

The difference between CCS, CCU, and CDR – and why it matters

While carbon dioxide removal, carbon capture and storage, and carbon capture and utilisation are methods of the broader family of 'carbon management', they have different impacts on climate change due to their crucial divergence in source and destination of handled CO₂. Clear distinctions of these terms are essential to enable effective climate action, avoid greenwashing and strengthen public confidence.

Carbon capture and storage (CCS) is the separation of CO₂ from industrial exhausts coupled with the permanent geological storage of that carbon (applied, e.g., on cement, steel, power plants, chemical production facilities, etc.). When the origin of the CO₂ is exclusively fossil or geological carbon (e.g., fossil fuels, limestone), then this action is emission reduction, not carbon removal. **Carbon dioxide removal and CCS are distinct, but some carbon dioxide removal methods (e.g., direct air capture) may share the same capture processes or long-term storage infrastructure used for conventional CCS.**

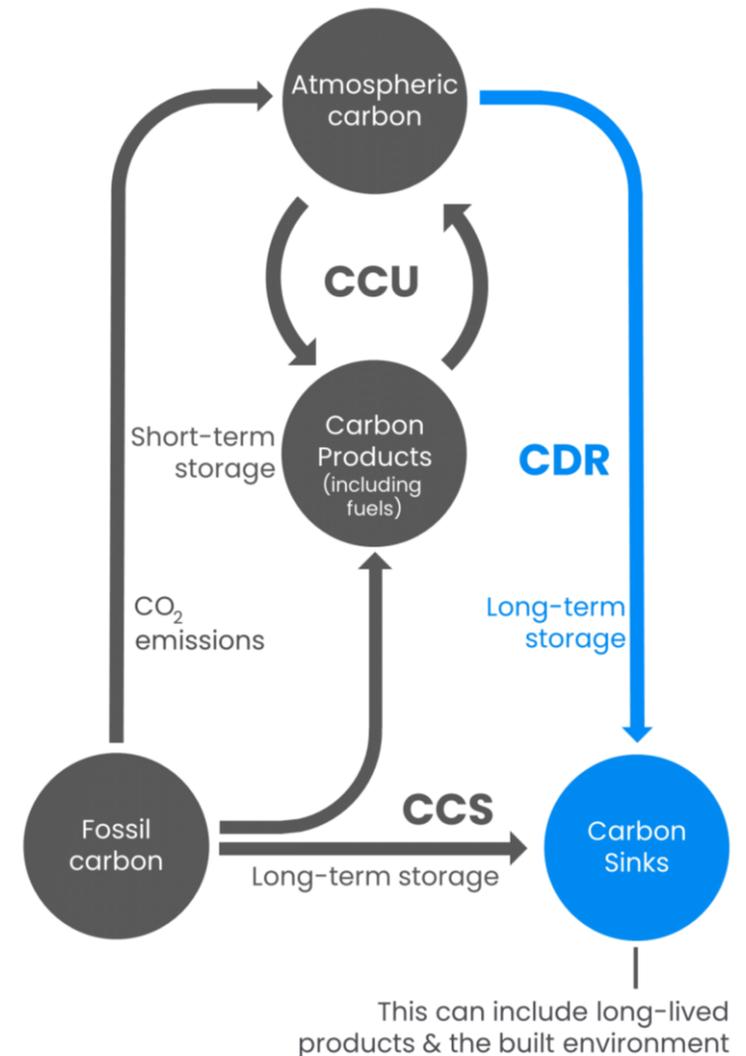
Carbon capture and utilisation (CCU) is part of a broader set of 'carbon recycling' applications, describing the reuse of captured carbon either directly (e.g., to fertilise greenhouses, in beverages) or as an ingredient in new products (e.g., concrete, fuels, chemicals). CCU can displace additional fossil fuel use, thereby reducing emissions. If the carbon is removed from the atmosphere and stays in a closed loop over many decades or centuries (e.g. when incorporated into cementitious building materials), the method may be considered removal. All other cases of CCU, in which carbon is rapidly (re-)released to the atmosphere, only delay (re-)emissions. **As most captured carbon is not durably stored, CCU is generally not considered removal.**

Carbon Dioxide Removal (CDR) refers to "anthropogenic activities removing CO₂ from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products" (IPCC). Removals can 1) accelerate the reduction of net emissions (immediately), 2) counterbalance 'hard-to-abate' emissions (near-term), and 3) deliver net negative emissions (long-term). Carbon removals lead to the **generation of "negative emissions"**, which are crucial in achieving our climate goals. In the words of the IPCC,

"the deployment of CDR to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO₂ or greenhouse gas (GHG) emissions are to be achieved"

CDR's deployment is currently facing many obstacles and legitimate questions around how it can be developed and maintained as an effective, ethical, and scalable means of addressing climate change. While the need for ambitious emission reductions cannot be overstated, the need for CDR is clear as well. Unlocking the full potential and range of opportunities of CDR starts with effective political discussions and clear distinctions of what it is, and what it isn't.

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