

Carbon Engineering: Current Projects and Future Prospective

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Goldman Sachs Carbonomics



De-carbonization Cost Curve (Conservation approach, excludes sequestration)

Source: Goldman Sachs Global Investment Research

WITHOUT SEQUESTRATION, THERE ARE NO KNOWN SOLUTIONS FOR SOME SOURCES & MANY COSTS ARE VERY HIGH

Goldman Sachs Carbonomics



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"DIRECT AIR CARBON CAPTURE & STORAGE (DACCS): THE WILD CARD TECHNOLOGY THAT COULD UNLOCK ALMOST INFINITELY SCALABLE DECARBONIZATION POTENTIAL."

Three Primary Challenges in Achieving Net Zero & Climate Restoration

Carbon Abatement Curve – **Conservation and Sequestration (excluding DAC)** Includes all emissions reduction, CCS and natural sink potential



Source: Goldman Sachs Global Investment Research

THE NET ZERO CHALLENGE IS IMMENSE. THE WORLD NEEDS STRONG LEADERSHIP AND ACCELERATED TECHNOLOGICAL SOLUTIONS.

The Technological Missing Piece

Only one solution is available today that addresses the three key problems:

COST

Is affordable compared to alternatives for many emissions

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GROWTH IN EMISSIONS "Has the potential to be almost infinitely scalable"¹

3 LEGACY CO_2

Eliminates any emission from any point in time; can offset today's emissions and supports climate restoration through permanent removal of atmospheric CO_2



COPYRIG

1. Goldman Sachs – Carbonomics: The Future of Energy in the Age of Climate Change

CE Brings...

- Permanent Carbon Removal by removing CQ from the atmosphere.
- Drop-in compatible fuels that reduce the carbon intensity of transportation fuels by recycling atmospheric carbon



ELIMINATION OF ANY CO2 EMISSION, OF ANY TYPE, FROM ANYWHERE AND FROM ANY TIME

Placeholder Video

CE regenerative liquid sorbent process was designed for deployment at scale

Reduced Technology Risk	A combination of pre-existing technologies have been adapted and combined with patented innovations and proprietary know-how, which has allowed us to scale rapidly to the full commercial size of 1 Mt/yr
Reduced costs from Closed Chemical Cycle	Non-volatile, non-toxic, closed-loop chemical process that meets environmental health and safety standards and minimizes operating costs.
Freedom to locate where economics are best	Plants can be located where economics are optimum to take advantage of lowcost local energy and proximity to geologic sequestration site, low-carbon fuel production, or other demand center.



Equipment	Industrial Precedent
Air Contactor	Industrial cooling tower
Pellet Reactor	Water treatment technology
Slaker	Standard equipment for converting Calcium Oxide to Calcium Hydroxide
Calciner	Refractory lined circulating fluidised bed calciners are commonly used in mining for ore processing and petroleum coke



Carbon Engineering Projects

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Pilot – 300 t/ y

- Squamish, BC
- Operational since 2016



Early DAC and AIR TO FUELSTM Pilot

- DAC pilot operational since 2015
- ► AIR TO FUELSTM pilot operational since 2016
- Pilot scale equipment was designed to accurately replicate the performance of commercial-scale modules.
- Still operating for extended testing and optimization efforts.
- When running, the plant captures and purifies roughly 1 ton of CO₂ per day.

Validation -1000 t/yr

- Squamish, Canada
- Under construction, operational H2



World's largest DAC R&D Centre

- CE's Innovation Centre is currently under construction
- ~1000 t/yr DAC plant operational test facility
- Advanced development and R&D centre with extensive lab and bench scale test facilities
- Schedule:
 - Construction complete: mid year
 - Operational: H2

LONG TERM TEST FACILITY FOR VALIDITATING OPERATIONAL AND PROCESS IMPROVEMENTS

Commercial – Up to 1MT/ yr

- Permian basin, US
- In FEED, operational 2024
- Developer: lPointFive



World's first climate relevant scale DAC plant

- License agreement concluded with 1PointFive, a partnership between Oxy Low Carbon Ventures and Rusheen capital
- Multiple plants to be in operation by 2030
- Key strategic move by Occidental, with vision to transform its core business to a "carbon management company"
- United Airlines has announced its intention to be a strategic investor
- Advanced stage of development: 40,000 hours of joint engineering effort by Oxy, CE, BBA, Black & Veatch, Saulsbury
- Independent engineering report provided by Leidos, an expert in new technology assessments

THIS PLANT BECOMES THE BLUEPRINT FOR GLOBAL BUILDOUT, DEMONSTRATING THAT DIRECT AIR CAPTURE AT LARGE SCALE IS FEASIBLE, AFFORDABLE AND AVAILABLE

In the US, the business case for DAC-EOR closes today

- Permian CQ: USD 20-30/t
 - Commodity value for Enhanced Oil Recovery (EOR)
- California LCFS Credits: USD 200/t
 - Atmospheric CO₂ permanently sequestered per California Air Resources Board standards earns Low Carbon Fuel Standard Credits.
 - Commercial market, currently trading over \$200/t.
 - EOR qualifies
 - Credits can be earned for sequestration <u>anywhere in</u> <u>the world</u> but currently only on-shore.
- 45Q Tax Credits: USD 35 or 50/t
 - CO₂ permanently sequestered per US Environmental Protection Agency qualifies for 45Q Federal Tax Credit of \$35/t for EOR, \$50/t for pure sequestration
- Plants may also sell negative emissions to third party customers

Total value per tonne of atmospheric CQ captured



 1 CO₂ commodity value and 45Q tax credit value also count for CQ captured from NG used for heat in processing (0.3t per 1.0t of atmospheric CO₂).

Future Prospective



Source: Goldman Sachs Global Investment Research

ENORMOUS MARKET FOR AFFORDABLE, SCALABLE, DECARBONIZATION SOLUTIONS







Path Forward

- CE's DAC Technology provides two significant new tools:
 - Large scale atmospheric carbon removal
 - Highly scalable ultra low carbon fuels
- CE is actively seeking partners to help accelerate global deployment, including:
 - Regulatory consultation
 - International plant development opportunities
 - Offtake agreements (negative emissions, CO₂, fuels)





Our Vision

Our vision is to lead the world in the large-scale removal of carbon dioxide from the air and advance our shift to a sustainable carbon-neutral society.

A GLOBAL SOLUTION FOR CLIMATE CHANGE



MORE INFORMATION CAN BE FOUND AT:

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