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The Economic Opportunities of Highly Durable CDR: Summary for Policymakers

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Galen Bower (gbower@rhg.com), Nathan Pastorek (npastorek@rhg.com), John Larsen (jwlarsen@rhg.com)

The emerging industry of carbon dioxide removal (CDR) encompasses an array of innovative solutions that are ready for takeoff. The US has an opportunity to maintain and enhance its position as a global leader in this space thanks to its high geologic carbon dioxide (CO_2) storage potential, varied landscapes, skilled workforce, and advanced research capabilities. While climate change mitigation may be the primary motivation for CDR support, a host of additional benefits will accompany a scaling of this industry. These include economic, social, and environmental benefits. Given the diversity of CDR approaches, these opportunities will be distributed over a range of workers, communities, and ecosystems.

Job opportunities associated with scaling CDR

In this analysis, we focus on leading highly durable forms of CDR—those that keep CO_2 out of the atmosphere for at least 1,000 years—included in our recent Landscape of CDR report. The five CDR approaches we explore are enhanced rock weathering (ERW), biomass with carbon removal and storage (BiCRS), direct ocean capture (DOC), ocean alkalinity enhancement (OAE), and direct air capture (DAC). As CDR continues to gain momentum, companies with new and compelling methods to remove CO2 will keep popping up. The rapidly evolving nature of this field underscores the importance of tech neutrality when developing CDR policies.

Each CDR project type is unique in process, location, and capture capacity. To provide an idea of CDR employment opportunities once the industry has reached commercialization in the US, we conducted an analysis exploring cumulative CDR jobs associated with scaling each approach to capture 20 million metric tons (MMT) of CO_2 annually—totaling 100 MMT of CO_2 removal across our five in-scope solutions. Policies that support carbon removal at this scale can unlock significant job creation. With adequate support, each CDR of these approaches could achieve at least 20 MMT of annual capacity between 2030 and 2040.

Employment associated with highly durable CDR will total between 95,000 and 130,000 jobs per year once the industry reaches 100 MMT of annual capture capacity.

These job estimates include project-level and upstream supply chain jobs, but not induced jobs. Across approaches, just over one-third of the employment opportunities will come

from project investment jobs, which are associated with the construction, engineering, materials, equipment, and supply chains required to establish a project, and the remaining two-thirds will come from ongoing jobs to operate the projects. The exact distribution is dependent upon the type of CDR.

Supporting a diverse array of CDR approaches will support a diverse variety of workers

The breadth of CDR approaches is reflected in the wide variety of occupations that these projects will support. For this analysis, we explored the top occupations associated with each highly durable CDR approach (Table 1).

TABLE 1
Top occupations associated with each highly durable CDR approach

Direct Ocean Capture	**Enhanced Rock Weathering**
Metal workers and assemblers	Transportation occupations
Operators and production occupations	Mining and quarry workers
Engineers	Construction trades
Project developers and site managers	Project developers and site managers
Machinery installation, maintenance, and repair technicians	Machinery installation, maintenance, and repair technicians
Direct Air Capture	**BiCRS: Bioenergy with CCS**
Construction trades	Metal workers and assemblers
Metal workers and assemblers	Construction trades
Engineers	Engineers
Machinery installation, maintenance, and repair technicians	Project developers and site managers
Project developers and site managers	Transportation occupations
BiCRS: Bio-oil / Biowaste Injection	**Ocean Alkalinity Enhancement**
Machinery installation, maintenance, and repair technicians	Transportation workers
Transportation occupations	Machinery installation, maintenance, and repair technicians
Project developers and site managers	Operators and production occupations
Operators and production occupations	Mining and quarry workers
Metal workers and assemblers	Engineers

Source: Rhodium Group

Certain skill sets will be important across CDR approaches, including metal workers and assemblers (such as welders); engineers; machinery installation, maintenance, and repair technicians; and site managers. In contrast, some CDR approaches will support unique

occupations that cater to their process. For instance, ERW and OAE will support mining and quarry workers. BiCRS approaches will support biomass waste transportation occupations due to their use of agricultural and livestock waste. Moreover, CDR approaches that require geologic storage of CO_2 and biomass (DAC, DOC, and BiCRS) can offer job opportunities for oil and gas workers who have easily transferable skill sets.[1]

Co-benefits beyond employment opportunities

Each CDR approach has a unique set of environmental and social benefits, in addition to employment opportunities. Below we highlight a few key co-benefits associated with highly durable CDR approaches. This is by no means an exhaustive list.

- **ERW:** Agricultural ERW can improve soil health, increase crop productivity, and enhance resilience to heat and pests.[2,3] Wastewater ERW can improve water quality by removing dissolved CO_2 and reducing nitrogen pollution.[4]
- **BiCRS:** Biomass-based solutions can help reduce excess woody biomass from forests residues in fire prone area, reducing wildfire risks.[5]
- **OAE & DOC:** These approaches can help reduce ocean acidity by introducing an alkaline water stream into the ocean. In turn, this can have positive impacts on marine life, especially species with carbonate shells such as mussels, oysters, and corals.[6]

[1] CarbStrat. (2024, April 25). *Carbon management in energy transitions*.
[2] The Conservation Foundation. (2024, January 29). *Enhanced weathering: Using Rocks to Address Climate Change*.
[3] Everest Carbon. (2023). *Frontier Carbon Removal Purchase Application*.
[4] Crew Carbon. (2024). *Engineering Wastewater to Remove CO2*.
[5] Energy Futures Initiative. (2023, July 19). *Bioenergy and carbon capture combined can reduce and remove emissions*.
[6] National Academies of Sciences, Engineering, & Medicine. (2021). *A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration*.

DISCLOSURES

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