C2G
Carnegie Climate Governance Initiative

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POLICY BRIEF

Direct Air Carbon Dioxide Capture & Storage (DACCS)

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Carbon Dioxide Removal (CDR), also known as negative emissions, aims to address the primary driver of climate change by removing carbon dioxide (CO_2) from the atmosphere and ensuring its long-term storage. Direct Air Carbon Dioxide Capture and Storage (DACCS) is an approach to CDR which may have the potential to contribute to slowing the rate of global warming and help prevent ocean acidification. DACCS should not be confused with Carbon Capture and Storage (CCS). DACCS captures CO_2 directly from ambient air and subsequently stores it. CCS stops additional new CO_2 from entering the atmosphere at its point of source[1].

According to the Intergovernmental Panel on Climate Change (IPCC) all pathways to keep global warming under 1.5°C project the need for CDR to remove between 100 and 1000 Gigatonnes (Gt) of accumulated CO_2 from the atmosphere by 2100. CDR methods that could potentially contribute to this target include nature-based approaches such as afforestation, or engineering-based approaches, such as DACCS, that aim to directly capture CO_2 from ambient air. They all vary in their potential, readiness, permanence, cost, and risks of negative side-effects.

DACCS seeks to separate CO_2 from the air, using engineering approaches and to store the sequestered carbon in ways that will not contribute to global warming, for example, in geologic storage. It is essential to avoid leakage of the captured carbon. This will require infrastructure, financing and robust governance frameworks over the very long term. Such governance would need to encompass, for example, transport to depositories, addressing the environmental impacts of facilities, safe management, ensuring secure financing, including through market instruments and arranging compensation mechanisms for leakage harm.

Currently, DACCS technologies are situated between the pilot plant stage and prototype demonstration in the field. Currently, only one is permanently sequestering the captured CO_2. However, large-scale systems are expected to be available by 2030 and DACCS may have a global capture and sequestration potential of 0.5 to 5 Gt per annum by 2050.

DACCS plants would have high heat or energy requirements and would depend on a reliable and secure power supply such as low-carbon, low impact renewable sources, nuclear power or by co-locating plants with industrial processes that emit waste heat. Currently, there is insufficient global supply from such sources to satisfy the demand of DACCS working at Gigatonne-scale. DACCS plants would also require access to secure and sustainable water resources.

Recent estimates of the financial costs of mature DACCS technologies range from USD $100 to $300 per tonne of CO_2 captured. This large range reflects uncertainties about future energy requirements and costs. The costs of policy development may also be considerable. Given uncertainty about how a market for DACCS infrastructure might function, coupled with the energy requirements and costs, DACCS may not be commercially viable in the short term.

If DACCS energy and water needs were met in sustainable ways, DACCS is unlikely to harm ecosystems, where due attention is paid to location, construction and maintenance of the infrastructure. However, a full life cycle assessment of DACCS technologies is required before a definitive environmental assessment can be made.

While DACCS may become an important element of plans to reach net zero, it is important to remember that it cannot be a substitute for rapidly reducing greenhouse gas (GHG) emissions given the scale of the challenge. It is also important to note that the impact of DACCS deployment on global temperature change would not be immediate, and any DACCS deployment is likely to take decades to affect temperatures.

DACCS governance

DACCS instillations, which are likely to have a footprint comparable to medium-sized industrial facilities are not expected to cause environmental, economic, social and political transboundary harm requiring international governance.

DACCS facilities would not need to be in sensitive areas, or close to populations and would not produce any significant pollution. However, it has been suggested that there may be opposition to DACCS if its deployment is seen to create a form of moral hazard by delaying climate change mitigation efforts.

Transparent monitoring, reporting and verification (MRV) of the carbon sequestration achieved by DACCS will be required to both monitor global progress, and to provide accurate accounting of states' contributions and any carbon sequestration credits that may accrue.

DACCS MRV will be complex and may create novel challenges for United Nations Framework Convention on Climate Change (UNFCCC) and its associated mechanisms. Further, CO_2 captured by DACCS may not be permanently stored within the capturing country's borders.

It is also unclear how the international community might agree, set and stabilise atmospheric CO_2 concentration targets over the long-term. Nor how this process, and the outcomes of the decisions taken, can balance the individual interests of nation states with the global need to reduce CO_2 concentrations in the atmosphere.

More detailed information about DACCS is available in C2G's Policy and Evidence Briefs.

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[1] When DAC occurs, and the removed gas is stored it becomes DACCS. DAC is a subset of DACCS – the first element of the process after which the gas can be stored or used, for example in fuel manufacture.