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Mitigation and Adaptation Emissions Embedded in the Broader Climate Transition

Corey Lesk[1], Denes Csala[2], Robin Krekeler[3], Sgouris Sgouridis[4], Antoine Levesque[3], Katharine Mach[5], Daniel Horen Greenford[6], H. Damon Matthews[6], and Radley Horton[1]

[1]Lamont-Doherty Earth Observatory, Palisades, NY, USA (csl2164@columbia.edu)

[2]University of Lancaster, Lancaster, UK (d.csala@lancaster.ac.uk)

[3]Potsdam Institute for Climate Impact Research, Member of the Leibniz Association, Potsdam, DE

[4]Dubai Electricity and Water Authority, R&D Center, Dubai, UAE

[5]Department of Environmental Science and Policy, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, FL, USA, & Leonard Jayne Abess Center for Ecosystem Science and Policy, University of Miami, Coral Gables, FL, USA.

[6]Department of Geography, Planning and Environment, Concordia University, Montréal, Québec

Climate change necessitates an immediate and sustained global effort to reduce greenhouse gas emissions while adapting to the increased climate risks caused by historical emissions. This broader climate transition will involve mass global interventions including renewable energy deployment, coastal protection and retreat, and enhanced space cooling, which will result in CO_2 emissions from energy and materials use. Yet, the magnitude of these emissions remains largely unconstrained, leaving open the potential for under-accounting of emissions and conflicts or synergies between mitigation and adaptation goals. Here, we use a suite of models to estimate the CO_2 emissions embedded in the broader climate transition. For a pathway limiting warming to 2°C, we estimate that selected adaptations will emit ~1.5GtCO_2 through 2100. Emissions from energy used to deploy renewable capacity are much larger at ~95GtCO_2, equivalent to over two years of current global emissions and ~8% of the remaining carbon budget for 2°C. These embedded transition emissions are reduced by 80% to 20GtCO_2 under a rapid decarbonization scenario limiting warming to 1.5°C. However, they roughly double to 185GtCO_2 under a low-ambition transition consistent with current policies (2.7°C warming by 2100), mainly because a slower transition relies more on fossil fuels. Under this status-quo, the emissions embedded in the transition total nearly half the remaining carbon budget for 1.5°C. Our results provide the first holistic assessment of the carbon emissions embedded in the transition itself, and suggest that these emissions can be largely minimized through rapid energy decarbonization, an underappreciated benefit of enhanced climate ambition.