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From Planetary Boundaries to national fair shares of the global safe operating space - How can the scales be bridged?

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The planetary boundaries framework proposes precautionary quantitative global limits to the anthropogenic perturbation of crucial Earth system processes. In this way, it marks out a planetary 'safe operating space' for human activities. However, decisions regarding resource use and emissions are mostly made at much smaller scales, mostly by (sub-)national and regional governments, businesses, and other local actors. To operationalize the planetary boundaries, they need to be translated into and aligned with targets that are relevant at these smaller scales. In this paper, we develop a framework that addresses the three dimension of bridging across scales: biophysical, socio-economic and ethical, to provide a consistent universally applicable approach for translating the planetary boundaries into national level context-specific and fair shares of the safe operating space. We discuss our findings in the context of previous studies and their implications for future analyses and policymaking. In this way, we help link the planetary boundaries framework to widely- applied operational and policy concepts for more robust strong sustainability decision-making.