



ESG Investment



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Key Takeaways

- ▶ Carbon capture and sequestration (CCS) is critical in addressing emissions, particularly from manufacturing, and will be all the more so as capacity additions ramp up globally in the coming years.
- ▶ There are many unconventional types of CCS, and ClearBridge holdings with which we engage regularly represent a diverse portfolio of technologies.
- ▶ Recent engagements with ClearBridge portfolio companies have touched on ways they are developing CCS across several industries and how in most cases advanced carbon-capturing capabilities are driving share gains and improving cash flows.

While deployment of renewable energy sources such as solar, wind and hydro will likely play the largest role in the energy transition, carbon capture and sequestration (CCS) remains an important technology for heavy industries that produce unavoidable CO₂ emissions.

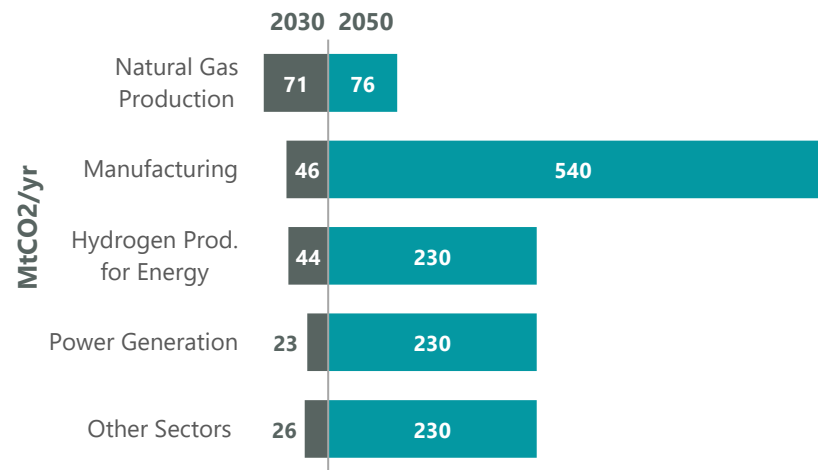
There are many types of CCS, and ClearBridge holdings with which we engage regularly represent a diverse portfolio of CCS technologies. Recent engagements with portfolio companies have touched on ways they are developing CCS across several industries and how in most cases CCS capabilities are driving share gains and improving cash flows.

Cleaner Hydrogen Technologies Advancing in Manufacturing

CCS is critical in addressing emissions from manufacturing and will be all the more so as capacity additions ramp up globally in the coming years (Exhibits 1 and 2). In North America, the main applications are hydrogen and ammonia. These were focal points of recent ClearBridge discussions with industrial gas company Linde, which we find is well-positioned to continue taking share in clean hydrogen, specifically blue hydrogen. (Blue hydrogen is produced using fossil fuels but with carbon capture technology preventing emission of CO₂, and is used for various industrial, energy and transport applications.)

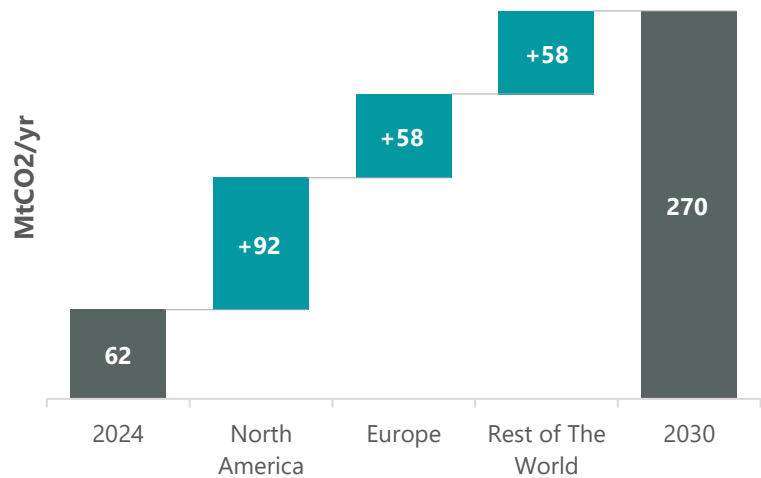
ClearBridge recently toured Linde's autothermal reformer (ATR) site at its Clear Lake facility in Texas, where Linde provides blue hydrogen and CO₂ to support industrial chemicals supplier and manufacturer Celanese with its methanol and acetyl production.

Exhibit 1: CCS by Sector 2030 and 2050



As of 2025. DNV, "Energy Transition Outlook CCS to 2050."

Exhibit 2: CCS Capacity Additions to 2030



As of 2025. DNV, "Energy Transition Outlook CCS to 2050."

An ATR is essentially a large chemical reactor that combines natural gas, oxygen and water/steam to produce synthesis gas or syngas (hydrogen plus carbon monoxide/dioxide), a critical input for applications like chemicals production (such as methanol, which is used for paint solvents, antifreeze, fuels, pharmaceutical laboratories and adhesives, among other things). Syngas is also used in power generation, ammonia and fertilizer production for growing crops, and refining (desulfurizing oil, which reduces sulfur dioxide emissions).

Linde's ATR technology is especially attractive as it is more efficient than other methods of producing these inputs given its better energy efficiency, higher CO2 concentration for better carbon capture, higher product yield and lower maintenance.

Linde has been able to leverage the success of this technology as a proof point to win other projects that support clean hydrogen and

ammonia production in the U.S. Other blue hydrogen deals, such as in Nederland, Texas (where Woodside/OCI creates blue ammonia for agriculture, power and marine sectors), in Alberta, Canada (where Dow produces blue hydrogen for ethylene production with two ATRs), and the latest in Modeste, Louisiana (where CF Industries runs a large-scale air separation unit to support blue ammonia).

Linde represents an excellent example of a company where technological expertise in a sustainability practice is driving both emissions savings and growth for the business. In 2024, Linde helped its customers to avoid more than 96 million metric tons of carbon dioxide equivalent, more than twice the emissions that Linde generated from its own operations.

What is Biogenic CO2?

Green Plains, a U.S.-based agricultural technology and biorefining company based in Nebraska, is one of North America's largest producers of ethanol and bio-based products. It serves several main industries, such as ethanol for fuel, agricultural services (grain management), high-protein feed for livestock and aquaculture and renewable corn oil.

ClearBridge recently met with Green Plains's CFO and Director of Sustainability to discuss the company's carbon capture initiatives and other developments that impact its carbon intensity (CI) and ability to meet its target of net-zero emissions by 2050. The company recently suspended its clean sugar technology (CST) and ultra-high protein (UHP) initiatives to focus on carbon capture, which is more cost-effective under current tax credit structures.

Green Plains considers carbon capture a key tactic in decarbonizing biorefineries by capturing the pure stream of biogenic CO₂ from fermentation (CO₂ is released from the fermentation process of biological materials such as plants used for biofuels). Initiatives include partnering with Tallgrass Energy on the Trailblazer carbon pipeline, which will initially serve three Green Plains facilities in Nebraska, and is expected to sequester 800k tons of CO₂ annually beginning this year. These facilities are also expected to generate \$150 million in 45Z tax credits (for clean fuel production).

In addition, running other plants in a similar fashion without carbon capture can net another \$50 million under 45Z. Green Plains is raising capital for another deal with startup Carbon Solutions to perform carbon capture on other Midwestern plants. If the 45Z program isn't extended after 2029, Green Plains would drop down to 45Q credits, which are worth one-third of 45Z, until that program ends in 2038.

Overall, however, these credits are valuable programs that get Green Plains past recent liquidity issues after years of capex on plant modernization. With roughly \$50 million left in carbon capture capex, Green Plains has already cut its operating expenses by more than 50%, setting it up to generate ample free cash flow going forward.

Rocks Can Sequester Carbon

In a recent engagement with Vulcan Materials, the largest producer of construction aggregates such as crushed stone, sand and gravel in the U.S. and a name widely owned across ClearBridge, we checked in on Vulcan's goal of 10% absolute reduction in Scope 1 and 2 emissions by 2030. Vulcan shared that its Scope 1 and 2 emissions profile declined by 3% in 2024 versus its 2022 baseline, an improvement on 2023's flat performance. While 3% may seem low, aggregates production already carries a low GHG intensity, so the incremental progress is notable.

Key drivers were increasing renewable adoption (now 14% of total electricity versus a 5% stated goal), upgrades to engines with 20%–50% lower emissions and increased renewable diesel usage in California. Renewable diesel — produced from vegetable oils, waste oils and animal fats and, unlike biodiesel, a “drop-in” fuel that can be used directly in engines without blending or modifications — now accounts for 9% of Vulcan's total diesel usage.

We also touched on Vulcan's operational use of water to wash residue off rocks and to suppress dust. We were encouraged to hear water recycling takes place at roughly 75% of Vulcan's sites and that the company is striving for further improvement.

Increasing water recycling is a win-win from both a sustainability and economic perspective. At the 25% of sites where there is no recycling, Vulcan purchases water and absorbs the cost of trucking it. This seems like an easy target for the company to address over time.

Another interesting facet of Vulcan's environmental profile is that some of its basalt fines (i.e., dust byproduct of rock production) actually help sequester CO₂. We learned the agricultural market can spread this byproduct on soil to support “enhanced rock weathering” whereby rainwater spurs a chemical reaction that traps atmospheric CO₂ in newly formed, solid material. While sequestering CO₂ with basalt fines is certainly not a core part of Vulcan's business, it is nonetheless a positive attribute in its environmental profile.

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