Investing in the Energy Transition

The role of carbon-capture technology on the path to net zero

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In December 2020, the Canadian government announced an ambitious plan to reduce greenhouse gas (GHG) emissions by 36% below 2005 levels by 2030, exceeding Canada's Paris Agreement target. The plan includes several measures to reduce emissions across various sectors, support the development and adoption of clean technologies, and enhance the resilience of communities and infrastructure against climate change impacts.

Moreover, the Canadian government has committed to achieving net-zero GHG emissions by 2050, as outlined in the Canadian Net-Zero Emissions Accountability Act, which became law in June 2021. The transition to a low-carbon economy presents significant challenges and opportunities, and our commitment to decarbonization will require a comprehensive national effort involving all sectors of the economy.

The Canadian government has identified several strategies and policies that together will help us achieve our net-zero goals. These measures include carbon pricing, clean energy investments, clean fuel standards and carbon capture, utilization and storage (CCUS).

Reduction Opportunities (Government of Canada 2030 Plan)

	% Contribution to Emissions Reduction
Fuel Switching	35.2%
Methane Emissions and Non-Combustion Emissions	14.1%
Net Carbon Capture Utilization and Storage (excluding Hydrogen production)	12.9%
Direct Air Capture	0.3%
Biofuels	3.3%
Hydrogen	10.1%
Zero-Emissions Vehicles	2.1%
Solvents	7.8%
Green Production	14.2%
Total	**100%**

Source: Environment and Climate Change Canada, "2030 Emissions Reduction Plan – Canada's Next Steps for Clean Air and a Strong Economy."

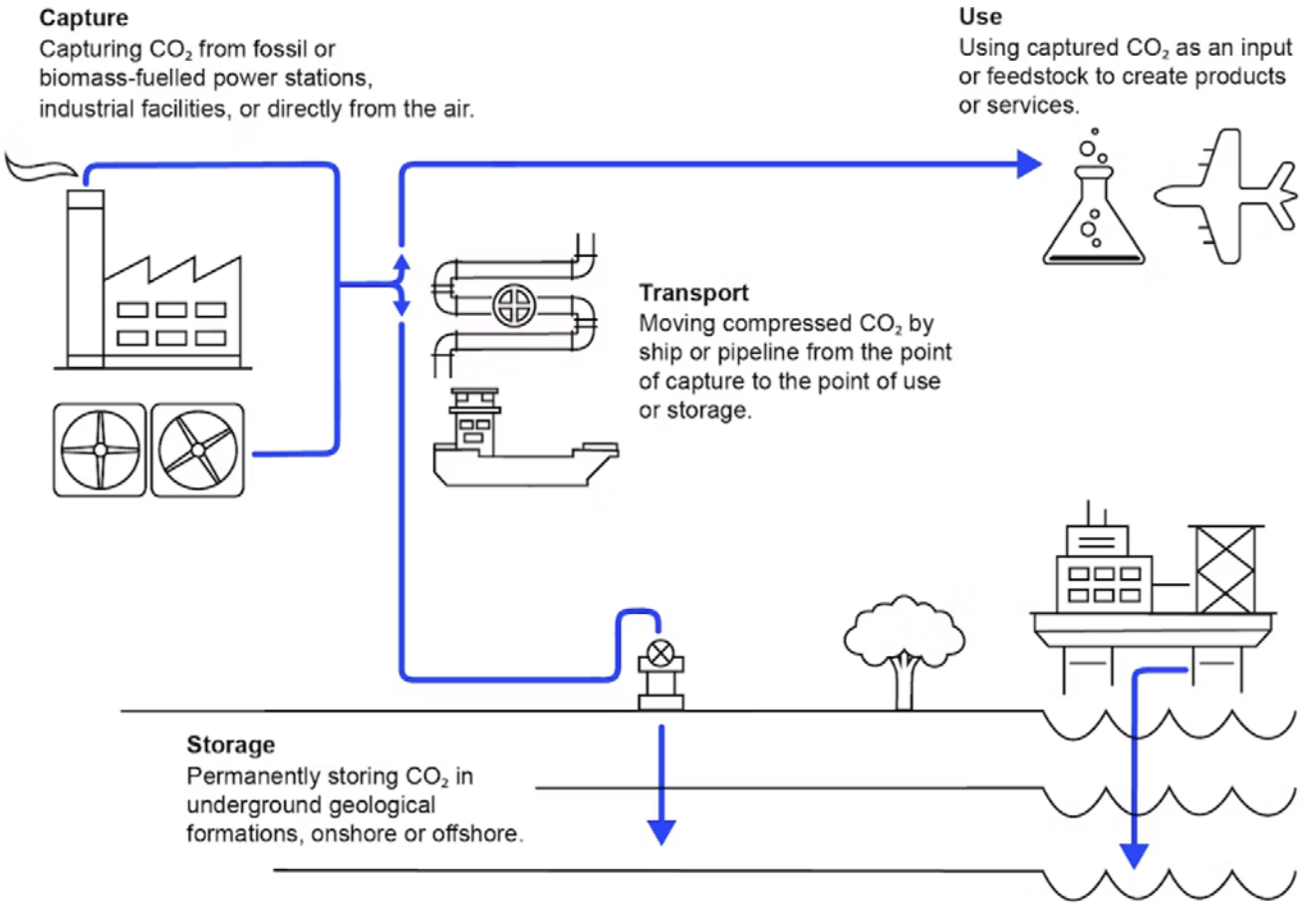
In this paper, we focus on CCUS and the environmental and economic considerations that are shaping its adoption in Canada. We also discuss CCUS' potential as an investment theme and explore some of the ways Canadians can gain exposure to this burgeoning opportunity.

CCUS: How it works

CCUS comprises three stages:

1. **Carbon capture:** This step involves capturing CO2 emissions from industrial processes, separating them from other gases, and purifying them for use or storage.
2. **Carbon utilization:** Captured CO2 can be used for various purposes, such as enhanced oil recovery, production of building materials (e.g., cement or plastic) and manufacturing of chemicals (e.g., methanol).
3. **Carbon storage (or sequestration):** Captured CO2 can also be stored underground permanently once it is purified.

Schematic of CCUS



Source: International Energy Agency.

Importance of CCUS for achieving net-zero targets

CCUS technology has emerged as a promising solution to reduce GHG emissions, create new products and revenue streams, and decarbonize industrial sectors. The technology can play a key role in achieving net-zero targets because it allows for the decarbonization of industries that have struggled to become fully electrified, such as cement, steel and chemicals. By using CCUS, these industries can reduce their carbon footprint with no disruptions to their operations.

> CO2 captured from industrial processes can be used to harden concrete in a process known as carbonation, which reduces the carbon footprint of concrete by up to 30%.

Additionally, CCUS technology supports the transition to renewable energy by providing a source of low-carbon hydrogen, which can replace fossil fuels used in transportation and heating. In its 2030 Emissions Reduction Plan, the Canadian government suggests the deployment of CCUS will account for 13% of total reductions by 2030.

A proven technology

CCUS has been studied and developed for decades. However, commercial-scale CCUS projects that capture, utilize and store CO2 emissions from large industrial processes started to emerge only recently.

The first ever large-scale carbon capture and storage project was the Sleipner project, operated by Norwegian energy company Equinor (formerly Statoil). Launched in 1996, it has been in continuous operation since.

The Sleipner project captures CO2 from natural gas extracted from the Sleipner West field in the North Sea and injects it into a saline formation located approximately 1,000 meters below the seabed for permanent storage. Every year, the project captures around one million tons of CO2, which is equivalent to taking 250,000 cars off the road each year.

The Quest project, located in Alberta and operated by Shell, has been effective at reducing carbon emissions. The project is one of the largest carbon capture and storage projects in the world and has been successfully operating since 2015.

The Quest project captures approximately one-third of the CO2 emissions produced at the Scotford Upgrader, which processes heavy oil into lighter crude oil and petroleum products. The captured CO2 is then transported to a nearby underground storage site and injected approximately 2.3 kilometers below the surface, where it is permanently stored.

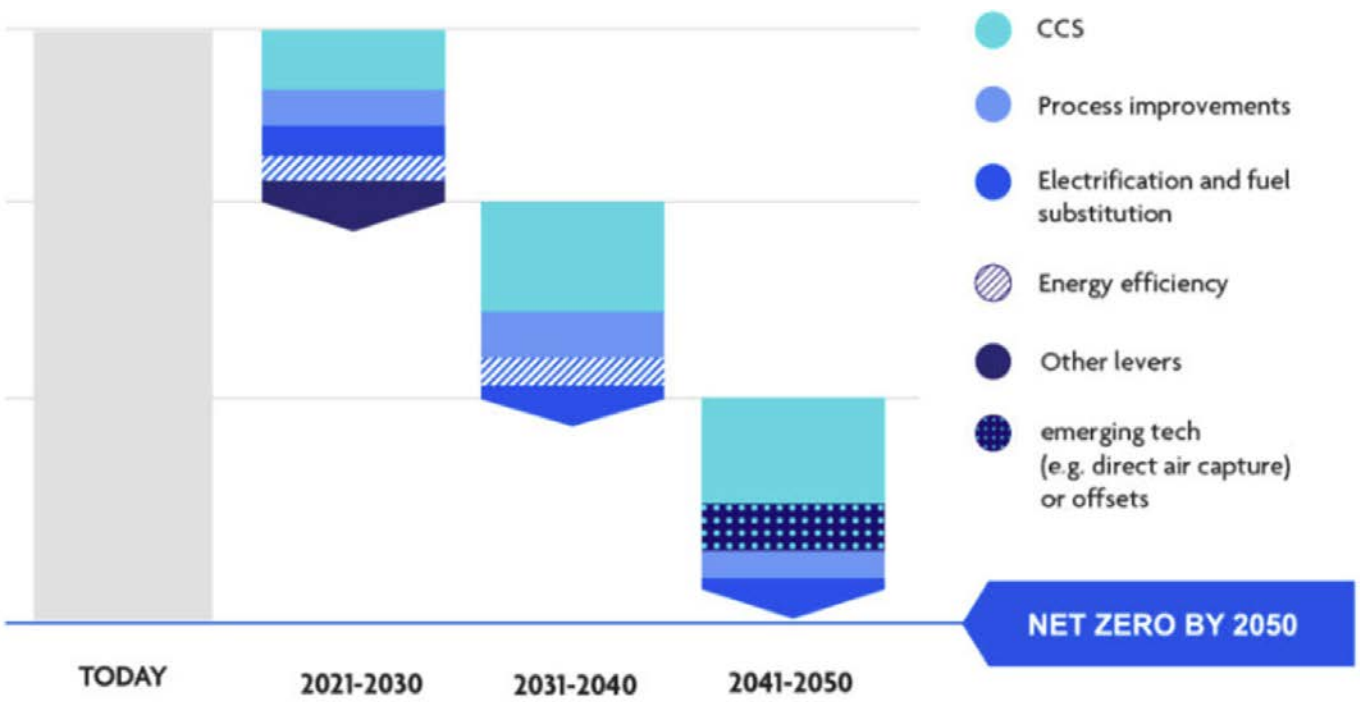
Other existing CCUS projects include Canada's Boundary Dam, United Arab Emirates' Al Reyadah, and Petra Nova in the U.S.

A coordinated effort

The Pathways Alliance project is a regional initiative that aims to accelerate the deployment of CCUS technology in Alberta. The project, led by Emissions Reduction Alberta and the Alberta Carbon Capture and Storage Development Council, aims for a 50% reduction in the province's GHG emissions by 2030 compared to 2005 levels by deploying CCUS technology at a large scale.

The project's partners include a broad range of stakeholders from industry, government, academia and civil society, including Suncor, Canadian Natural Resources, Enbridge and the University of Calgary.

The Pathways Alliance has a three-phased plan to achieve net-zero emissions by 2050 from the current level of 87 Mt per year. This ambitious goal will require an investment of around ~$75 billion over the next 30 years.



Source: Pathways Alliance.

Key challenges

The challenges faced by CCUS mostly occur in the carbon-capture stage, which is considered the most significant and difficult part of the CCUS process.

One example of this is the Gorgon CCUS project, located in Western Australia. The project, which was launched in 2019 and is considered one of the largest CCUS ventures globally, is facing operational problems with its CO2 injection system.

According to Chevron (the project's operator and one of the partners), the technical issues relate to the valves and piping in the injection system. As a result of these issues, the Gorgon CCUS project has been operating at a reduced capacity since July 2020, with a current carbon-capture rate of approximately 40% of the project's design capacity. Chevron is actively working towards fixing these issues.

While CCUS technology presents enormous opportunities for mitigating climate change, there are some significant reservations regarding its adoption, such as its high cost and potential safety risks. Nonetheless, with proper management strategies and awareness-raising initiatives in place, these challenges can be overcome and the technology can be leveraged to minimize the impacts of climate change.

Private sector buy-in

Several global companies are actively involved in CCUS development, including:

- Shell – has invested in several CCUS projects globally, including the Alberta Carbon Trunk Line and Quest in Canada.
- ExxonMobil – has invested in several CCUS technologies, projects and initiatives, including the Global CCS Institute, the National Carbon Capture Center and the Gas Technology Institute.
- Total – plans to reach net-zero emissions by 2050 and is actively investing in CCUS projects.
- BP – aims to be net-zero by 2050 and has invested in several CCUS technologies and projects, including Teesside and Humber, Northern Lights and Acorn.
- Air Products – a leading carbon-capture technology provider that is involved in several CCUS projects globally, including Air Products Port Arthur and Air Liquide Port Arthur in the U.S.

Conclusion and investment implications

CCUS technology is essential to achieving net-zero targets and combating climate change. The technology presents a vast array of benefits, such as decarbonizing industrial sectors, providing low-carbon hydrogen for transportation and heating, and creating new products and revenue streams. Although this technology presents some challenges, notably cost and safety risks, they are not insurmountable.

Advanced technological capabilities such as solid adsorbents have the potential to significantly improve carbon-capture rates and project economics, enhancing the appeal of CCUS technology.

Moreover, many companies and industries stand to benefit given the level of investment required to deploy CCUS technology globally. For example, in the U.S., the 45Q tax credit has the potential to support investment for many years, while in Canada the combination of provincial and federal support could have a similar effect.

Considering all these factors, we believe CCUS is becoming an attractive investment theme with multiple avenues for gaining exposure.

CCUS presents an important growth area for engineering companies. They play a key role in the development and implementation of the technology, from the design of the necessary facilities to the development of new and innovative carbon-capture technologies.

Energy equipment and services companies will also benefit from opportunities to tap into new markets, introduce new technologies and services, and provide sustainable solutions for the future. The companies that are ready to embrace CCUS will be well-positioned for the industry's future. Also, some energy companies are working on the modularization of CCUS. It could be a game-changer for the industry by driving efficiencies and materially reducing costs.

Finally, large companies that are investing in CCUS solutions have the potential to create new business opportunities and provide sustainable solutions to reduce GHG emissions, making it a win-win approach in terms of environmental and economic benefits. ExxonMobil's recent acquisition of Denbury is a case in point. The combined assets and capabilities further accelerate ExxonMobil's low-carbon solutions business and create an even more compelling customer decarbonization proposition with a comprehensive carbon capture and sequestration offering.

In our funds, we currently have exposure to engineering firms and energy equipment and services companies. We are also exploring opportunities to invest in companies that offer comprehensive carbon capture solutions.

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