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Using an emulator to apply a Carbon Takeback Obligation alongside demand-side carbon pricing in Integrated Assessment Models

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Integrated Assessment Model (IAM) design philosophy currently focuses on demand-side global carbon pricing as the principal policy tool to drive mitigation. However, ambitious mitigation scenarios produced with these IAMs rely heavily on the availability of carbon capture and storage (CCS) technologies in the mid-century, at the scale of billions of tonnes. If integrated assessment continues to employ demand-side policies exclusively we risk a gap forming between the requirements of economically-optimal mitigation trajectories in these IAMs and the reality of developed CCS capacity.

If CCS capacity fails to keep up with the ambition of mitigation policy, carbon prices could rise well above the cost of direct air capture as markets aim to drive residual emissions down. To avoid this, scenarios could include both supply and demand-side policies in tandem, where supply-side policies are targeted to increase CCS capacity to appropriate levels.

One such supply-side policy option is a Carbon Takeback Obligation (CTBO), where suppliers of fossil carbon are required to recapture and store an increasing fraction of the carbon in their products. This 'stored fraction' would be increased from near zero at present, up to 100% at the time of net-zero. By applying such a policy suppliers of fossil carbon products are forced to take responsibility for decarbonising their own products and provide the drive to develop the CCS capacity necessary to achieve net-zero emissions in the mid-century. In theory, if a CTBO was enforced globally the costs associated with the production of one tonne of CO_2 would be capped around the price for the capture, transport and storage of diffuse, mobile, or otherwise hard-to-abate CO_2 emission sources (i.e. the cost of direct air capture).

Here, we discuss the implementation of a global CTBO. Using an Integrated Assessment Model emulator, tuned to existing IAM carbon price/abatement rate relationships, we explore the total policy cost of applying a CTBO globally to achieve net-zero by 2050. Using the emulator we harmonise the combined CTBO and demand-side carbon price policies, and show how a SSP2-26 level of ambition can be achieved using these policies with a similar total policy cost. Further, we explore what additional near-term carbon prices can be included to achieve SSP2-19 level policy

ambition. These results suggest there are significant benefits to defining climate policy around measures targeting suppliers of fossil carbon, including for long-term planning, implementation and governance of the policy, and overall cost. For further insight, and to provide a greater variety of policy options feeding into IPCC's WG3, we argue IAMs should look to include CTBO-like policies in future scenario design.