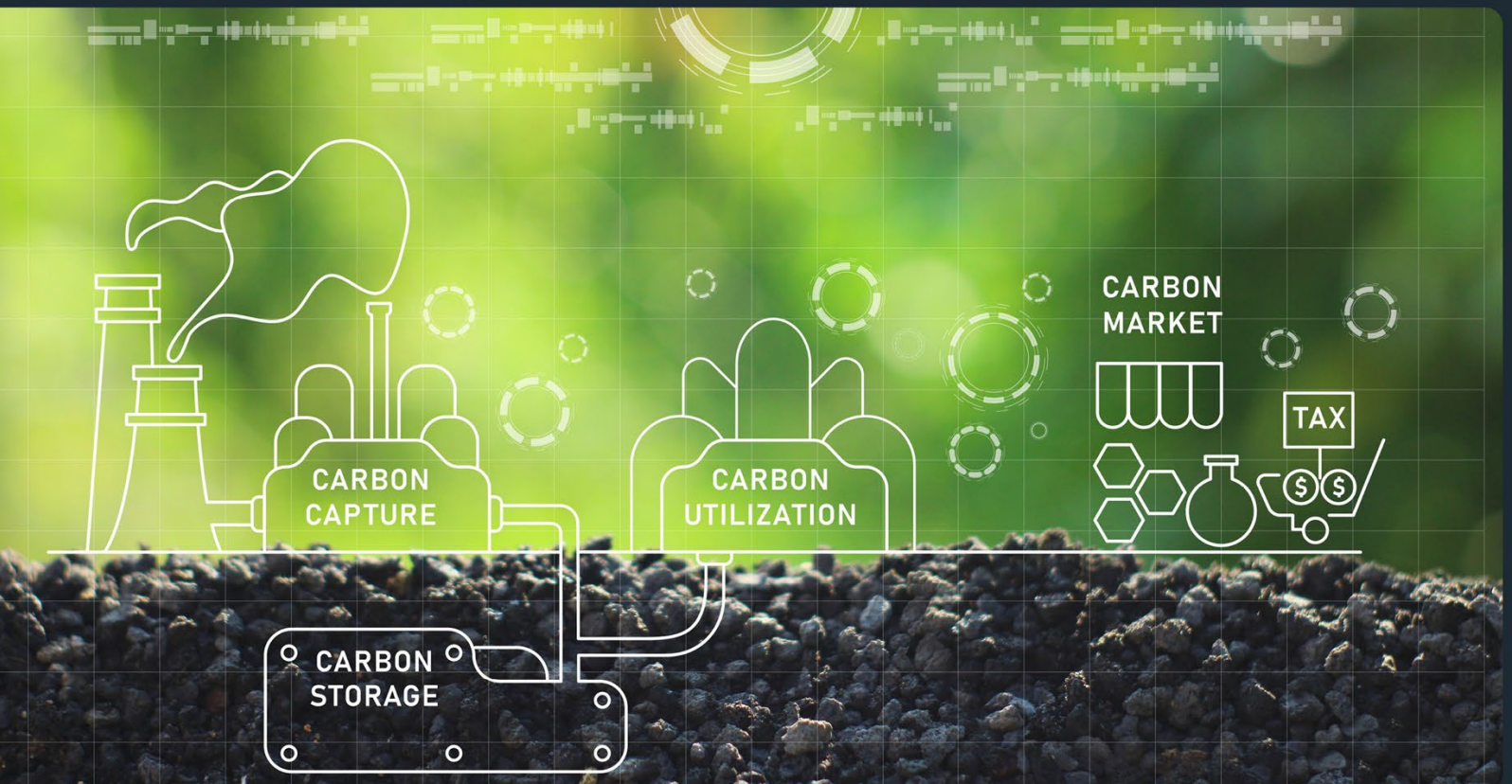


Financial Risks of Carbon Capture and Storage in Canada: Concerns About the Pathways Project and Public Energy Policy

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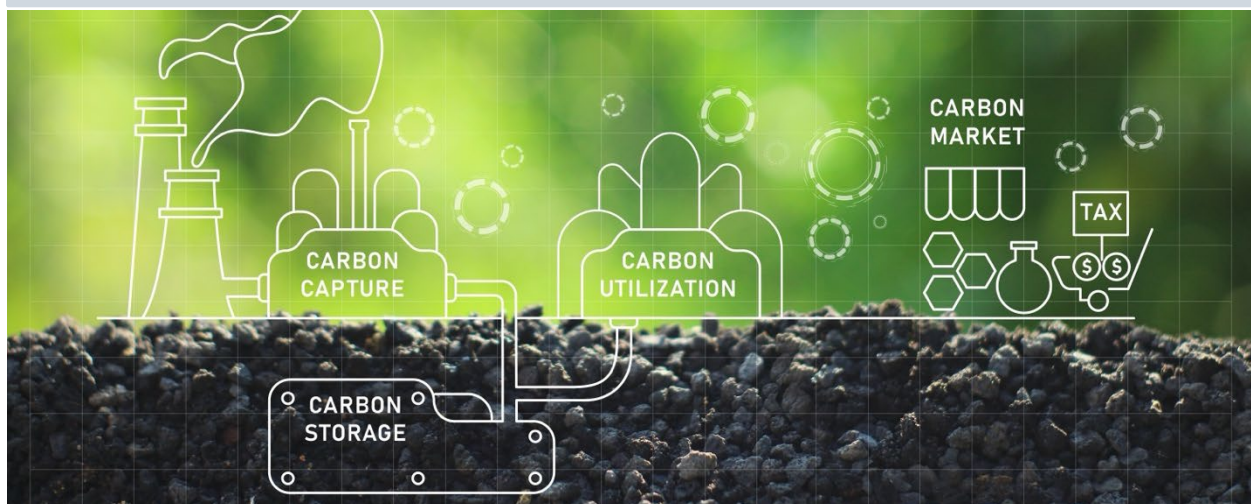
Key Findings

A plan to capture CO₂ from 13 oil sand processing facilities and store it in Alberta is threatened by cost challenges.

Total costs including interest, insurance, depreciation and taxes for existing commercial-scale carbon capture plants in Alberta are approaching thresholds that threaten profitability.

There is a risk that the oversupply of carbon emission performance credits (EPCs) will reduce project revenues.

Without substantial efficiency improvements, the cost per tonne of CO₂ captured at the Pathways facility is likely to exceed the revenue that the project can generate for each tonne captured.



Executive Summary

Cost challenges threaten the ability of a large, planned carbon capture project to achieve financial sustainability. The Pathways Alliance plans to capture carbon dioxide (CO₂) generated at 13 oil sand processing facilities, compress the gas and send it by pipeline to a storage hub near the Cold Lake region in Alberta. Publicly available financial information on the Pathways project is scant. It is instructive, however, to analyze the experiences of two existing commercial carbon capture facilities in Alberta—the Alberta Carbon Trunk (ACTL) line facility and Shell’s Quest facility.

The Institute for Energy Economics and Financial Analysis (IEEFA) examined the two currently operating CCS projects, together with current policy and provincial carbon market dynamics. The resulting report identified troubling cost implications for the Pathways CO₂ transport and storage project and raises the concern that the Canadian federal government and the province of Alberta may be pressured to make up the likely shortfall.

- We find total costs including interest, insurance, depreciation and taxes for existing commercial-scale carbon capture plants in Alberta are approaching thresholds that threaten profitability.
- Rising project costs are not being offset by commensurate increases in CO₂ capture volumes and associated revenue. Operating costs are growing at twice the rate of CO₂ captured volumes.
- CCS operating revenue is uncertain. An effective cap on emission performance credit (EPC) pricing of CAD\$170 per tonne limits project revenue potential, while a looming oversupply of carbon EPCs is an example of risks to project cash flows. The option to combine Clean Fuel Regulation credits with EPCs is available to ACTL, but this significant financial benefit is not available to the Pathways project.
- Performance risk is financial risk. Without substantial efficiency improvements, the cost per tonne of CO₂ captured is likely to exceed the revenue that the project can generate for each tonne captured.
- An unprofitable carbon capture project will struggle to bring lasting positive economic benefits to host communities and become dependent on external financial subsidies to maintain operations.

Even under optimal conditions, the Pathways project may struggle to break even, and real-world operations are rarely optimal.

Large-scale public investment in CCS is misguided. The technology has struggled to achieve meaningful emissions reductions or prove its long-term viability. The lack of demonstrated success and heightened financial risks indicate public investments are unlikely to yield the desired environmental or economic benefits.

Government officials face a choice. Subsidize and perhaps over-subsidize the project, or invest in more tenable renewable energy alternatives. If the project goes forward, the primary emitters (polluters) should bear the financial burden and the risk for pollution prevention.

Background

The industrial process that turns bitumen from oil sands into synthetic crude oil generates carbon dioxide (CO₂)—a primary greenhouse gas that is driving climate change. The Pathways Alliance, a coalition of Canada's six largest oil sands producers, plans to manage this environmental challenge through carbon capture and sequestration (CCS). Members of the Pathways Alliance—which include Canadian Natural Resources, Suncor Energy, Cenovus Energy, Imperial Oil, MEG Energy and ConocoPhillips Canada—are responsible for 95% of the output from Canada's tar sands.¹

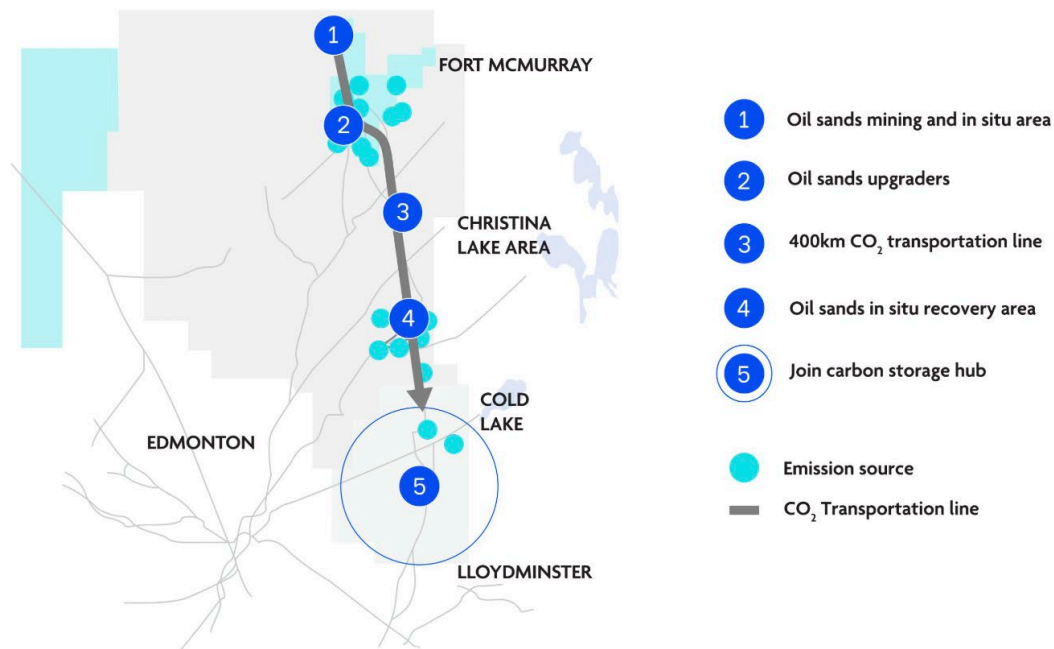
The Pathways Alliance's CO₂ transportation and storage hub project plans to capture CO₂ gas generated at 13 oil sand processing facilities by using amine-based technology to separate the CO₂ from the flue gas. The captured CO₂ would be compressed and transported by a 400-kilometre pipeline to a central storage hub near the Cold Lake region in Alberta. The CO₂ would be injected into wells for permanent storage within the Basal Cambrian Sandstone geological formation that lies one to two kilometres underground.² The project has a targeted capacity of 10 million to 12 million tonnes of CO₂ per annum, which would make it one of the largest carbon capture facilities in the world.³

¹ Pathways Alliance. [Pathways Alliance - About Us](#). October 15, 2023. The Alliance is targeting reduction of 22 mega-tonnes of CO₂ annually by 2030, through various strategies, including direct air capture, solvent injection, electrification, and emission site-based CCS.

² Cision. [Pathways Alliance advances key oil sands CO₂ emissions reduction activities](#). November 27, 2023.

³ Global CCS Institute. [Global Status of CCS 2024](#). November 6, 2024, pp.57-79.

Figure 1: Pathways Project Map



Source: Canadian Energy Centre.

The federal government is encouraging such projects, believing CCS technology can be a productive part of a strategy to achieve net-zero emissions. The Canada Energy Regulator projects Canada could sequester between 60 million and 80 million metric tonnes of CO₂ per year by 2050—up from roughly 4 million tonnes per annum today.⁴ The government of Canada passed the Greenhouse Gas Pollution Pricing Act (GHGPPA), which places a nationwide price on carbon pollution. The current carbon price is set at CAD\$80 per tonne of CO₂ for 2024. It is expected to plateau at CAD\$170 per tonne by 2030. The government seeks to create economic incentives for the development of carbon dioxide removal technologies and associated ventures by making it more expensive to pollute.

⁴ Canada Energy Regulator. [Role of carbon management on the path to net zero](#). October 15, 2023.

In addition, federal and provincial governments have rolled out an array of fiscal incentives and grants aimed at CCS project development—covering everything from research and front-end engineering design to construction and operational costs:

- Canada’s federal CCS investment tax credit (ITC) offers refunds of as much as 50% of eligible carbon capture facility capital costs.⁵ This business tax benefit is projected to cost taxpayers at least CAD\$5.7 billion.⁶
- Alberta’s Carbon Capture Incentive Program (ACCIP) offers a grant of as much as 12% of eligible CCS capital expenses. It is expected to cost the province between CAD\$3.2 billion and CAD\$5.3 billion.⁷

Overall, federal and provincial governments are providing financial support and incentives that cover close to half of total project expenditures at the large-scale carbon capture projects currently operating in Alberta.⁸

While these generous incentives may be well-intentioned, various stakeholders are beginning to question the prudence of these investments.

IEEFA has long expressed skepticism about the effectiveness of CCS technology due to widespread technical challenges, the tendency of CCS projects to underperform industry-promoted target capture rates, and the potential of CCS investment programs to distract from more effective climate solutions.⁹ While the oil and gas industry has had decades to refine the extraction of oil from the ground and has used carbon capture for many years to provide CO₂ for enhanced oil recovery (EOR) operations, its use as a greenhouse gas pollution reduction technology—essentially the process of capturing CO₂ at high efficiency levels for permanent sequestration—is nascent and remains largely unsuccessful on a broad scale. The figure below illustrates the actual annual carbon capture rates achieved by existing commercial-scale CCS facilities, compared to the industry-promoted claim that CCS facilities can maintain a 95% or higher carbon capture rate.

⁵ Office of the Parliamentary Budget Officer. [Investment Tax Credit for Carbon Capture, Utilization and Storage](#). February 1, 2024.

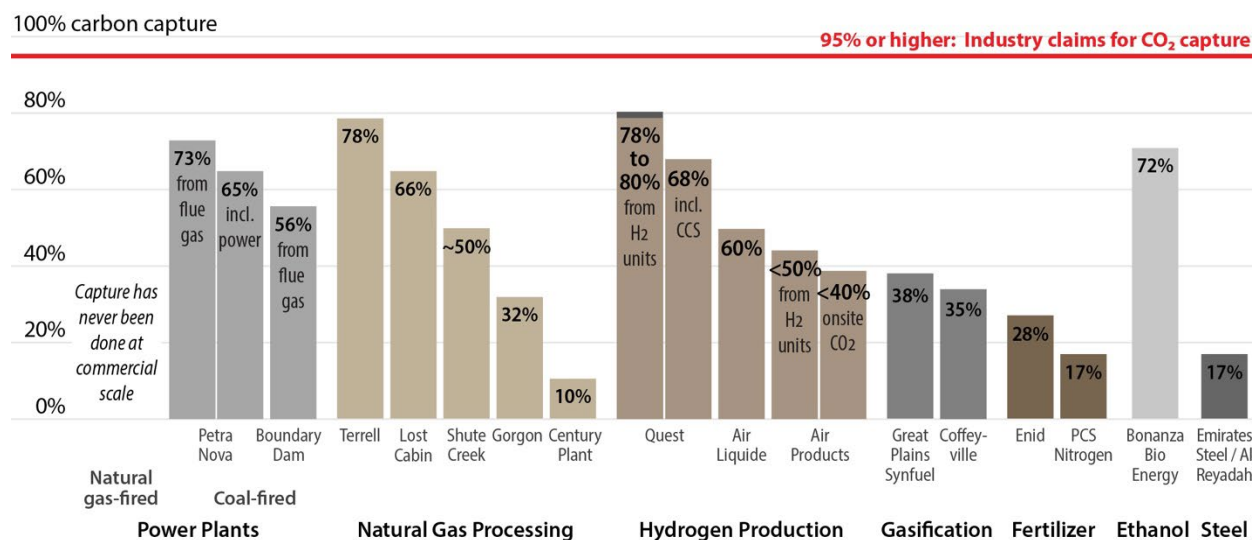
⁶ *Ibid.*

⁷ Government of Alberta. [Alberta Carbon Capture Incentive Program](#). June 15, 2024.

⁸ The Alberta Carbon Trunk Line and Quest CCS project have received 41% and 63%, respectively, of total project expenses from inception to 2023 from federal and provincial government sources.

⁹ IEEFA. [Carbon Capture and Storage: An unproven technology that cannot meet planetary CO₂ mitigation needs](#). October 15, 2024.

Figure 2: CO₂ Real-World Capture Rates at Commercial-Scale Hydrogen Production, Coal-Fired Power Plants, Natural Gas Processing and Gasification Facilities



Source: IEEFA analyses based on publicly available data.

The economic feasibility of the concept is also a matter of concern. Given that CCS projects are very expensive to implement, it is unclear if the value of the captured carbon is high enough to justify the significant costs involved in capturing and managing it. Recently, Capital Power Corp., an Edmonton-based utility, cancelled plans for a CAD\$2.4 billion, 3 million-tonne CCS project at its Genesee gas-fired plant. Capital stated that the project would not be financially viable even if it were effective.¹⁰

The Pathways carbon hub project—with an estimated price tag of CAD\$16.5 billion, half of which is expected to be borne by Canadian taxpayers—ought to be examined through a similar lens.

The outcome of a recent highly subsidized, large-scale energy infrastructure project should serve as a red flag. The Trans Mountain Expansion (TMX) project—a pipeline that runs from Edmonton to Burnaby, B.C.—saw its capital expenditure soar from initial estimates of CAD\$7.4 billion in 2017 to CAD\$30.9 billion after the federal government took over financing the project. IEEFA's analysis had concluded that the pipeline would struggle to be economically feasible since tolls required to be charged to recoup capital and operational costs on the line would be excessive.¹¹ The investment has been embroiled in uncertainty, with shippers balking at paying the elevated tolls required to recoup the massive public expenditure.¹²

¹⁰ Capital Power. [Capital Power Q1 2024 results - Discontinuation of \\$2.4 billion Genesee CCS project](#). May 1, 2024.

¹¹ IEEFA. [Trans Mountain expansion could never return the expected \\$26.1 billion spent by taxpayers](#). March 9, 2022.

¹² Financial Post. [Trans Mountain tolling dispute could stretch into mid-2025: Cenovus](#). May 1, 2024.

The potential for large, unviable CCS plants to become a burden on Canadian taxpayers—while also failing to achieve the public interest goal of 95% carbon capture and safe sequestration—is worthy of scrutiny.

Methodology

This paper aims to provide a preliminary assessment of the financial viability of the Pathways proposed carbon transportation, and storage hub project.

The analysis is focused primarily on two key variables:

- The estimated cost to capture one tonne of CO₂ at the facility; and
- The anticipated revenue expected to be generated from one tonne of captured carbon.

By comparing the cost of capturing CO₂ with the revenue to be generated from that process, we can gain key insight into the core economics of the facility and Alberta's CCS sector in general.

Carbon emission performance credits (EPCs) are expected to be the primary source of operating revenue for the Pathways carbon hub. The financial viability of the Pathways project will depend largely on its ability to generate and monetize enough EPCs to recover construction costs as well as to cover capital, operating and non-operating expenses.

To assess potential costs at the facility, IEEFA analyzed the levelized cost of carbon (LCOC) metric that is calculated and published by commercial-scale CCS projects in Alberta. The levelized cost of carbon is an annualized estimate of the cost per tonne of CO₂ captured, utilized, or stored over the life of a facility after accounting for all capital, operating and maintenance expenses. The LCOC reflects the total costs expected to be incurred over the course of the project, and divides that by the total amount of carbon expected to be captured. The result is a cost per tonne estimate that is useful for assessing project economics and comparing efficiency among different projects.

The LCOC for the Pathways network has not been made publicly available. Our request for this information or prerequisite data needed to conduct an independent estimation was not granted.¹³ However, two commercial-scale CCS projects currently operating in Alberta—the Alberta Carbon Trunk Line (ACTL) operated by Wolf Carbon Solutions and the Quest CCS project operated by Shell Canada Energy—publish comprehensive levelized cost estimates using uniform methodology approved by the Alberta Energy Regulator. Both facilities are comparable to the proposed Pathways network and are generally exposed to similar macroeconomic, labour, and financial market

¹³ IEEFA sent an email to the CCUS Implementation team at the Alberta Ministry of Energy & Minerals on Aug. 7, 2024, formally requesting a breakdown of levelized capex and opex cost estimates and revenue projections for the Pathways hub. IEEFA received a response on Aug. 8, indicating that the requested information is considered confidential and contains commercially sensitive data that cannot be disclosed to the public. On Aug. 23, IEEFA forwarded the same request to an email listed on the Pathways Alliance website for inquiries related to its flagship CCS project. This email received no response.

conditions. (ACTL and Quest are described in Section I below). The assessment is not exhaustive, however, and the approach employed has limitations.

Limitations

The absence of data specific to the Pathways hub hampers the ability to perform a thorough and definitive financial analysis on the project. Aside from a general estimate of construction costs,¹⁴ the Pathways Alliance has released little publicly available information on the financials of its flagship CCS project. Using other facilities as a proxy may not fully capture the unique financials and risks peculiar to the project since material differences may exist among various CCS projects, including the technology employed, location of infrastructure, scale and properties of the CO₂ source.

The alliance has previously been accused of violating the Competition Act in Canada by allegedly making misleading and unsubstantiated environmental claims in its nationwide advertising campaign promoting the project.¹⁵ The Competition Bureau, which is a federal agency responsible for promoting fair business practices in Canada, has acknowledged that that matter is under investigation.¹⁶ The Pathways Alliance now states that its disclosures will be limited due to uncertainty around the application of rules related to the Competition Act. Subsequently, all content relating to the proposed carbon hub has been removed from its website.¹⁷ This action has further obscured details around this project.

The absence of data specific to the Pathways hub hampers the ability to perform a thorough and definitive financial analysis on the project. Using other facilities as a proxy may not fully capture the unique financials and risks peculiar to the project since material differences may exist among various CCS projects, including the technology employed, location of infrastructure, scale and properties of the CO₂ source.

The cost analysis in this report relies on data and cost estimations provided in reports to the Canadian government by Shell Canada and Wolf Carbon Solutions. We do not have full transparency or independent verification of the accuracy of this information. Our conclusions are contingent on self-reported data that may be subject to bias or optimism.

This analysis focuses primarily on operating revenue generated from the sale of EPCs. The degree to which the Pathways network will generate revenue from ancillary streams such as pipeline tariffs and enhanced oil recovery operations is unclear. However, revenue from tariffs and EOR are unlikely to be robust enough to materially alter project economics.

¹⁴ Cision. [Pathways Alliance advances key oil sands CO₂ emissions reduction activities](#). November 27, 2023.

¹⁵ Greenpeace. [Application for Inquiry into false and misleading representations made by the Pathways Alliance about their climate action and the climate impact of their business](#). March 2023.

¹⁶ Reuters. [Canada's Competition Bureau investigates oil sands group over advertising](#). May 11, 2023. The Competition Bureau is yet to provide an update on the status of this investigation.

¹⁷ Pathways Alliance. [Canada's Competition Act amendments - FAQ](#). July 2024.

Government subsidies, though material, are excluded from our revenue estimates. The subsidies can create an inflated perception of profitability and are generally not expected to persist for the life of the project, so they have been excluded to provide an assessment of the project's independent earning capacity.

Our findings are discussed below.

I. Costs for CCS Are Spiraling Upward—With No Commensurate Increase in Productivity—and May Already Be Underestimated

IEEFA examined publicly available financial data for the two commercial CCS facilities operating in Alberta. We identified concerns regarding escalating costs and the approach taken to estimate the levelized cost of carbon at the plants.

The Alberta Carbon Trunk Line (ACTL) project consists of a 240-kilometre pipeline with a stated ultimate capacity to transport as much as 14.6 million metric tonnes per annum (mmtpa) of CO₂ from various emitters. The ACTL commenced commercial operations in June 2020 at a cost of CAD\$988 million.¹⁸ Captured CO₂ is currently sourced from the Nurien Fertilizer Manufacturing Plant in Redwater, Alberta, and the Sturgeon refinery operated by the Northwest Redwater Partnership. The CO₂ is delivered to the Clive oil field to stimulate extraction via EOR operations. Clive is a legacy oil field operated by Enhance Energy.¹⁹

The Quest CCS facility captures CO₂ produced from Shell's Scotford upgrader near Fort Saskatchewan, Alberta. Steam methane units at the Scotford upgrader produce both hydrogen and CO₂ as byproducts from bitumen processing. The CO₂ is captured and transported via a 65-kilometre pipeline to a storage site, where it is ultimately deposited into the Cambrian basal sands formation two kilometres below ground.²⁰ The facility commenced commercial operations in 2015 with a capital construction budget of CAD\$790 million and capacity of 1.2 million tonnes of CO₂ per annum.²¹

¹⁸ Enhance Energy Inc., Wolf Carbon Solutions Inc., and Northwest Redwater Partnership. [ACTL knowledge sharing summary report, 2023 - Section 10: Costs and Revenues](#), pp. 30, 31.

¹⁹ Enhance Energy Inc., Wolf Carbon Solutions Inc., and Northwest Redwater Partnership. [ACTL knowledge sharing summary report, 2023 - Executive Summary](#), pp. 9, 15.

²⁰ Shell.com. [Quest facility project overview](#). August 19, 2021.

²¹ Shell Canada Energy. [Quest Annual Summary report - cost and revenues](#). March 2024, p. 47.

In their most recent annual reports, Wolf Carbon and Shell Canada estimate the average cost to construct and operate their respective facilities, i.e., their levelized cost of carbon (LCOC), as CAD\$106.4 per tonne at the ACTL,²² and CAD\$165.94 per tonne of net CO₂ captured at Quest.²³

However, key variables used in the calculation of these estimates—such as projected cost inflation and average CO₂ capture rates—were found to be unrealistic. IEEFA’s analysis shows that once adjusted for more suitable figures, the revised LCOC estimates would result in materially higher figures with negative implications for proposed CCS plants in the province.

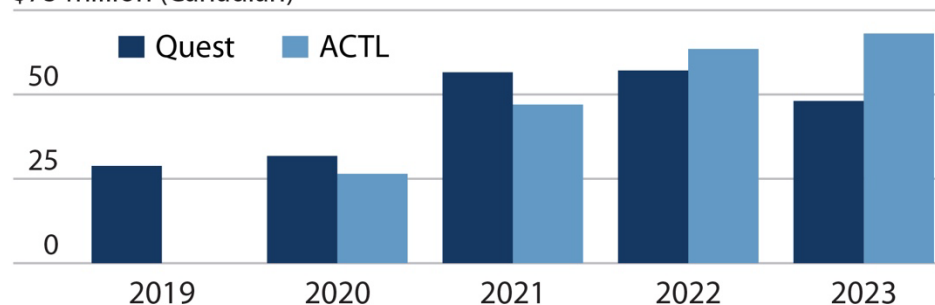
A. Escalating Operating Costs Are a Red Flag: Higher-Than-Projected Cost Inflation Is a Threat to CCS Projects

At the Quest facility, operating costs per tonne of net CO₂ captured have ballooned from CAD\$34.70 in 2016 to CAD\$62.54 in 2023—an increase of more than 118% and annual growth of more than 8%.²⁴ Similarly, the Alberta Carbon Trunk Line has seen costs go up from CAD\$30.44 per tonne of net CO₂ captured in 2020 to CAD\$49.25 per tonne in 2023—more than 60% increase in three years and annual growth rate of 13%.²⁵ It is noteworthy that these cost increases are largely being incurred with no corresponding increase in absolute amounts of net CO₂ captured.²⁶

Figure 3: Carbon Capture Operating Costs Rise Sharply in Canada

Total operating expenses at the Quest and ACTL CCS projects

\$75 million (Canadian)



IEEFA

Sources: Shell Canada Energy; Enhance Energy; Wolf Carbon Solutions.

²² Enhance Energy Inc., Wolf Carbon Solutions Inc., and North West Redwater Partnership. [Alberta Carbon Trunk Line project knowledge sharing report](#). March 31, 2024, p.101.

²³ Shell Canada Energy. [Applicable reported costs for the project - Quest cost per tonne](#). August 1, 2023, p. 4.

²⁴ Shell Canada Energy. [Applicable reported costs for the project - Quest cost per tonne](#). August 1, 2023, p. 5.

²⁵ Enhance Energy Inc., Wolf Carbon Solutions Inc., and North West Redwater Partnership. [Alberta Carbon Trunk Line project knowledge sharing report](#). March 31, 2024, p.102.

²⁶ Operating costs at the ACTL and Quest project are growing at a compound annual growth rate (CAGR) of 26% and 6% per annum respectively, compared to net CO₂-captured CAGR of 12.6% and -1.5% per annum.

Observed rates of cost escalation are at variance with assumptions made in published levelized cost calculations. In their LCOC estimation models, ACTL and Quest assume an annual inflation rate of 2% and an annual cost escalation rate of 1% over the life of their respective facilities. Although there is always the possibility that cost efficiency could improve in future years, such an assumption likely would be unduly optimistic, since such efficiency gains have yet to materialize after almost a decade of operations at Quest and four years at the ACTL. Realistic escalation rates should be factored into cost projections to properly account for rising operational, maintenance and capital costs. The observed disparity between actual and projected cost inflation indicates that the published levelized cost estimates are likely underestimated and do not reflect the true cost of constructing and operating both facilities.

The Pathways project will likely have to deal with similar challenges of escalating energy, material, and labour costs. If operating costs rise at currently observed industry rates for the life of the project, then total cost per tonne of CO₂ at the proposed facility would balloon to levels that make breakeven or profitability highly improbable.

B. Performance Risk Is Financial Risk: Reductions in CO₂ Capture Rates Have Negative Financial Implications for CCS Projects

Facilities that struggle to achieve target capture rates will face increasing cost pressures that hurt project viability. At higher achieved capture rates, total CCS expenditure is divided by a larger quantity of captured CO₂, resulting in a lower per-tonne cost estimate. At lower achieved capture rates, in contrast, the calculation results in a higher per-tonne cost.

Figure 4: LCOC Equation

$$\text{LCOC} = \frac{\text{Total Lifetime CCS Cost}}{\text{Total Lifetime Mass of Net CO}_2 \text{ Captured}}$$

Levelized Cost of Carbon

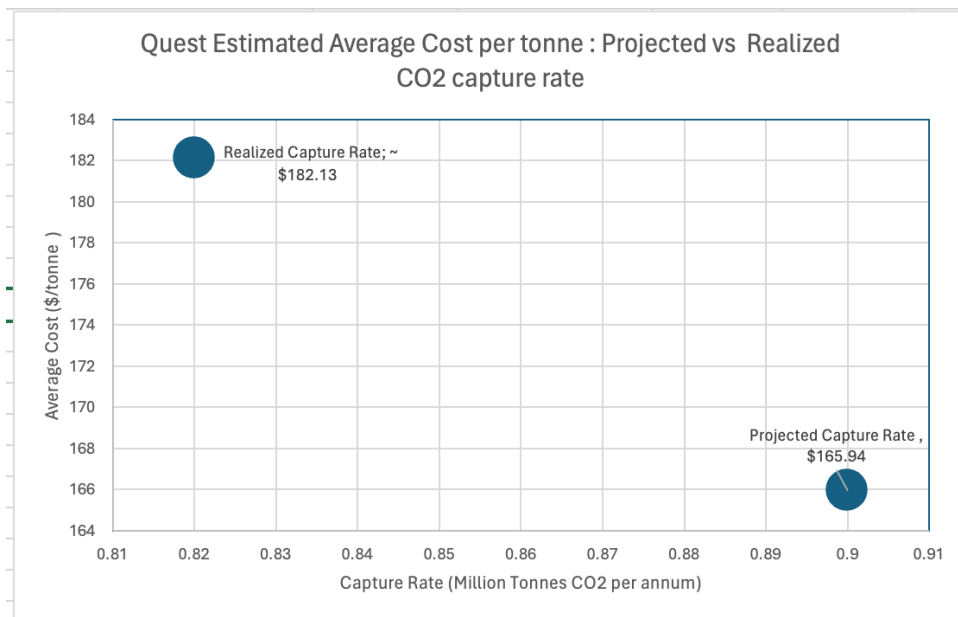
In their LCOC calculations, operators at both the ACTL and Quest appear to be forecasting optimistic annual rates of net CO₂ capture at their respective facilities. The ACTL assumes it will capture an average of 1.48 million tonnes of net CO₂ per annum for 25 years,²⁷ while Quest is assumed to capture 0.9 million tonnes for the same period.²⁸ Neither facility has achieved these capture rates on average since they began operations.

²⁷ Enhance Energy Inc., Wolf Carbon Solutions Inc., and North West Redwater Partnership, *op. cit.*, p.101.

²⁸ Shell Canada Energy, *op. cit.*, p. 4.

In reality, ACTL has captured an average of 0.994 million tonnes of net CO₂ per annum, and the Quest facility has captured an average of 0.829 million tonnes of net CO₂ per annum since inception.^{29, 30} To produce accurate estimates, capture rates assumed in cost models should reflect realistic performance averages, not optimistic projections. By adjusting the LCOC estimate for real average plant performance (average capture rate since project inception), our calculations show the levelized cost of CO₂ should rise closer to ~\$145 per tonne for the ACTL and ~\$180 per tonne at Quest.

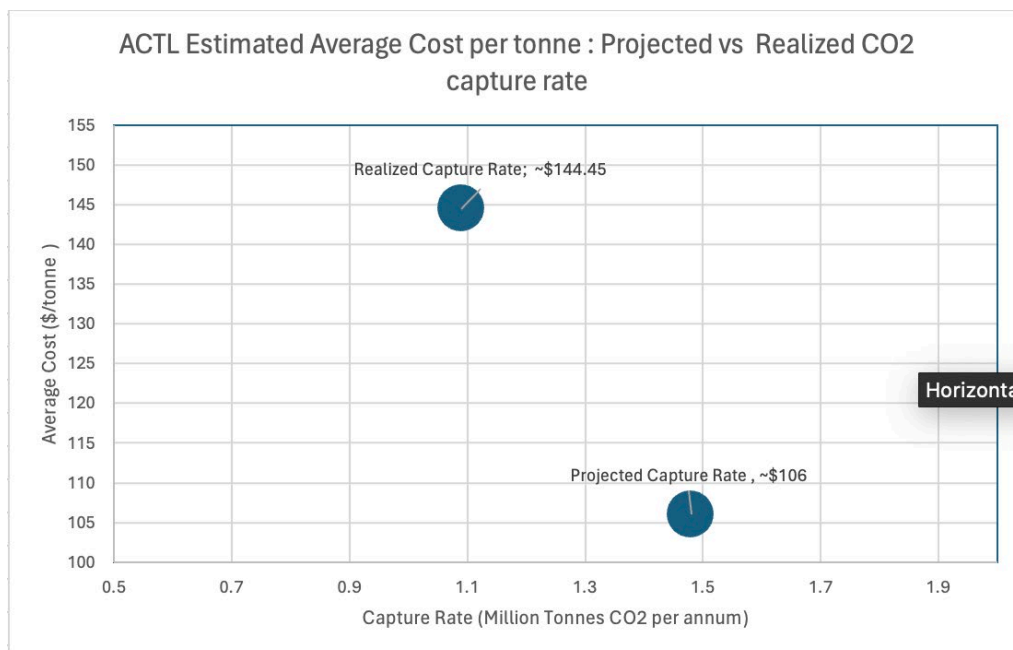
Figure 5: Quest Levelized Cost Per-Tonne Estimate Adjusted for Average Project Capture Rate



Source: Shell Canada Energy & IEEFA analysis.

²⁹ Enhance Energy Inc., Wolf Carbon Solutions Inc., and North West Redwater Partnership, *op. cit.*, p.102.

³⁰ Shell Canada Energy, *op. cit.*, p. 5.

Figure 6: ACTL Levelized Cost Estimate Adjusted for Average Project Capture Rate

Source: Enhance Energy Inc., Wolf Carbon Solutions Inc., Northwest Redwater Partnership and IEEFA analysis.

The risks of capture underperformance should not be understated. IEEFA has documented that performance challenges are common at carbon capture facilities across the globe.³¹ In recent years, Shell Canada has attributed reductions in CO₂ availability and sub-capacity capture performance to operational challenges encountered at its Quest facility.³² For the Pathways hub, the complexity of managing emissions from 13 different capture sites introduces variability in capture rates and makes the project especially vulnerable. Technical issues, maintenance shutdowns, pipeline leakages, supply chain disruptions, workforce gaps, and the discovery of subsurface or plant abnormalities in any of the 13 capture sites or the storage location could lead to sub-optimal capture rates over the life of the network. If the Pathways hub is unable to capture CO₂ volumes at projected levels consistently over its lifetime, it will experience significant cost pressures and higher per-unit costs.

³¹ IEEFA, [Blue Hydrogen: Not clean, not low carbon, not a solution](#), September 2023. Also see: IEEFA Australia, [CCS Hypes and Hopes Sinking Fast](#), October 2024.

³² Shell Canada Energy, [Quest Annual Summary Report 2022 - Executive Summary](#), 2022, p. 5. Also see: [Quest Annual Summary Report 2023 - Executive Summary](#), 2023, p. 5.

C. After Accounting for Critical Non-Operating Costs, the Likelihood of Pathways Maintaining Overall Costs Below Profitability Thresholds Is Doubtful

The LCOC estimates provided by both Shell Canada and Wolf Carbon do not appear to include non-operating cost items that would be critical to the operation of a Pathways facility.

Insurance Costs: Environmental and liability insurance will be required to hedge the financial impacts of accidental leaks, cleanup costs, restoration expenses and compensation of affected communities. Throughout the life of the project and the pre-closure period, the Pathways alliance will bear liability and be financially accountable for any spill or adverse events along the 400-kilometre pipeline and storage network. In addition, Alberta requires CCS operators to make financial contributions to a post-closure stewardship fund to support the government's assumption of long-term liability for storage sites.³³ Given the uncertainties around long-term behaviour of CO₂ in the ground and the potential effects on host communities,³⁴ it is safe to assume that at the minimum, the project will incur costly insurance premiums that reflect the heightened risks associated with its extensive transport and storage infrastructure.

Financing and other costs: Interest, taxes and depreciation present additional cost burdens that should be considered. Depending on the financing strategy and amount of debt employed, interest expenses on capital borrowed to fund construction may surpass all other operating cost items. Assuming a conservative 35:65 debt-to-equity ratio, the Pathways project could incur annual interest costs of more than CAD\$200 million. Current central bank monetary policy, characterized by relatively elevated interest rates, poses an additional challenge to project economics and cost efficiency. Depreciation refers to the gradual loss in value of key assets such as capture equipment, pipelines, and storage infrastructure. As these assets depreciate, project operators must account for their declining value in financial statements. Statutory levies such as corporate income taxes, environmental taxes and fees, must also be offset from already constrained revenue and cash flow.

³³ Government of Alberta. [Mines and Mineral Act - Section 122](#). December 7, 2023.

³⁴ IEEFA. [Norway's Sleipner and Snøhvit CCS- Industry models or cautionary tales](#). June 14, 2023, p.32.

II. CCS Revenue Potential Is Weak and Uncertain

The Pathways project is likely to have trouble raising enough revenue to cover the costs of the project.

A. CCS Operating Revenue at the Pathways Project Is, in Effect, Constrained at CAD\$170 per Tonne of Net CO₂ Captured

The federal government allows provinces to implement their own carbon pricing and trading systems, provided they comply with minimum standards set by the GHGPPA.³⁵ In Alberta, the issuance and trading of EPCs is governed by the province's Technology Innovation and Emissions Reduction (TIER) framework. Under TIER, industrial emitters are assigned a specific benchmark for allowable emissions and are rewarded with EPCs if their emissions are less than the benchmark. Facilities are awarded roughly one EPC per tonne of CO₂ reduced below their assigned benchmark. Facilities that exceed their allowable emissions incur a compliance obligation that must be settled by either purchasing EPCs or by making a payment into the TIER fund at a prescribed price per tonne that is aligned with the official carbon price.³⁶

The official carbon price was set at CAD\$80 per tonne of CO₂ for 2024 and is expected to top out at CAD\$170 per tonne in 2030. Currently, the government has provided no mechanism for upward adjustments of the federal carbon schedule to accommodate for inflation or any future economic considerations.

Facilities looking to settle their compliance obligations are expected to form the bulk of demand for EPCs in Alberta. The option to fulfill compliance obligations by paying into the TIER fund rather than purchasing credits effectively limits demand for EPCs and creates a ceiling on the maximum price to be derived from their sale. If the market price of EPCs exceeds the official carbon price, facilities can settle their compliance obligations by simply paying into the TIER fund at the lesser prevailing carbon price rate. In other words, they can achieve compliance by spending less. Such prospective buyers thus have no financial incentive to buy EPCs at prices of more than CAD\$170 per tonne, and Pathways is unlikely to see any persisting demand for its credits at prices materially higher than the prevailing carbon price.

It is reasonable to assume the maximum price to be derived from the sale of EPCs in the TIER market will likely not exceed CAD\$170 per tonne of CO₂.

³⁵ Government of Canada. [Carbon pollution pricing systems across Canada](#). June 8, 2024.

³⁶ Government of Alberta. [TIER Regulation Factsheet](#). August 17, 2023.

B. Oversupply of Carbon Credits Could Reduce Project Revenue

While EPC prices may have an effective ceiling at CAD\$170 per tonne, no floor exists, at least in theory, on their price. A looming oversupply of EPCs in the provincial TIER market (i.e., more EPCs available for sale by the facilities who have earned them but not enough facilities seeking to buy the credits to satisfy their own compliance obligations) means the Pathways network could generate far less revenue for each tonne of net CO₂ captured.

The government of Alberta has received numerous applications for CCS hubs and has shortlisted seven key facilities that claim to have the potential to capture and sequester as much as 56 million tonnes of CO₂ per year by 2030.³⁷ If a majority of facilities are commissioned, the TIER market could see a significant increase in the number of EPCs issued annually, to the tune of 30 million to 50 million additional credits. It is uncertain that demand in provincial carbon markets will be able to sufficiently absorb such levels of incremental credit supply. In 2022, for example, emitters looking to regularize their emissions required just 600,000 credits to settle compliance obligations. Aggregate compliance obligation—a key measure of credit demand thresholds—was 20.1 million tonnes in the same year.³⁸

If provincial carbon markets become saturated, the price of EPCs will fall accordingly. This would translate to revenue shortfalls that hamper the ability of CCS projects to cover operating and capital expenses from internally generated cash flow.

Recent accounts from market participants indicate that EPCs in Alberta are already trading at a significant discount to the official carbon price. The discount has been estimated to have widened significantly from 10% in 2021 to 37.5% in 2024.³⁹ This reflects doubts on the future market value of the credits and concerns about their ability to hold up to the federal carbon price.

The Canada Growth Fund (CGF)—a federal initiative with the mandate to provide price certainty for EPCs in Canada—may help mitigate some of these risks. However, operators looking to the fund as a panacea may be disappointed. A recent carbon offtake deal announced by the CGF would see sponsors of a proposed carbon capture project selling their credits to the CGF at prices that are actually less than the official carbon price.⁴⁰

³⁷ Canada Energy Regulator. [Upcoming CCS projects in Alberta](#). December 21, 2022.

³⁸ Government of Alberta. [Alberta Industrial Greenhouse Gas Compliance](#). August 11, 2023.

³⁹ Clean Prosperity. [Strengthening TIER for Alberta's Low-Carbon Growth](#). July 2024, p. 17.

⁴⁰ Canada Growth Fund. [Government guarantees price of carbon for Canadian-made carbon capture technology](#). December 20, 2023.

III. *Caveat Emptor*: Just Like Quest and ACTL, the Pathways Hub Expects To Rely on Government Subsidies for Survival—and the Level of Reliance May Increase

An analysis of the financial disclosures from the two other large-scale CCS projects in Alberta indicates the true cost to operate a commercial-scale CCS project in the province is higher than projected and may continue to rise. The Pathways CCS network will have to contend with these same operating and financial realities. Given already elevated cost estimates and projected revenue constraints, it is reasonable to assume the project will struggle to achieve cost-revenue parity. In such a scenario, the project can only become viable through the infusion of further external subsidies.

This should probably not come as a surprise. The ACTL and Quest projects exist today because of extensive federal and provincial government subsidies that have provided more than 50%—and by some estimates, as much as 90%—of total capital and operating project expenditures at both projects.⁴¹ Shell Canada was also able to secure a deal with the provincial government that provided its Quest project with an additional carbon credit for each one legitimately earned—effectively doubling its revenue per tonne of CO₂ captured.⁴² The controversial deal expired in 2022 and is not available to other proposed CCS projects. The ACTL generates additional revenue through EOR operations and the monetization of clean fuel regulation (CFR) credits. In 2023, ACTL generated the equivalent of roughly CAD\$100 million in revenue from CFR credits.⁴³

The Pathways facility is excluded from eligibility to generate CFR credits. Emissions from Pathways members' carbon capture facilities are byproducts of fuel produced for export, not part of the supply chain of fuel used domestically, which is the target of the federal CFR credit program. The Pathways project is therefore ineligible to access CFR credits as an additional source of revenue.⁴⁴

The Pathways hub has the option of deferring to its deep-pocketed parent organizations for required financial assistance. Permanently subsidizing a risky, unproven and high-cost venture, however, is unlikely to be an attractive proposition to their shareholders. The prospect of negative-to-marginal returns is hardly a magnet for investor capital, and management decisions to invest in sub-optimal projects are unlikely to boost market confidence or win shareholder votes. This might explain why—

⁴¹ The Alberta Carbon Trunk Line and Quest CCS project have received 41% and 63% of total project spend from inception to year 2023 from federal and provincial government sources.

⁴² Greenpeace. [Shell loves a bargain](#). May 29, 2024.

⁴³ ACTL reports generating 892,469 CFR credits X reported average price of \$133 per credit = ~\$118.7 million.

⁴⁴ The Pathways Alliance apparently is lobbying for an arrangement that would enable the project to qualify for and generate revenue from CFR credits. See: The Narwhal. [Inside the Canadian oilsands lobby's request to fast-track a major project](#). May 27, 2024.

despite near record cash flow and sky-high profits—the oil sands industry continues to lobby government officials for additional financial support for the project.⁴⁵

Public officials should be cautious, however, about assuming the role of funder of last resort for carbon capture facilities in Canada. While the rationale for government investment may transcend financial returns, the actual public value of most CCS facilities is highly uncertain. CCS technology has consistently failed to deliver on its promises of high efficiency, and numerous projects have failed globally. These include the Kemper project in Mississippi and Petra Nova facility in Texas, both of which were touted as breakthroughs but were ultimately shut down after billions were spent without achieving their emissions goals.⁴⁶

It is instructive that despite the Kemper collapse happening 15 years ago, the industry has not yet pieced together a business model for the effective, profitable deployment of CCS. According to ExxonMobil CEO Darren Woods, the oil giant has captured more carbon than any company in the world over the last 40 years and still has not seen a viable business model for CCS. Woods also noted that the original purpose of CCS was not a tool to reduce emissions, but as a method to increase oil production.⁴⁷ Evidently, the adaptation of business models has not been mastered.

An unprofitable carbon capture project will struggle to bring lasting positive economic benefits to local host communities. These projects will be unable to create sustainable job opportunities or lasting infrastructure development. Instead, host communities may end up saddled with environmental exposures and short-term gains with no meaningful long-term improvements in local conditions.

Even if successful, broad public investment in CCS may not bring Canada closer to achieving its climate goals. For example, the ACTL, by supplying captured CO₂ to the Clive oil field for EOR, paradoxically increases overall emissions as the additional fuel produced is combusted, causing more CO₂ to be released into the atmosphere. Similarly, the Pathways network is focused on reducing emissions at site while ignoring and exacerbating the much larger problem of Scope 3 emissions.⁴⁸ The government of Canada would be further entrenching this outcome by providing financial support.

Taking a cue from the TMX debacle, care must be taken that subsidies like the CCS ITC do not become open-ended commitments that effectively hook taxpayers into footing the bill for massive cost overruns. This can create moral hazard for other CCS projects, leading to less rigorous financial planning, execution, and innovation. If anyone, the primary emitters should bear the financial burden and take the risk for pollution prevention and remediation initiatives.

⁴⁵ *Ibid.* Also see: CTV Calgary. [Federal tax credit not enough to get carbon capture projects built: Cenovus CEO](#). April 27, 2022.

⁴⁶ IEEFA. [The ill-fated Petra Nova CCS project: NRG Energy throws in the towel](#). October 5, 2022.

⁴⁷ Motley Fool. [ExxonMobil \(XOM\) Q4 2023 Earnings Call Transcript](#). February 2, 2024.

⁴⁸ Greenpeace. [Application for Inquiry into false and misleading representations made by the Pathways Alliance about their climate action and the climate impact of their business](#). March 2023, Section 3.3.1.

A comprehensive global survey of CCS project performance concludes that the final commercialization model for the concept is likely to require permanent government subsidization.⁴⁹ The constellation of risks identified in the survey demonstrates the private sector is likely unwilling to absorb the risks to create a workable business model.

Conclusion

The economics of CCS projects are shaky.

In Alberta, the cost to capture one tonne of CO₂ at the two commercial-scale facilities in the province is rising substantially and likely exceeds the maximum federal carbon price of CAD\$170 per tonne—a key indicator of future revenue thresholds.

The proposed Pathways carbon hub is likely to confront several adverse industry trends including operating cost escalation, constrained revenues and CO₂ capture underperformance. If the cost to capture a tonne of carbon exceeds the revenue that can be expected to be generated from that process, then the project cannot be said to be commercially viable.

The growing realization that carbon capture and storage projects are likely to require permanent government subsidies resets the discussion about the viability of CCS as a tool to effectively reduce carbon emissions. As with several projects already mentioned, there is a point at which additional government support must stop. The result has been project closure and substantial headline risk without yielding desired environmental or economic benefits.

Public funding of CCS is a costly gamble that may not yield tangible returns on Canada's journey towards achieving net-zero emissions.

⁴⁹ M. Bui, *et al.* [Carbon capture and storage \(CCS\): The way forward](#). *Energy Environmental Science*, 11:1062-1176. 2018. (see Section 16.6).

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