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The sustainable development implications of carbon removal technologies in the context of net-zero climate pathway.

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Achieving a global net-zero emission pathway around mid-century is a critical precondition to limiting global warming to well below 1.5°C. The role of carbon dioxide removal technologies (CDR) such as direct air capture (DAC) and enhanced weathering (EW) have gained centre stage in the discourse of net-zero emission policies. Using an integrated energy-economy-climate modelling tool called GCAM, this study examines the broad sustainability implications of deploying CDR technologies of a global net-zero pathway. Specifically, the applies several Sustainable Development Goals (SDG) indicators as a lens to assesses the synergies and trade-offs associated with upscaling the deployment of DAC and EW technology options.

Based on the best techno-economic performance estimates of DAC and EW technologies, the results show that these technologies can provide about 10.2GtCO2/year of negative emission by 2065. The upscaling of these CDR technologies can substantially reduce the short-to-medium term mitigation cost by about 54.3 %. This policy cost reduction has potential to ameliorate the adverse economic impact of a net-zero pathway by enhancing the SDG targets of No Poverty (i.e. SDG 1) & Decent work and economic growth (i.e. SDG 8). The results also reveal that CDR technologies can reduce the global temperature overshoot by 0.2°C (i.e. SDG 13 (Climate Change)). Further, these CDR solutions can substitute the demand of bioenergy, which in turn leads to major gains in the reduction of cropland (i.e. SDG 15 (Life on Land)).

The enormous transformations in the global energy system to meet the high energy demand for CDR technologies can lead to substantial trade-offs. For instance, the result points to a 27.3% increase in fossil fuel use, nuclear fuel, and carbon sequestration. This trend is counter to the SDG of “responsible consumption and production” (i.e. SDG 12). Also, due to the high capital cost associated with CDR technologies, deploying these technologies at scale has the potential to exacerbate the average cost of energy. Relatively, the increase in energy prices can have adverse effect affordability of energy (i.e. SDG (Affordable and clean energy)). Finally, the result shows other potential security trade-offs in the food and water sectors. Overall, the results provide instructive policy insights about the importance of designing strategies that balance the short and long-term costs and risks of net-zero and CDR technologies.