Investment Opportunities from Technological Carbon Dioxide Removals

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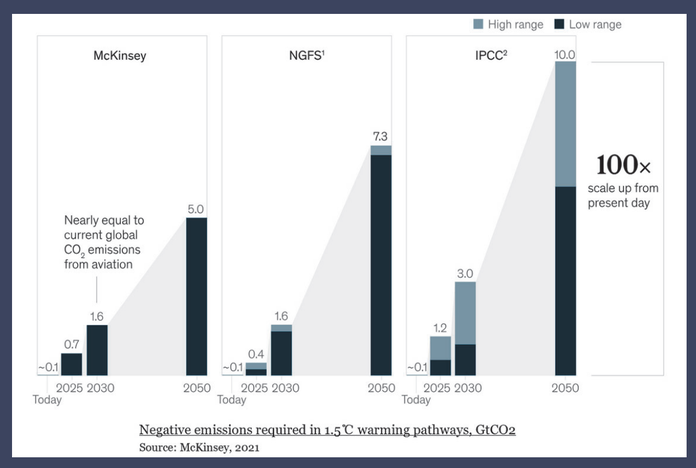
Introduction

To limit global temperature rise to 1.5°C, carbon removals need to scale up 100x to remove ~10 GtCO2 by 2050, creating an investment gap between $6-16T.

Carbon removals have two broad pathways: natural and technological. Rapid developments are seen in the technology-based removals space with scope for strong commercial returns to investors in the future.



Negative emissions required in 1.5℃ warming pathways, GtCO2
Source: McKinsey, 2021

Methodology

1. Policy Landscape: Analyze global policy mechanisms to enable technological carbon removals by region and technology.
2. Technology Overview: Compare TRL*, durability, scalability, cost, pros/cons and market size/CAGR to rank technologies.
3. Focused Technology Deep-dive: Study high-potential technologies regarding cost breakdown, value chain and market outlook.
4. Investment Opportunity Mapping: Identify, compile and categorize investment opportunities using a step-by-step process.
5. Highlighted Opportunity Analysis: Highlight high-potential targets and develop investment pitches with thesis, catalysts, valuation and risks.

Note: TRL is technical readiness level.

Analysis

Sector outlook remains bullish as climate targets drive demand for proven carbon removal solutions. Pathways that offer a compelling mix of technical readiness, durability, scaliability, cost-effectiveness, and manageable risks are viable opportunities.

Deep diving into spotlight technologies require comprehensive survey of value chain segments, sub-technologies, market potential, and policy incentives to determine when the opportunities will become investible, the scale at which they will emerge, and the specific asset classes they will impact.

Key findings on favorable regions and promising pathways.

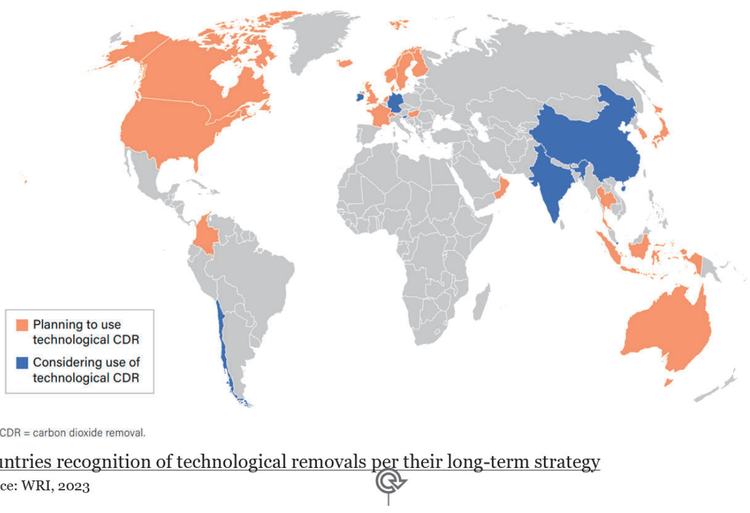
4 Highlighted Regions

3 Highlighted Technologies

38 Investment Opportunities

6 Spotlight Companies

Global policy overview with regions recognize of technical removals as a net-zero pathway.



Note: CDR = carbon dioxide removal.

Countries recognition of technological removals per their long-term strategy
Source: WRI, 2023

Technology overview with nine technical pathways identified.

Biomass Carbon Removal and Storage (BiCRS): Utilize biomass to capture CO2 and store as charcoal or underground, incl. biochar & bioenergy (BECCS).

Direct Air Carbon Capture and Storage (DACCS): Capture CO2 from the air and store it underground permanently.

CO2-Enhanced Oil Recovery (EOR): Inject CO2 into mature oil fields to recover oil, where CO2 retains.

Enhanced Weathering (EW): Spread crushed rock powder on land to chemically bind with and store CO2 as a solid.

Ocean Nutrient Fertilization: Supply nutrients to stimulate phytoplankton growth and convert CO2 into organic form.

Artificial Upwelling & Downwelling: Manipulate ocean currents to enhance the natural processes of nutrient circulation and carbon storage in the ocean.

Electrochemical CO2 Removal: Use electrochemical processes to capture and convert CO2 into products or stable forms for storage.

Ocean Alkalinity Enhancement: Spread crushed rock powder on the beach or in the ocean to chemically bind with and store CO2 as a solid.

Conclusion

In the technological carbon removals space, regions with commitment to, highest targets of, and most comprehensive policies for removals are the strongest enablers. Meanwhile, technologies that are most technically and commercially ready with high potential in permanence, mitigation capacity, co-benefits, and risk management are investable.

Investment Caveat

High-potential, high-cost technologies, if receiving significant policy incentives to cut costs and scale deployment, can be viable business in the near term despite the current hurdles.
On the other hand, nascent removal pathways where research gaps and uncertain ecological impacts persist warrant investor patience.