



Producing Biochar from Scope 1 Feedstocks



February 14, 2024

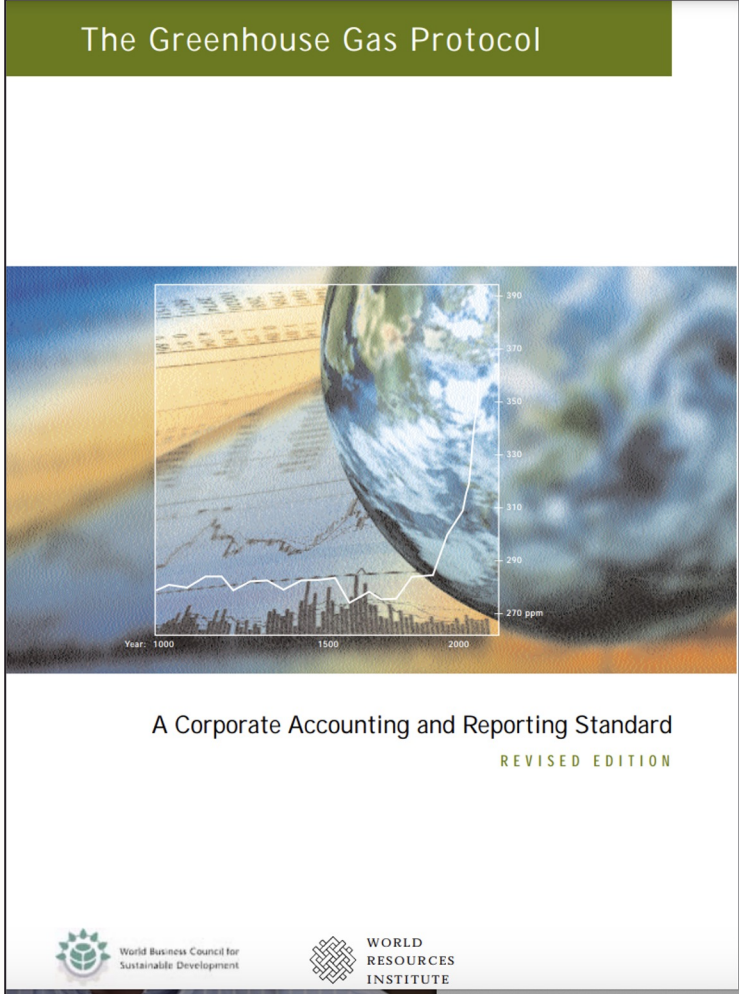
11:10 – 11:35 AM

Jeff Hallowell

Founder & Executive Chair

Biomass Controls PBC

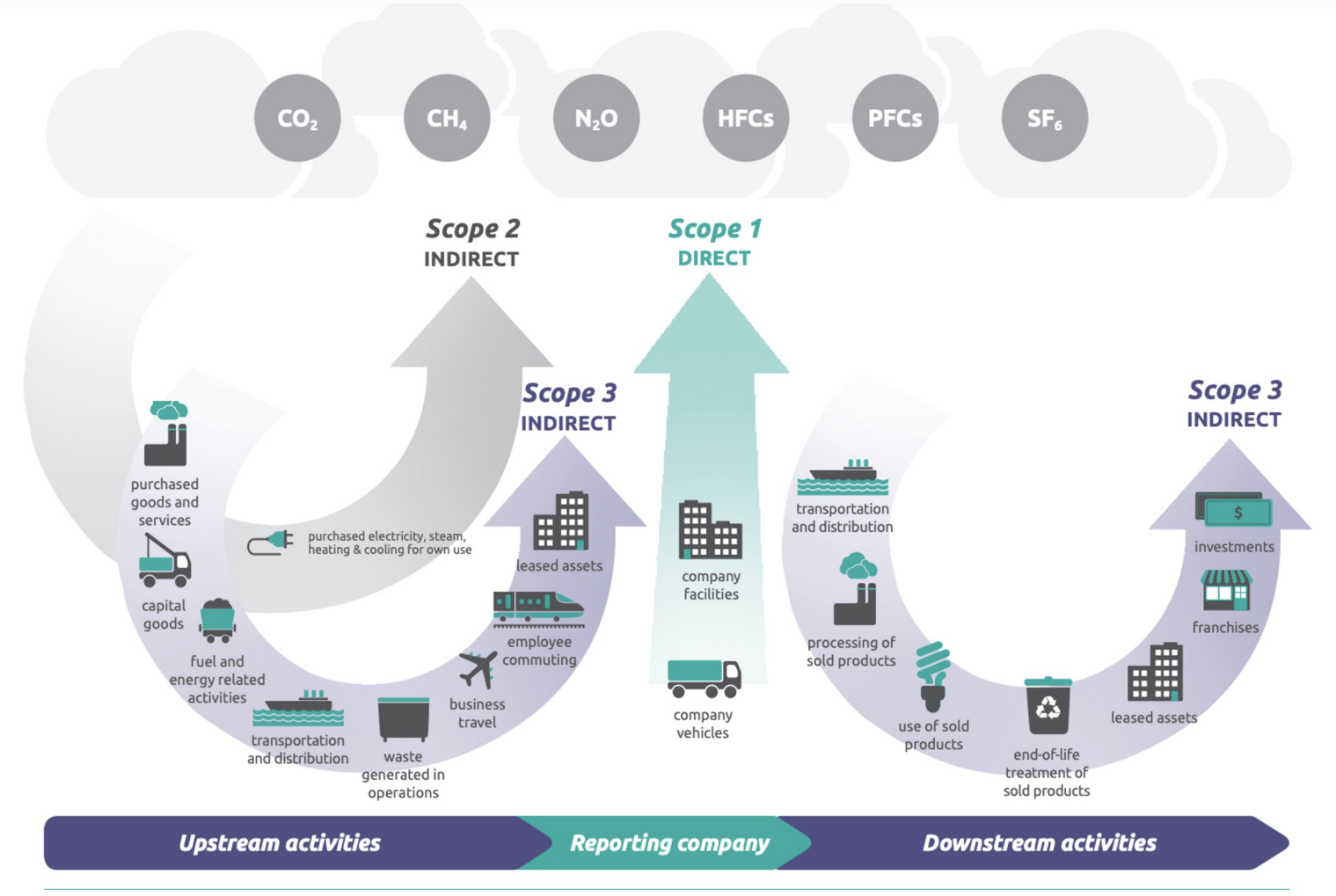
Greenhouse Gas Protocol Origin



Scope 1 – Direct Emissions

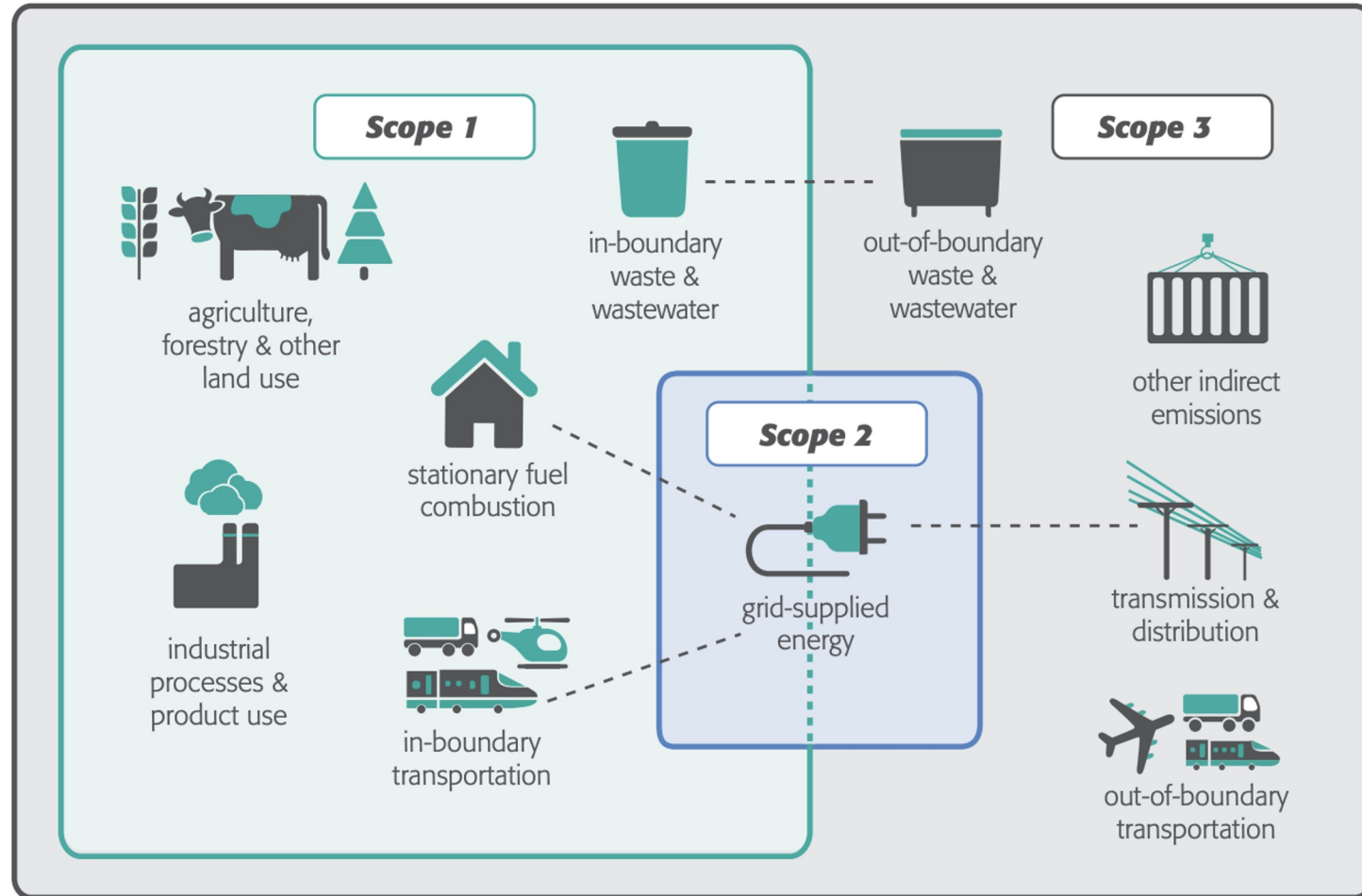
“These are emissions that come from sources owned or controlled by an organisation.”

Scope 1, 2, 3 High Level for Corporations



Scope 1, 2, 3 for Cities

Figure 1 Sources and boundaries of city GHG emissions



— Inventory boundary (including scopes 1, 2 and 3) — Geographic city boundary (including scope 1) — Grid-supplied energy from a regional grid (scope 2)



California SB 253 AND SB 261

- The overall objective of California's climate disclosure bills is to promote **corporate accountability, integrity, and transparency** in the reporting of greenhouse emissions, climate-related financial risks and climate action-related claims needed to develop a roadmap towards building a resilient low-carbon economy within California.
- Public and private US-based companies that do business in California and **exceed revenue thresholds of \$1 billion and \$500 million** under SB 253 and SB 261 respectively will be **required to disclose** their greenhouse gas emissions and climate-related financial risks.
- AB 1305 applies to **all business entities** operating in California that make net-zero, carbon-neutral, or other similar claims about the goods and/or services they market to consumers located in California or make such claims about the business entities themselves.



Approaches to Mitigate GHGs

- Avoid Producing Greenhouse Gases
- Plant a Tree
- Drive an Electric Car
- Take CO₂ Out of the Air
- Eat More Vegetables
- Purchase Carbon Offsets
- Use Solar Lights



Greenhouse Gas Avoidance



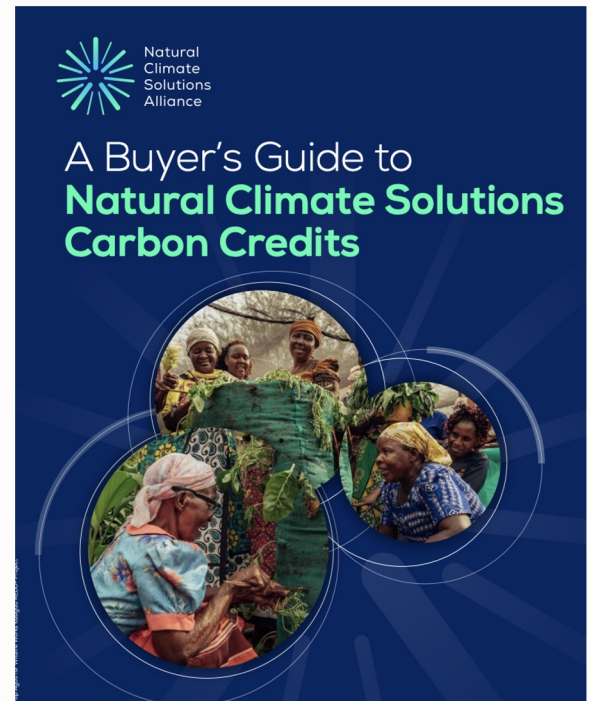
Greenhouse Gas Removal



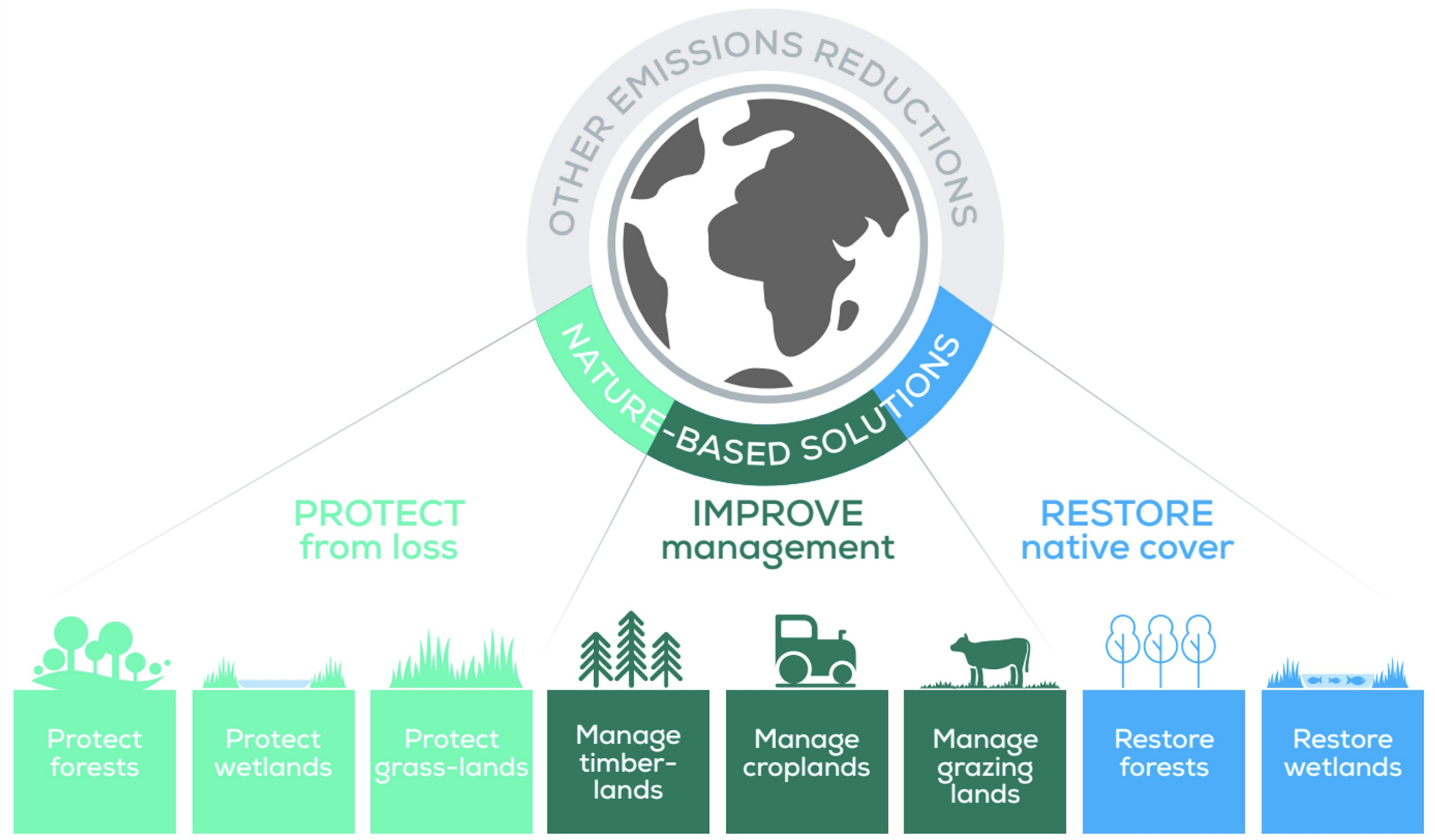


Types of Mitigation Strategies

- Nature Based (NbS)(NCS)
- Engineered
- Hybrid



Nature Based Solutions (NbS) (NCS) for Carbon Removal



Griscom, B.W., et al. (2019).



Engineered Systems for Carbon Removal

- Direct Air Capture (DAC)
- Soil Carbon Sequestration (Biochar)
- Biomass Carbon Removal and Storage (BiCRS)
- Enhanced Mineralization
- Bioenergy Carbon Capture and Storage (BECCS)



Hybrid Systems for Carbon Removal

- Biochar
- Bio-Oil Sequestration
- Membrane
- Cryogenic



Emissions Credits

- The U.S. Environmental Protection Agency's (EPA's) leaded gasoline phase down in the 1980s
- The sulfur dioxide allowance trading program under the Clean Air Act Amendments of 1990
- The Regional Clean Air Incentives Market in southern California
- NOX trading in the Eastern United States; the Regional Greenhouse Gas Initiative in the northeast United States
- California's AB-32 cap-and-trade system
- The European Union Emissions Trading System.



The Concept of Additionality

“Additionality means that the emissions reductions achieved by the project must be "above business-as-usual". That means they would not have happened unless the project was implemented.

Assessing additionality involves considering several aspects, such as:

- **Financial additionality**: Can project activities sustain themselves financially without revenues from carbon credits?
- **Policy & regulatory**: Are there regulations or incentives that enforce or encourage the project's actions?
- **Common practice**: Are the project's practices and methods unusual, or are they typical for the region?



Corporate Net-Zero Standard from the Science Based Targets initiative (SBTi)

Requires companies to cut **more than 90%** of their emissions and then “use **permanent carbon removal** and storage to counterbalance the final <10% of residual emissions that cannot be eliminated [by their net zero target year],” explains SBTi.

“Carbon removals should be used as a complement to long-term value chain emission reductions, rather than being the main tool in a climate strategy. Those who follow the SBTi guidelines, for example, will prioritize reducing their own emissions, with less than 10% of their emissions neutralized.”



“Net-Zero” and “Absolute Zero”

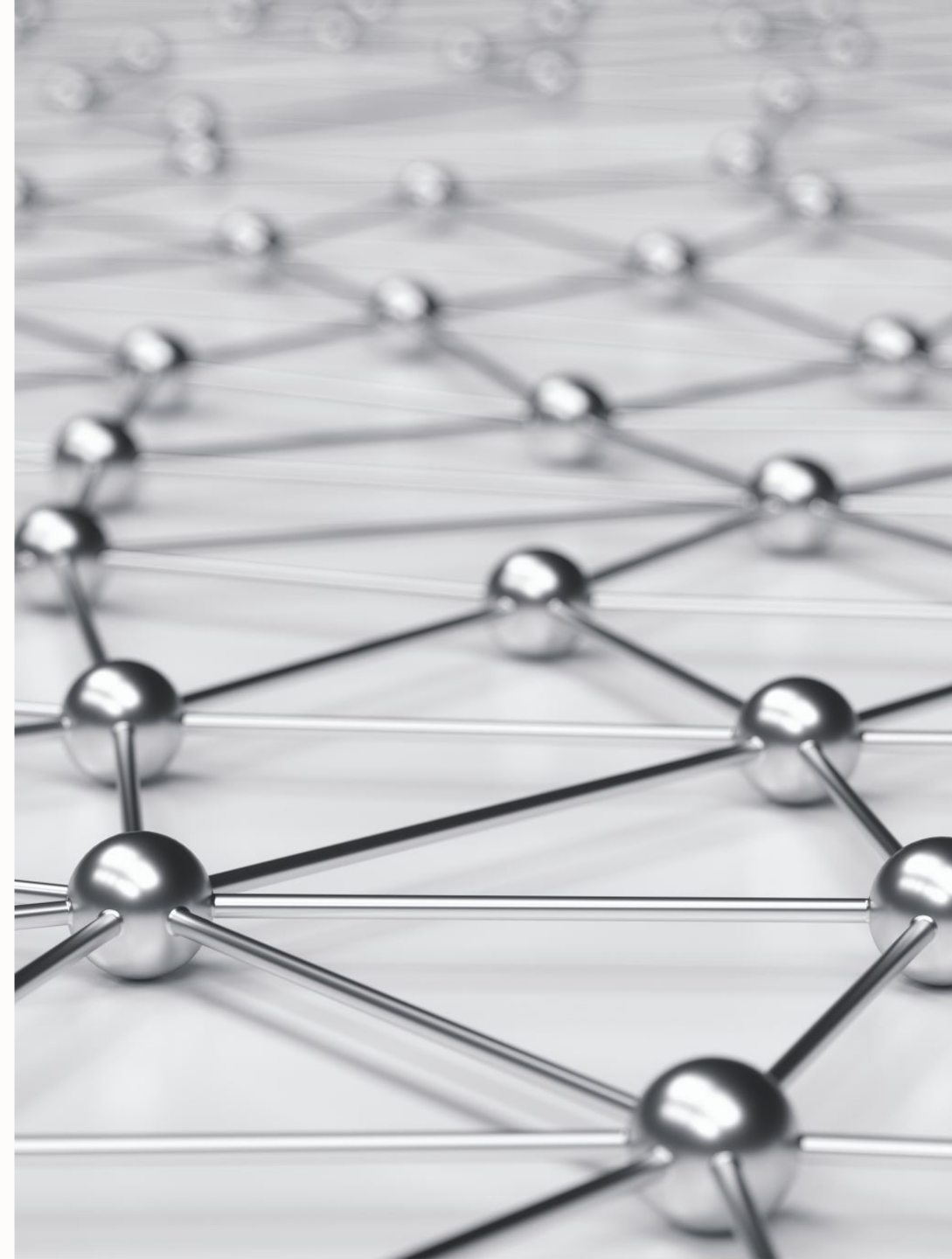
“No GHG emissions are attributable to an actor’s activities across all scopes.

Under this definition, no offsets or balancing of residual emissions with removals are used.”



The Oxford Offsetting Principles Credits

- *A key part of their first principle is to prioritize reducing an organization's own emissions, minimizing the need for carbon credits to achieve net-zero. Companies should maximize the emissions reduction opportunities they have available, before considering the use of credits as part of a net-zero strategy.*

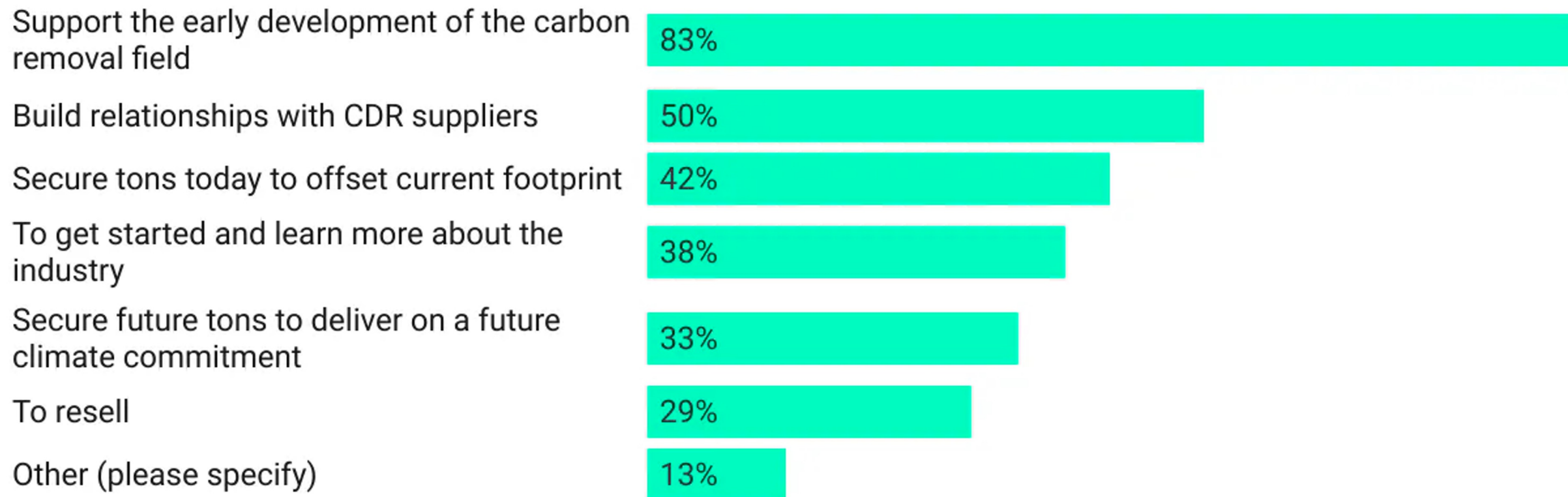


Voluntary Carbon Markets Integrity Initiative (VCMI)

Before credits are used and any claims are made, companies are required to publicly commit to achieving net-zero emissions by 2050, and publicly disclose validated, science-based near-term targets to reduce emissions.



Primary intent for purchasing durable CDR now

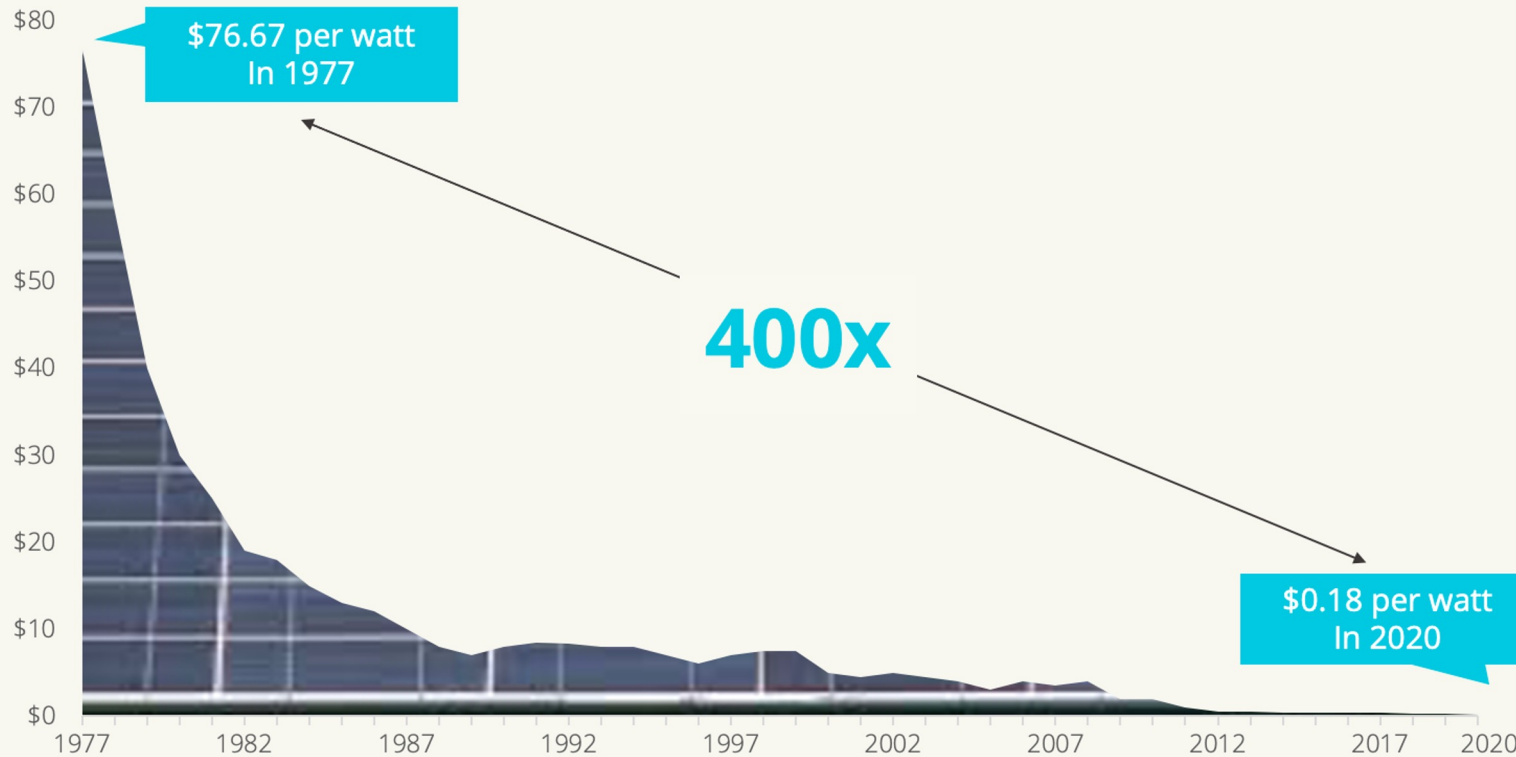


Source: CDR.fyi • Created with Datawrapper



Solar Panel Example (NREL)

The cost of solar has dropped 400x



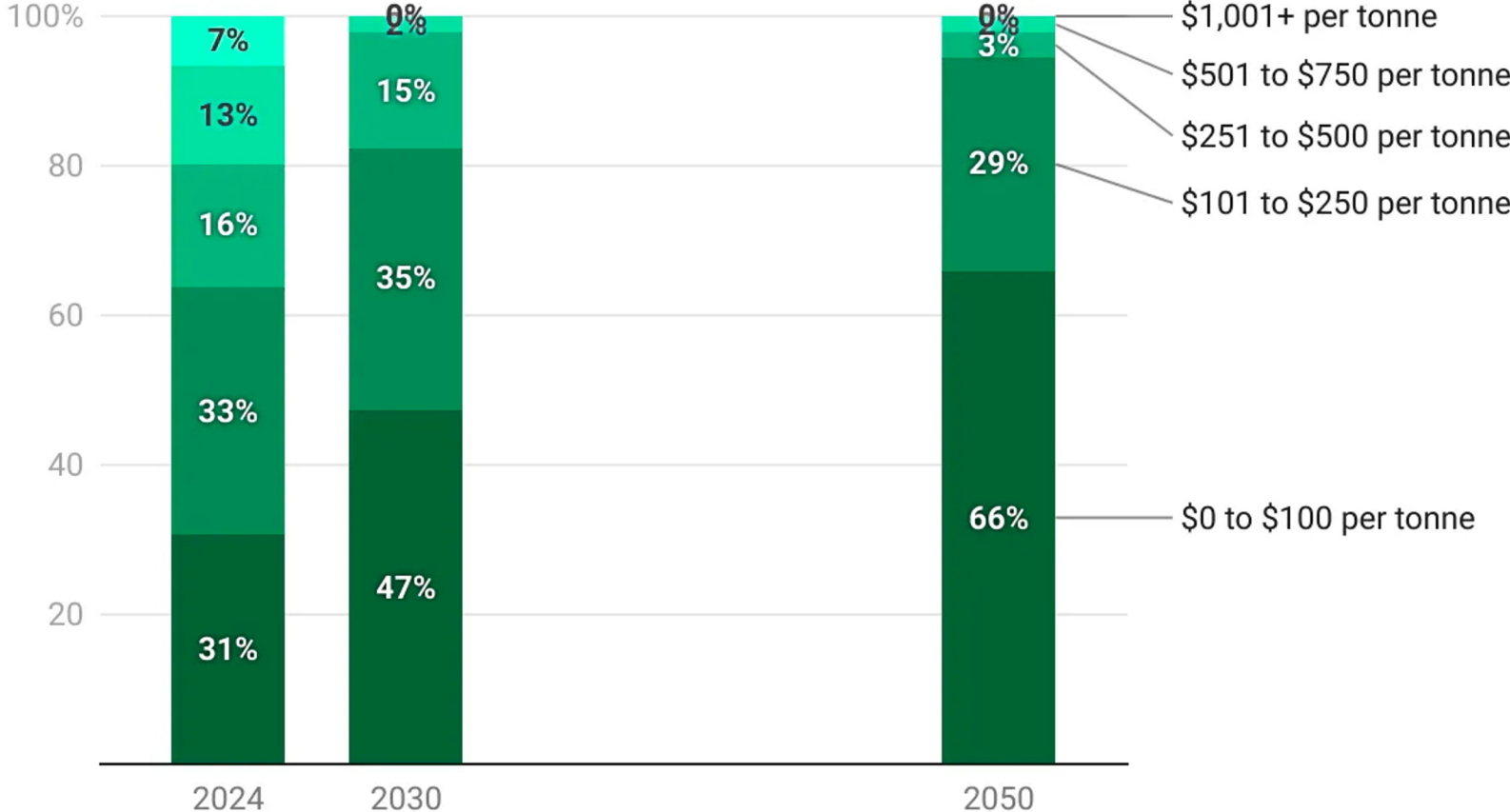
FREEING
ENERGY

Sources: Bloomberg, NREL | <http://fep.link/g116>



Cost of Biochar Production is Declining

Average production cost per metric tonne suppliers expect to achieve



Source: CDR.fyi • Created with Datawrapper



Top 3 Ways to Leverage Scope 1 Feedstocks

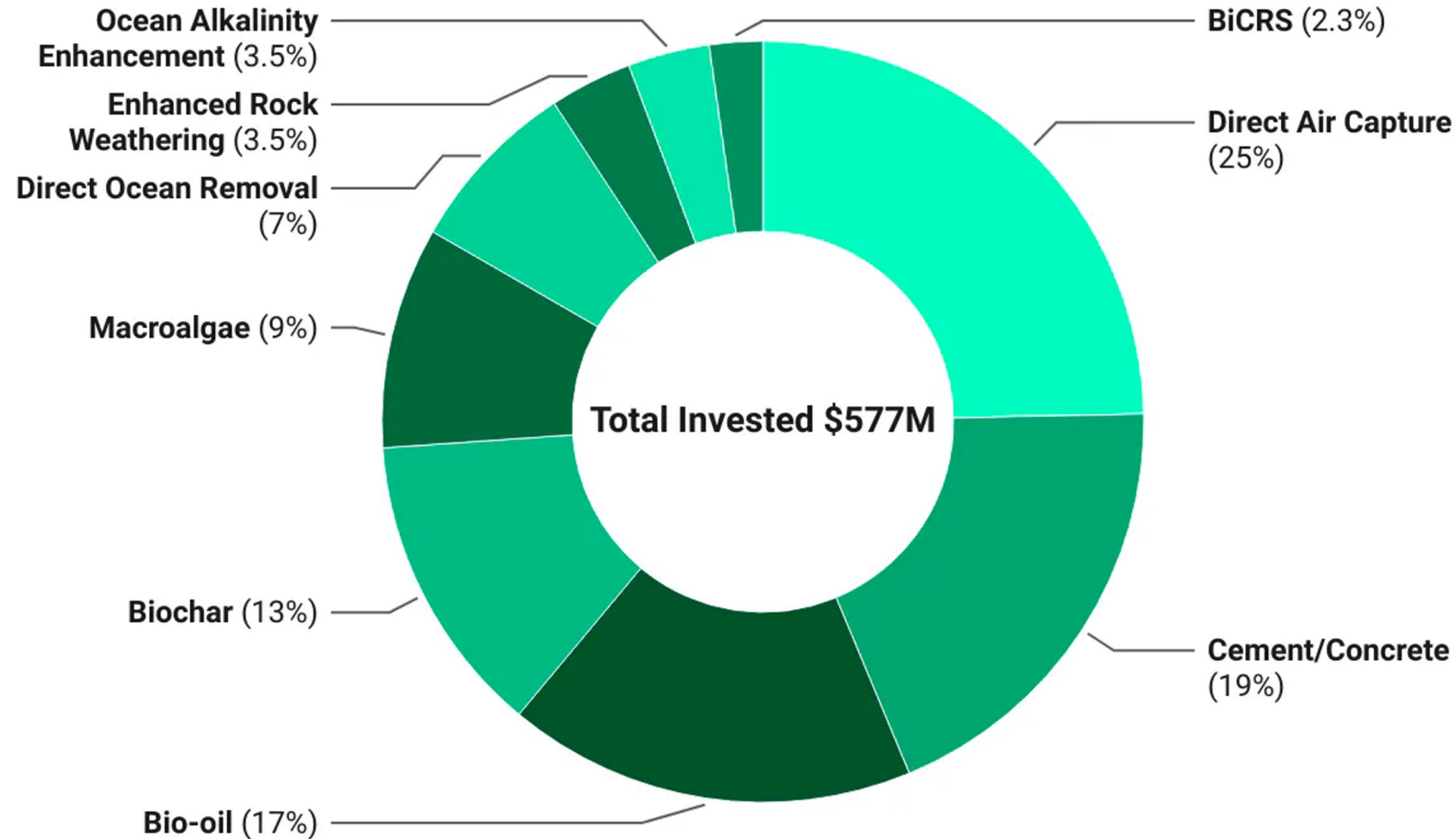


Idea #3
Be Everywhere as a Hybrid Solution



2023 Investment in Durable CDR by Method

Total invested (\$)



**Excluding soil, forest, and other less-durable forms of CDR*

Chart: CDR.fyi • Source: Compiled from public announcements, as of Dec 24, 2023 • Created with Datawrapper



2023 Investment in Durable CDR by Method/Stage

Total invest (\$)

Grant Pre-Seed Seed Series A Series B Unknown Rounds

Direct Air Capture



Cement/Concrete



Bio-oil



Biochar



Macroalgae



Direct Ocean Removal



Enhanced Rock Weathering



Ocean Alkalinity Enhancement



BiCRS

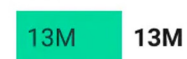


Chart: CDR.fyi • Source: Compiled from public announcements, as of Dec 24, 2023 • Created with Datawrapper



Direct Air Capture (DAC) Technology Examples

Two technological approaches for DAC are:

- **Solid DAC (S-DAC)** is based on solid adsorbents operating at ambient to low pressure (i.e. under a vacuum) and medium temperature (80–120 °C).
- **Liquid DAC (L-DAC)** relies on an aqueous basic solution (such as potassium hydroxide), which releases the captured CO₂ through a series of units operating at high temperature (300 °C to 900 °C).



...for direct air capture to be widely adopted, the cost must fall from \$600-\$1,000 per ton to below \$200 per ton and ideally closer to \$100 per ton.

[David Webb](#) Chief Sustainability Officer, Managing Director and Senior Partner, Boston Consulting Group (BCG)



Thermal Energy is Valuable Output

- Partner with competitive CDR Engineered Solutions that need thermal energy for their process.
- Invest in Thermal to Electric Technologies such as Turbine and Organic Rankine Cycle to reduce your LCA and to lower your operating cost.

