The Economist INTELLIGENCE UNIT

Investing in carbon removal: Demystifying existing approaches

Benchmark methodology report

Prepared by The Economist Intelligence Unit

September 2020

The Economist INTELLIGENCE UNIT

Table of contents

Overview

Ignoring climate change risk is no longer an option. Many of the climate scenarios that keep global warming within the 2°C level by 2100 established by the 2015 Paris Agreement rely both on the reduction of new carbon emissions as well as the removal of substantial quantities of existing emissions from the atmosphere. Removal is required for two reasons: First, the carbon dioxide already in the atmosphere will contribute to warming even if the world suddenly stopped emitting. Second, there are sectors such as agriculture and aviation that will be challenging to decarbonise soon.

The literature is clear that both mitigation and removal are required: carbon dioxide removal (CDR) is not a substitute for mitigation efforts, as the majority of removal will occur in the latter half of the 21st century, requiring continued near-term efforts to decarbonise the global economy.

Fortunately, there exist a number of carbon dioxide removal (CDR) solutions. With efforts to decarbonise the global economy falling short, these solutions will play an increasingly critical role in planning to meet the warming targets agreed to in the Paris Agreement. The literature on these removal solutions is in broad agreement that no single technology will be sufficient by itself and that an array of solutions applied together will be necessary.

About this report

The Economist Intelligence Unit (EIU) has developed a benchmark framework, sponsored by the ClimateWorks Foundation, to assess the current level of readiness of seven carbon removal technologies. The methodology for this benchmark, including pillars and indicator definitions, scoring criteria, and data sources, is provided below. The benchmark methodology and related research were informed by extensive research and guided by interviews with experts.

The Economist Intelligence Unit extends its gratitude to the following individuals (listed alphabetically) who have generously contributed their views and insights to the research and development of this benchmark: Alex Rudee, Associate, Carbon Removal, World Resources Institute; Katie Lebling, Associate, Carbon Removal, World Resources Institute; Neil Stein, Research Analyst, Carbon Removal, World Resources Institute;; and Eli Sari, Ph.D., Peatland Restoration Specialist, World Resources Institute Indonesia.

The CDR benchmark was created by Michael Paterra, Matt Terry and Zubair Fattahi of The Economist Intelligence Unit, with analytic support provided by Shilpa Shankar. The Economist Intelligence Unit bears sole responsibility for the content of this report. The findings and views expressed in the report do not necessarily reflect those of the sponsor.

Methodology

Definition of CDR solutions

For the purposes of this benchmarking framework, we defined CO_2 removal solutions as technologies or activities that have the ability to remove carbon from the atmosphere (i.e., those which go beyond carbon neutrality, actively removing carbon from the atmosphere).

Selection criteria

The benchmark assesses seven CDR solutions. These were selected after a review of the current literature, expert interviews and in consultation with the ClimateWorks Foundation and the Climate and Land Use Alliance. Consideration was given to solutions with sufficient background data and research to enable effective analysis.

We also sought to include a range of different solutions across both technical and natural sciences, and encompassing multiple stages of readiness (see Table 1).

Table 1. A portfolio of CDR solutions

NATURAL	COMBINED (NATURAL AND TECHNOLOGICAL)	TECHNOLOGICAL
Afforestation/ reforestation	Bioenergy carbon capture use and storage (BECCS)	Direct air capture
Peatland rewetting	Mass timber	Carbon mineralisation
Agricultural soil management		

Framework development

The benchmarking framework was developed using a two-step process. First, The EIU carried out a review of scientific literature to inform the selection of factors that contribute to the effectiveness, readiness and potential of CDR solutions.

Second, The EIU consulted eight experts as a means of verifying the choice of indicators and overall construction of the benchmark framework. Experts consulted (listed alphabetically) include Giana Amador (Carbon180), Katharine Mach (University of Miami), Greg Nemet (University of Wisconsin-Madison), Steve Pacala (Princeton University), Phil Renforth (Heriot-Watt University), Dan Sanchez (University of California, Berkeley), Pete Smith (University of Aberdeen) and Jennifer Wilcox (University of Pennsylvania and World Resources Institute).

Based on this due diligence, the benchmark framework is organized around three core pillars, which represent broad areas in which each CDR solution is assessed:

1. **Carbon removal potential** – assesses the maximum volume of carbon that could be removed by this approach now and in the future.
2. **Commercial potential** – assesses deployment readiness and the commercial potential of this approach now and in the future.
3. **Social and environmental impacts** – assesses the social and environmental impacts of each approach, beyond its climate mitigation benefits.

The following table consists of a list of all 11 indicators in the benchmark, organized by pillar.

#	Pillar / Question	Scoring criteria
1	**Removal potential and permanence**	
1.1	What is the estimated carbon removal potential per year?	**Limited**: <1 GtCO2/year **Moderate**: 1-3 GtCO2/year **High**: >3 GtCO2/year
1.2	How long before full removal potential is realized?	**Long-term** (30+ years) **Medium-term** (10-30 years) **Near-term** (0-10 years)
1.3	What is the risk of re-releasing captured carbon into the atmosphere?	**High risk**: Captured carbon may be released within a decade. **Medium risk**: Some captured carbon may be released within 50 years. **Low risk**: The carbon storage is expected to last for 50-100 years or more with little risk of reversal.
2	**Commercial potential**	
2.1	Current cost per ton	**High cost**: Majority of potential exceeds $200 per tCO2 **Moderate cost**: Majority of potential available for $100-200 per tCO2 **Low cost**: Significant potential available for <$100 per tCO2
2.2	Expected cost impacts from further R&D	**Limited:** No expected cost impact from R&D **Moderate:** Some cost reduction expected **High:** Significant cost reduction expected
2.3	Readiness for scaled deployment	**Low**: In proof of concept or demonstration phase **Medium**: Examples of commercialization exist **High**: Commercially available already; widely deployed
2.4	Commercial value from products or other services	**Limited** or no commercial value expected from products or environmental services **Moderate** commercial value expected from products or environmental services **High** commercial value expected from products or environmental services
2.5	Need for enabling infrastructure	**High**: Multiple types of large-scale infrastructure are required, such as advanced facilities and new pipelines. **Moderate**: Some large-scale infrastructure development may be required. **Low**: There is no large-scale infrastructure development required to implement this approach.

3	Social and environmental benefits	
3.1	Is there competition with other sectors for natural resources or energy?	**High competition**: In most applications this solution would compete with other negative emissions technologies or society at large for resources. **Moderate competition**: In some applications this solution would compete with other negative emissions technologies or society at large for resources. **Limited competition**: In few to no applications would this solution/technology compete with other negative emissions technologies or society at large for resources.
3.2	Are there known social or environmental risks from deploying this approach?	**High risks**: Known social and/or environmental impacts. **Moderate risks**: Potential social and/or environmental impacts. **Limited risks**: Little or no known social or environmental impacts.
3.3	Are there known social or environmental co-benefits from deploying this approach?	**Limited benefits**: Little or no known social and/or environmental co-benefits **Moderate benefits**: Potential social and/or environmental co-benefits. **High benefits**: Known social and/or environmental co-benefits.

Data sources

All quantitative and qualitative data for the benchmark were collected and analysed by the EIU project team. Data were gathered from reputable academic, scientific and public sources, with key attention being given to meta-analyses of the literature on negative emissions solutions. We also drew on the insights collected in our interviews with climate and technology experts.

Scoring

Solutions were scored on each question based on the available literature and expert input. Pillar level assessments have been made qualitatively based on available evidence.

For additional detail, including full explanations and references for assigned scores, please download the full benchmark workbook at carbonremoval.economist.com.