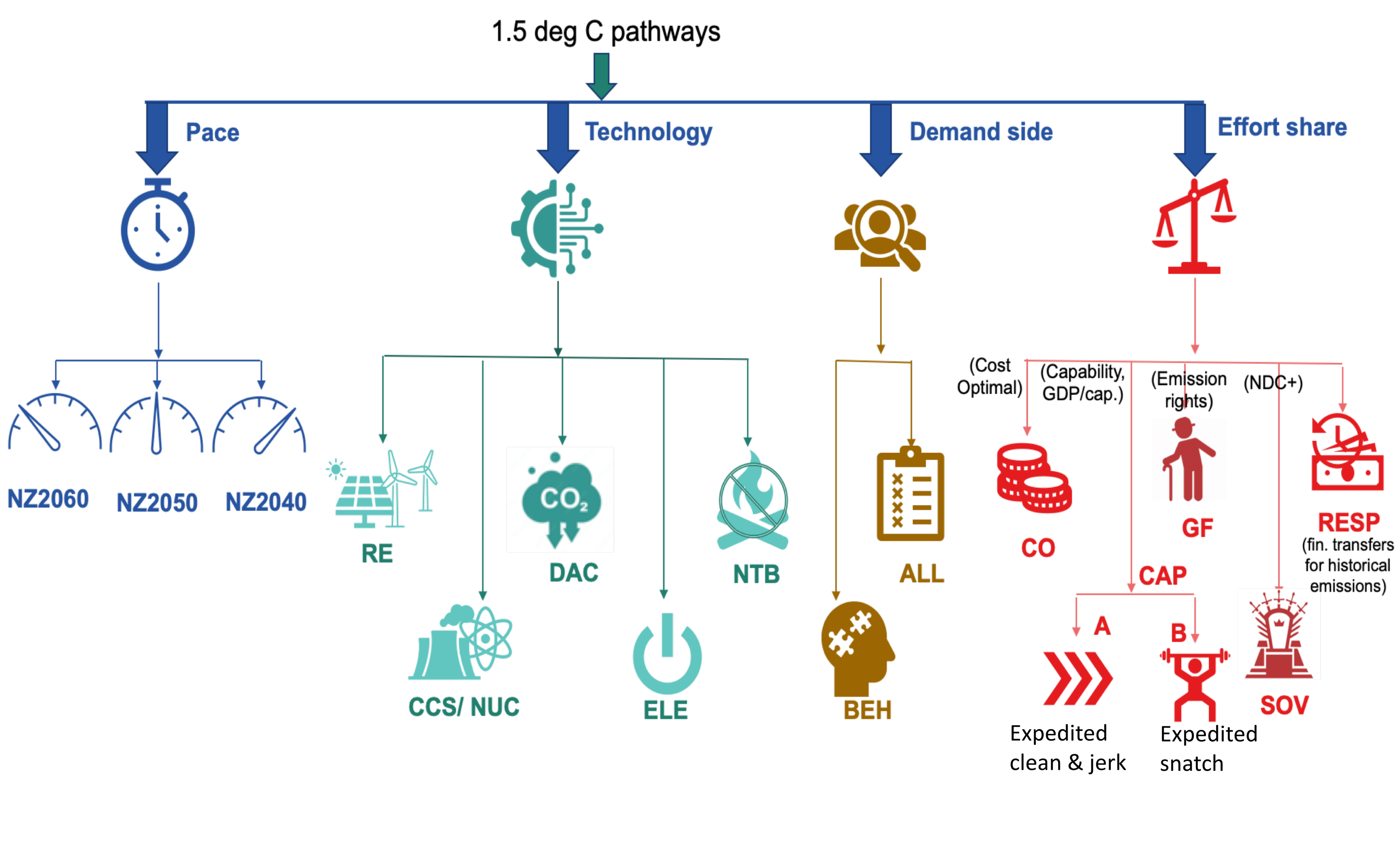
- ❑ "very little literature has formally examined distributions under 1.5C consistent pathways." *(IPCC Special Report on 1.5C, 2018)*
- ❑ Accounting for beyond-SSP pathway variations & identifying the implications of specific technologies & mechanisms
- ❑ Measuring implications on share of household income spent on all forms of residential energy services, instead of mere consumption levels *(Poblete-Cazenave et al. 2021; Cameron et al. 2016)*
- ❑ Including consideration of concomitant impacts on food prices

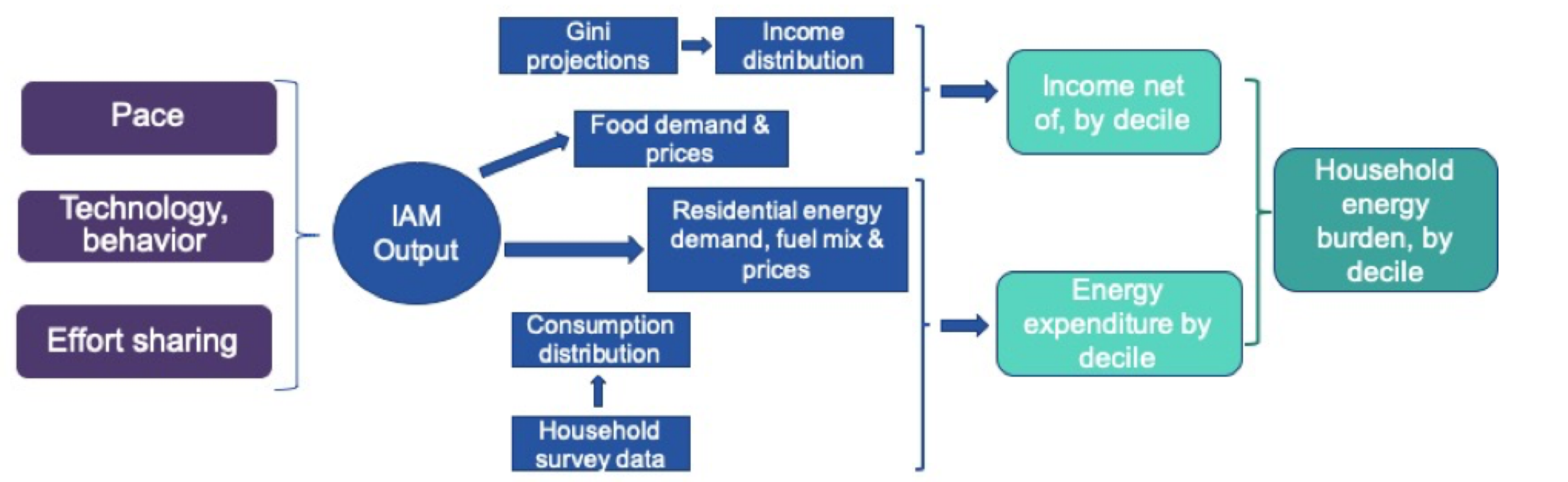
How do we do this?

17 scenarios modeled in GCAM v.5.4

Contrasting case studies: India & USA

IAM outputs combined with future income projections & household survey data to analyze change in household energy burdens relative to no new climate policy or BAU scenario

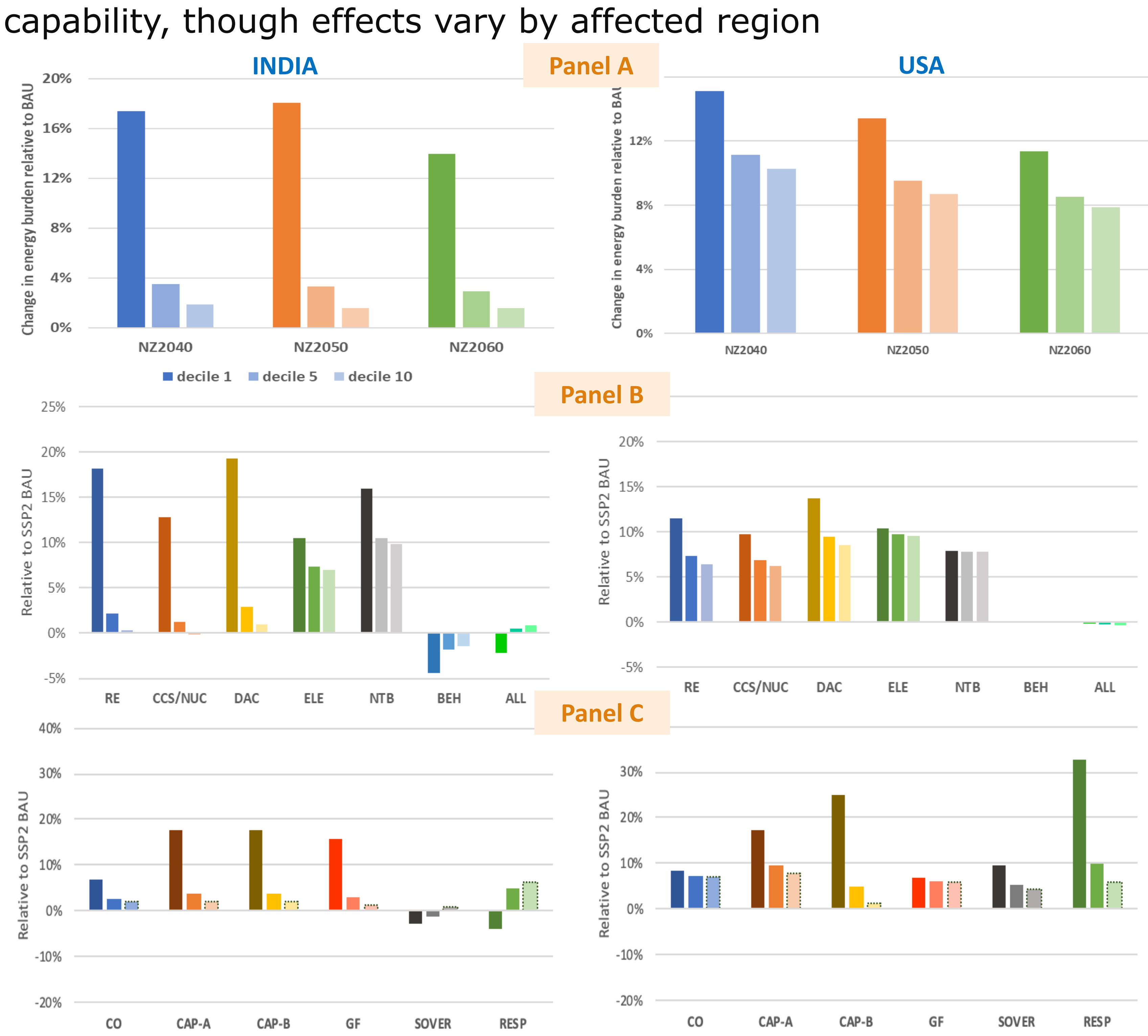




Downscaling scenario results in combination with income distribution and household survey trends

What we found

- ❑ More regressive impacts in lower income regions
- ❑ Heightened regressive effects supply side technologies are forced
- ❑ Overwhelming progressive effects in pathways with behavior changes, demand side mitigation efforts and luxury non-CO_2 emission reductions
- ❑ Regressive effects without burden sharing accounting for responsibility & capability, though effects vary by affected region



Short term (2030) impacts of diverse 1.5C consistent pathways on household energy burden changes for the poorest, middle & richest decile in India and USA. Panel A shows scenarios varying by pace of transition or global net zero year, Panel B shows supply side technology shift or demand side mitigation scenarios & Panel C shows different global effort sharing principles applied to 1.5C pathways

This matters for scholarship & policy

- ❑ Showcasing importance of improving heterogeneity modeling in IAMs
- ❑ Need to look beyond supply-side mechanisms and carbon prices for a just transition: an "all tools" comprehensive approach, including non-CO_2 emissions related to diet and affluence
- ❑ Need policies enabling consumption changes by the wealthy to limit regressive impacts on those most vulnerable

What's next?

Examining redistribution options to limit transition impacts

For more details, contact georgemv@umd.edu or scan this QR code for the full & detailed report including specific assumptions & sensitivity analyses

This work was supported under the IIASA Young Scientist Summer Program (YSSP) and funded by the US National Academy of Science, Engineering & Medicine (NASEM and National Science Foundation (NSF) Fellowships