

Reply to Grubler and Pachauri: Developing national obligations from individual emissions

We thank Grubler and Pachauri (1) for a careful reading of our PNAS article (2). In this response, we would like to further discuss their three main objections and provide some additional explanation.

Grubler and Pachauri (1) criticize our first order assumption of no change in inequality over time at the regional level, suggesting—after Kuznets—that a country's inequality first grows and then falls with economic development. Unfortunately, empirical evidence for the Kuznets curve hypothesis is extremely weak and has been disputed in several recent papers (3, 4). Only the World Bank, to our knowledge, has published projections of income distributions (5), and these are very uncertain. Thus, we took a conservative approach in our work. Note that, contrary to Grubler and Pachauri, our global distribution indeed varies over time, because our global projections are sums over EIA's 16 regions, each with its separately projected emissions growth.

Grubler and Pachauri criticize our simplifying assumption of constant elasticity between income and emissions over country and income group. Our article's supporting information reports our extensive investigation of a variable (though uniform) elasticity relating emissions to income and quantifies the robustness of our findings. The assumption of constant elasticity across income groups is standard in the literature and has been tested in several empirical works, including ones coauthored by Pachauri (6).

Finally, Grubler and Pachauri share our concern, noted in the paper, that a high tail of Indian household consumption is hidden in the Indian income distribution. Projected per capita CO₂ emissions for India in 2030 are 2.2 tons, and the tail of central interest in our paper begins at five times this value. We thank the authors for calling to our attention that the World Business Council projects 56 million private vehicles

for India in 2030. A more sophisticated model for high consumers would take such projections into account. A larger mitigation assignment for India might result, but the global implications would be minimal.

None of these objections affects the two major messages of our paper. We suggest a refocus on the emissions of individuals rather than national averages as a path to assignment of national responsibilities for mitigating climate change where every country participates. And we show that meeting basic energy needs can be accommodated via fossil-carbon sources, where convenient, with limited implications for the solution of the climate problem.

We share the view of Grubler and Pachauri that any politically useful scheme must be simple. Nonetheless, we need frameworks that can address concerns about equity and deal with the dynamic process of sharing the burden among countries in a rapidly changing world. We believe that our approach provides a tool for thinking about these issues over time as various countries grow at different rates.

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The authors declare no conflict of interest.

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