INSTITUTE for CARBON REMOVAL LAW AND POLICY

IPCC Working Group III Report: Key Findings for Carbon Dioxide Removal

The Institute for Carbon Removal Law and Policy (ICRLP) has created a resource summarizing key findings on CDR. This is a living document that will be uploaded to the ICRLP website soon

Introduction

Building on prior reports from the United Nations' Intergovernmental Panel on Climate Change (IPCC), the newest Working Group III report reaffirms that the world needs to remove gigatons of carbon from the atmosphere to meet the goals of the Paris Agreement.[1] The IPCC report also highlights that carbon removal must happen in tandem with, not as a replacement for, reducing emissions. Carbon removal has a number of roles to play in climate policy. One is to clean up legacy climate pollution, and another is to work alongside emissions abatement efforts to clean up the carbon pollution associated with hard-to-abate sectors. Carbon removal is also referred to as carbon dioxide removal (CDR).

IPCC reports are widely recognized as the most authoritative assessment of the science on climate change. They set the gold standard on science for policymakers. The Institute for Carbon Removal Law and Policy has created a resource with background information about the IPCC report, key findings from Working Group III related to carbon removal, and a summary of how the newest report builds on prior IPCC recommendations for carbon removal.

Reducing atmospheric concentrations of CO2 — currently over 400 parts per million, up roughly 25% since the Industrial Revolution — would require significantly scaling multiple carbon removal efforts (while continuing to reduce emissions). Accelerated research, development, and deployment of carbon removal solutions are required to combat climate change. As this work continues, community input and attention to climate justice are crucial to ensuring that both technological and nature-based solutions are deployed responsibly. The total amount of CDR required to meet the 1.5°C goal will depend on the pace of emissions reductions, especially in hard-to-abate sectors, and the scale of funding and innovation dedicated to carbon removal efforts.

Overview

The Working Group III report is released by the IPCC, which is a UN-convened panel of 195 member governments established in 1988 to provide policymakers with regular scientific assessments on the current state of knowledge about climate change. The Working Group reports help frame climate policy for countries around the world.

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[1] A gigaton is a unit of mass equivalent to one billion metric tons (2.2 trillion pounds), and is often used when discussing human carbon dioxide emissions. All of humanity's carbon dioxide emissions currently equal around 40 gigatons per year, climbing to 50 gigatons of carbon dioxide equivalent when other gasses that contribute to global warming are factored in. Keeping this figure of 40–50 gigatons of current emissions in mind can be helpful when trying to understand the magnitude of carbon removal called for by scientific assessments.

The Working Group III report covers pathways and options for limiting global warming, particularly in line with the goals of the Paris Climate Agreement[2] (2°C and 1.5°C by the end of the century). The report finds that carbon dioxide removal at multi-gigaton scale is required to limit warming to 1.5°C. Specifically, the report looks, in the nearer term, at the role of carbon removal in relation to hard-to-abate sectors, such as food production, long haul aviation, and steel production. In the longer term, scaling up CDR has the potential to help reduce legacy emissions by providing net-negative CO2 emissions (i.e. a net drawdown of CO2 from the atmosphere), and this must be done in tandem with mitigation efforts.

Scientists generally agree that carbon removal at scale can have beneficial climate impacts, and that it will require a variety of approaches. As stated by the IPCC in the 2018 special report, "Feasibility and sustainability of CDR use could be enhanced by a portfolio of options deployed at substantial, but lesser scales, rather than a single option at very large scale (high confidence)" (2018 SPM, pg 17). CDR methods differ with respect to their "maturity, removal process, timescale of carbon storage, storage medium, mitigation potential, cost, co-benefits, impacts and risks, and governance requirements" (WGIII SPM, C.11.1). Nature-based solutions, like reforestation, use natural processes to capture and sequester carbon. Technological solutions use engineered technologies to do the same thing. Many CDR approaches lie somewhere on a continuum between natural and technological approaches. Investing in a variety of approaches is the best precautionary path for mitigating climate change.

WGIII Key Findings on Carbon Removal

The Working Group III report has several references to carbon removal. Key findings and contextual notes:

- **CDR Balances Hard to Abate Sectors**: The IPCC finds that CDR is necessary to counterbalance emissions in hard-to-abate sectors, reporting that it is the only way to reach net zero emissions. Specifically, the IPCC states: "The deployment of CDR to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO2 or GHG emissions are to be achieved" (WGIII SPM, C.11).

- **CDR Can Help Limit Warming to 1.5 Degrees**: The WGIII report makes clear that there are still pathways available to limit warming to 1.5°C, which is the target set by the Paris Agreement, and emphasizes the dangers of overshooting 1.5°C. For pathways that return warming to below 1.5°C by 2100, with an overshoot of 0.15-0.3°C, global cumulative net-negative CO2 emissions are 380 [-860 to -200]" gigatons in the second half of the century (with rapid acceleration

[2] The Paris Agreement is a legally binding international agreement on climate change. It was adopted by 196 parties at COP21 in Paris, on December 12, 2015 and entered into force on November 4, 2016. Its goal is to limit global warming to well below 2˚C, preferably to 1.5˚C, compared to pre-industrial levels.

of other mitigation efforts across all sectors after 2030) (WGIII SPM, B.6.4). Such overshoot pathways are subject to large uncertainties in terms of feasibility, and large-scale deployment of CDR in such pathways entails greater climate-related risks (WGIII SPM, B.6.4). At the point of global net zero CO2 emissions in projected IPCC pathways, 5-16 gigatons of emissions from some sectors are "compensated for by net negative CO2 emissions in other sectors" (WGIII SPM, C.3.3). Net zero GHG emissions imply net negative CO2 emissions (to compensate for residual emissions of other GHGs and emissions from hard-to-abate sectors). While WGI highlighted that time is rapidly running out to avoid overshooting 1.5C, and WGII stated that overshooting 1.5C would have serious consequences, WGIII notes that avoiding overshoot means rapidly cutting fossil fuel use and using CDR to get to net-zero sooner by counterbalancing residual emissions (WGIII SPM, C.3).

- **Further CDR Scaling, Innovation, and Accounting Needed**: The report finds that the scale of CDR needed depends upon the rate and scale of decarbonization in hard-to-abate sectors, as well as reduced costs of CDR. Although current decarbonization models in the IPCC report do not forecast considerable success for lowering prices, prior general economic cost forecasts in IPCC reports also failed to forecast major innovations in wind, solar, and energy storage (WGIII Technical Summary, page 25). In the longer term, and at a global scale, scaling up CDR responsibly requires accelerated research and development, improved tools for risk assessment and management, targeted incentives, the development of agreed methods for measurement, and robust reporting and verification of carbon flows (WGIII SPM, C.11.5). Upscaling of CDR must ramp up now in order to ensure effective deployment at scale.

- **Nature-Based & Technological Approaches are Complementary:** The report finds that Agriculture, Forestry and Other Land Use **(**AFOLU) could offer a mitigation potential of 8-14 gigatons of CO2/year over the next 30 years at less than $100/ton (WGIII SPM, C.9.1). AFOLU mitigation options have "both co-benefits and risks in terms of biodiversity and ecosystem conservation, food and water security, wood supply, livelihoods and land tenure and land-use rights of Indigenous Peoples, local communities, and small land owners" (WGIII SPM, C.9.2). An article in MIT Technology Review covers how nature-based solutions can work in tandem with technological approaches, which require less land area and can have longer CO2 storage (WGIII SPM, C.11.3). Multiple CDR approaches may be required to reach necessary scales of removal.

- **Categorizing CDR with Carbon Capture and Storage (CCS) is Inaccurate:** The IPCC correctly places CDR and CCS in separate sections of the report. CDR and CCS are two distinct approaches to climate mitigation that use similar and overlapping vocabulary, but undertake very different activities via radically different approaches. CDR draws carbon dioxide back down from the

atmosphere with approaches like direct air capture[3], reforestation, and Bioenergy with Carbon Capture and Storage (BECCS). Carbon removal can address legacy emissions, which makes it a unique tool for meeting the goals of the Paris Agreement. Conversely, CCS does not remove carbon but instead reduces the amount of carbon added to the atmosphere. The IPCC makes a distinction between CCS as an option for reducing emissions from fossil fuels, and CDR as a means for removing carbon from the atmosphere.

IPCC's Previous Findings on Carbon Removal

The Working Group III report is the latest affirmation from the IPCC on the importance of carbon removal. The IPCC's WGII 2022 report, WGI 2021 report, and 2018 special report all identified limiting warming to 1.5°C as necessary for preventing irreversible climate catastrophes. The 2018 special report indicated, based on computer model runs, that there are few pathways forward that do not require some amount of carbon removal. The WGIII report doubles down on the importance of CDR, stating that it is required globally and nationally to limit warming to 1.5°C and reach net-zero emissions targets (WGIII Technical Summary, page 94).

- In 2018, the IPCC's special report mentioned negative emissions and stated that the success of most 1.5°C and 2°C pathways is heavily reliant on large-scale CDR before mid-century. The report found that global emissions of CO2 would need to fall by about 45 percent from 2010 levels by 2030, reaching "net zero" around 2050 (2018 SPM, pg 12).
- In the 2018 report, "all pathways that limit global warming to 1.5°C with limited or no overshoot" project the use of CDR on the order of "100–1000" gigatons of CO2 over the 21st century. Pathways that overshot 1.5°C of global warming relied on CDR to compensate for residual emissions in order to return to below 1.5°C by 2100, with larger overshoots requiring greater amounts of CDR (2018 SPM, pg 17).
- The WGI report in 2021 underscored that climate impacts are here and now and that the world's carbon budget is shrinking. According to projections, for the period of 1850-2019, a "total of 2390 ± 240 GtCO2 of 56 anthropogenic CO2" was emitted. Remaining carbon budgets (from January of 2020) for limiting warming to 1.5°C are estimated at 500 gigatons of CO2 for the 50th percentile, and 400 gigatons of CO2 for the 67th percentile (WGI Technical Summary, pg 71). These estimates assume that non-CO2 emissions are simultaneously mitigated.
- The WGI report also noted that "CDR approaches could be used to compensate for residual emissions from sectors that are difficult or costly to abate. CDR could also be implemented at a large scale to generate global net negative CO2 emissions " (WGI Technical Summary, pg 73).
- The WGI report noted that "deployment of CDR, particularly on land, can also affect water quality and quantity, food production and biodiversity" and that "these

[3] Direct air capture uses large industrial vacuums to remove carbon from the atmosphere and store it underground.

effects are often highly dependent on local context, management regime, prior land use, and scale" (WGI Technical Summary, pg 74). In this sense, CDR is not a silver bullet and must be responsibly pursued alongside diverse mitigation efforts.

- The WGII report released earlier in 2022 also highlighted the importance of avoiding an overshoot scenario. The report doubled down on the importance of strictly limiting warming to 1.5°C. CDR can play a role in reaching this goal by addressing emissions pollution in hard-to-abate sectors.