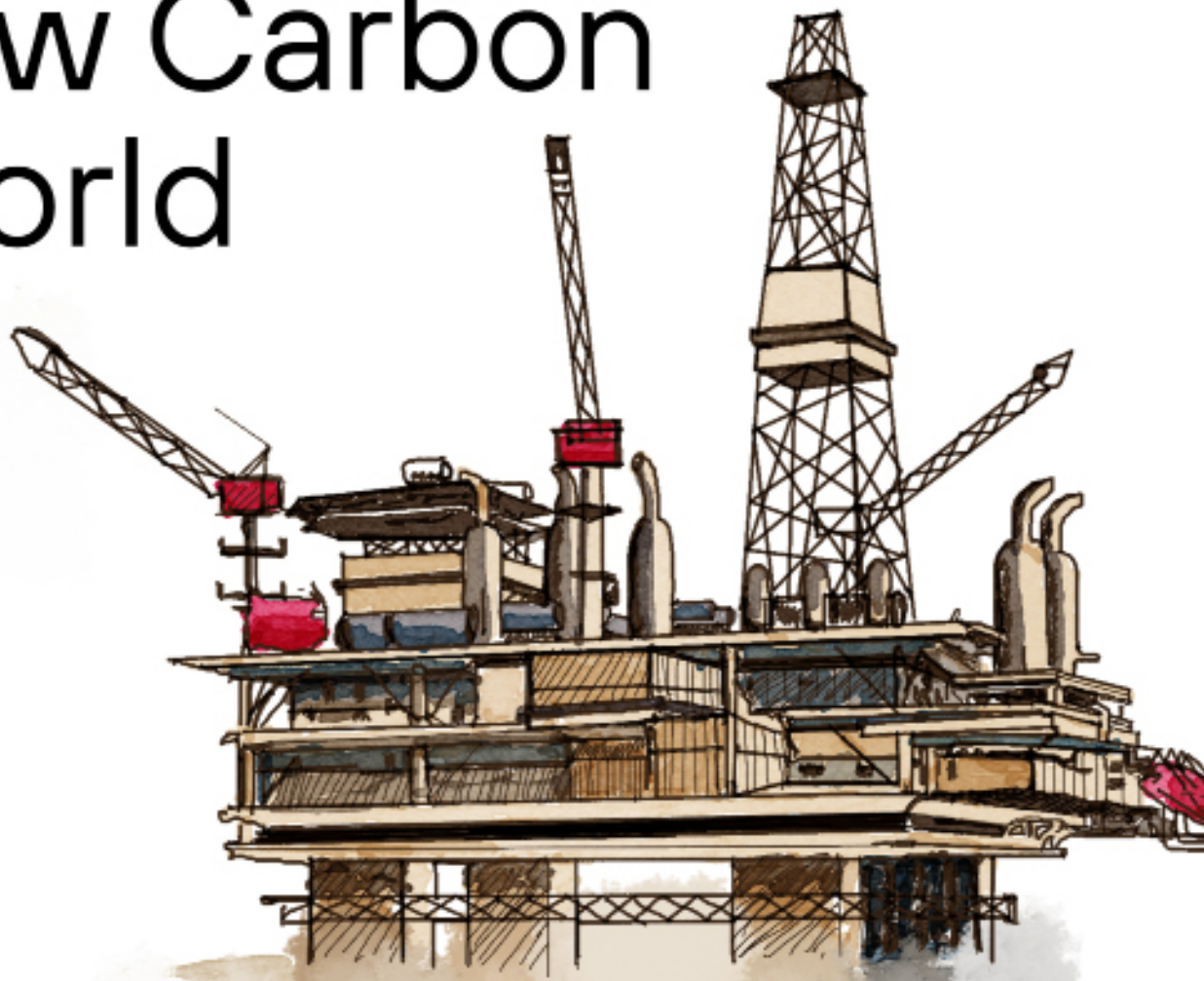
Falling Behind:

Canada's Future in a Low Carbon World



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Re_Generation, formerly the Canadian Business Youth Council for Sustainable Development, is Canada's largest youth-run organization dedicated to advancing sustainable and socially just business practices by amplifying youth perspectives and providing youth with skills-building and career resources. Our mission as an organization is to accompany the next generation of leaders throughout their journey to re_think the future of business and build an economy where human and ecological well-being is at the centre of every decision.

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Key Highlights

- Canada is the worst climate performer among G7 nations due to the ongoing expansion of our fossil fuel sector, which will cause the sector to overshoot its 2050 emissions target by 94%
- Peak fossil fuel demand is imminent, and rates of renewable energy deployment are now growing in line with the International Energy Agency's Net Zero by 2050 scenario; S-shaped learning curves for renewable technology, coupled with accelerating global climate policy ambition and the decline of fossil fuel demand growth in China, will make the low-carbon transition all but inevitable;
- New models developed by the Oxford Institute for New Economic Thinking show that a rapid transition to 100% clean energy is the cheapest pathway of all future energy scenarios;
- Canada's economy faces stranded asset risk of at least $100 billion, or 35% of the book value of oil and gas properties and 31% of the market capitalization of all TSXlisted oil and gas issuers;
- With assets that are near the top of the cost curve and are comparatively emissions-intensive, Canadian oil will be among the first to suffer demand decline;
- Canadian energy companies plan to increase fossil fuel production by 30% by 2030, and the proposed Emissions Cap will not be sufficient to address this exacerbated risk as it excludes Scope 3 emissions;
- Canadian energy firms are using the false promise of carbon capture and storage to delay the necessary transition and deepen fossil fuel dependence;
- The largest 5 Canadian banks have given $700 billion to the fossil fuel sector since the signing of the Paris agreement, and most Canadian financial institutions lag behind international peers in the decarbonization of their portfolios;
- A three-pronged policy approach is required to transform the Canadian economy to prepare for a climate-safe future, including 1) sustainable finance regulation outlining mandatory climate transition planning for all reporting entities, 2) improved integration between fiscal and monetary policy to coordinate the green transition, and 3) a robust just transition framework.

The energy transition is happening faster than predicted.

Today's growth rates for deployment of renewable technologies are already approaching the pace of change required by the IEA's Net Zero by 2050 (NZE) scenario.

The fossil fuel era is coming to an abrupt and inevitable end. In 2022, for the first time in its history, the International Energy Agency (IEA) forecasted in its World Energy Outlook that fossil fuel demand will peak in every region in all future scenarios.[1] According to the Rocky Mountain Institute, 58% of nations in the world have already reached peak demand for fossil fuels.[2] The IEA's least ambitious scenario (the Stated Policies Scenario, or STEPS), sees peak fossil fuel demand arriving in 2030, but this is unrealistically conservative given that today's growth rates for deployment of renewable technologies are already approaching the pace of change required by the IEA's Net Zero by 2050 (NZE) scenario.[3] There are even some estimations that the NZE scenario, which is designed to achieve a 1.5 degree temperature threshold without excessive reliance on negative emissions technologies, is itself too conservative given that its projection of 600 gigawatts of global solar capacity by 2030 would actually represent a slowdown from current growth rates.[4]

Electricity has now overtaken oil as the world's primary carrier of useful energy, and rates of electrification are only accelerating.[5] Spending on solar PV, batteries and electric vehicles is now growing at rates consistent with reaching global net zero emissions by 2050.[6]

Altogether, the technological innovations and policy changes observed since 2015 have collectively reduced projections of long-term temperature rise by 1 °C.[7] Observing these trends, some analysis posit that global oil demand may already have peaked at 2019 levels, and will decline from here.[8] Observing the pace of change, international oil major BP has significantly revised its peak oil demand forecasts by presenting two new scenarios in which global demand peaks by 2019.[9] Equinor has also revised its peak oil demand scenarios to 2027-2028, which is two years earlier than previous forecasts.[10]

Technological innovations and policy changes observed since 2015 have collectively reduced projections of long-term temperature rise by 1°C.

These changes have been surprising to most observers because the growth of clean energy has been drastically underestimated in the majority of energy-economy models used to predict the evolution of the global energy system. Analysis of 2,905 projections of the future cost renewables showed that most models predicted a yearly decline of 2.6%, which pales in comparison to the actual observed value of 15% annually.[11] The simple reason for this is that, until recently, models have been methodologically unable to account for the non-linear learning curves (also called "S-curves") associated with renewable technology deployment.[12]

These S-curves are a characteristic of early-stage technological innovations, in which steep learning curves lead to quickly declining costs and improved performance in a way that virtually guarantees rapid scaling towards market dominance.[13] Within such S-shaped curves, a 5% market share for a new entrant can begin a tipping point dynamic wherein the innovation consumes all subsequent demand growth, and the amount of time taken to reach a 5% share can be the same as the time required to scale from 5% to 50%. Some analysts predict that this tipping point may have already been reached, with solar and wind energy occupying 5% of primary energy supply and growing at a rate of approximately 20% per year.[14] Production costs for clean technologies have declined significantly, with solar power being the cheapest form of electricity in history (see Figure 1).[15]

FIGURE 1

	Cost declines over the past 10 years[16]
Onshore wind	59%
Offshore wind	61%
Solar	89%
Batteries	83%

	Compound Annual Growth Rate (CAGR)[17]
Solar (2000–2020)	39%
Wind (2000–2020)	21%
EV Sales (2010–2020)	68%
Batteries (2011–2020)	68%

Using a 1.4% discount rate as recommended in the Stern Review, the expected net present saving of a rapid transition to 100% clean energy is approximately $12 trillion.

The only known model to accurately predict renewable learning curves was developed by researchers at the Oxford Institute for New Economic Thinking in their recent paper on "Empirically grounded technology forecasts."[18] Using an approach to probabilistic cost forecasting that was statistically validated through backtesting on more than 50 technologies, they were also able to demonstrate that a rapid transition to 100% renewable energy is significantly cheaper and more cost-effective than any other potential future, when evaluated at any discount rate.[19] Using a 1.4% discount rate as recommended in the Stern Review, the expected net present saving of a rapid transition to 100% clean energy is approximately $12 trillion.

According to the Centre for Climate Finance at Imperial College Business School, renewable power presents a superior risk-return profile as compared with fossil fuels, generating 422.7% returns over the last decade as compared to just 59% for traditional energy.[20] As a result, the composition of energy investment has substantially shifted towards the power sector and away from fossil fuels, with renewables accounting for 80% of total electricity investment while fossil fuel investment has not recovered from 2019 levels.[21] Given these rates of growth, Rystad Energy now predicts that solar PV capacity will increase 800% to 6 terawatt hours by 2030.[22]

Combustion vehicle sales peaked globally in 2017 and are now in decline.

The electrification of transportation is also proceeding at a breakneck pace. Combustion vehicle sales peaked globally in 2017 and are now in decline, with Bloomberg New Energy Finance (BNEF) predicting a 19% decrease by 2025.[23] At the same time, BNEF forecasts that electric vehicle (EV) sales will overtake internal combustion engine sales by the mid-2030s,[24] and that EV adoption will increase 2000% to reach a global fleet of 360 million cars by 2030.[25] These trends are aligned with the rates of adoption that would be required by the IEA's NZE scenario, in which 64% of passenger car sales and 5% of truck sales should be electric by 2030.[26] This bears significant consequences for global oil demand, of which 44% derives from the transportation sector.[27] In fact, EVs are already displacing 1.5 million barrels per day of oil demand, equivalent to approximately 3% of total road fuel demand.[28] According to BNP Paribas, a $100 billion investment into renewables used to power EVs would produce six to seven times more useful energy than a similarly sized investment in oil, and therefore that gas prices would need to be $9-10 a barrel, and $17-20 for diesel, for oil to compete with new wind and solar projects that power electric vehicles.[29] Responding to these shifts, 18 of the world's 20 largest automotive manufacturers have committed to dramatically increase their EVs offerings and sales, with some companies announcing plans to reconfigure their product lines to produce only electric vehicles.[30]

These trends are only going to be amplified by the rapidly expanding suite of policy measures designed to incentivize EV adoption; governments controlling 25% of the global market have pledged to introduce 100% EV sales mandates for 2035, and in 2021 the total amount of EV-related subsidies doubled to nearly USD 30 billion.[31] 50 countries are now planning to ban ICE cars, up from a mere 5 in 2015.[32] In combination, these measures will have a large and sustained negative impact on the largest source of global fossil fuel demand.

The ambition, stringency, and scale of climate policy is accelerating across all sectors, not just transportation. In 2022, over 90% of the world's GDP was covered by some form of net-zero target, a large rise from just 6% in 2017, while the share of global emissions covered by a carbon tax has increased four fold over the last decade to reach 25%.[33] The global energy crisis spurred by the war in Ukraine has proved to be a momentous turning point in the path towards a cleaner energy, as evidenced by policy measures adopted in the Inflation Reduction Act in the United States or the RePowerEU plan in the European Union.[34] The energy crisis has helped convince policymakers that clean energy adoption increases both energy security and affordability while also advancing environmental goals, thus solving the age-old "energy trilemma". Most significant for Canada, the United States has passed three legislative measures over the past two years which will dramatically accelerate the clean economy in North America and put a large dent in the size of Canada's largest oil export market. According to a Credit Suisse report, the Inflation Reduction Act alone is expected to inject $1.7 trillion in new climate spending into the American economy over the next 10 years,[35] help annual solar and wind capacity additions in the US increase 2.5 times over today's levels while accelerating EV sales by a staggering 700%.[36] The Inflation Reduction Act will help decarbonize the US economy by between 37-41% by 2030,[37] driven largely by a 70-75% decline in electricity sector emissions alone.[38] The other major pieces of legislation, the CHIPS and Science Act (2022) and the Infrastructure Investment and Jobs Act (2021) are also designed to help dramatically increase support for research and development in early-stage innovations and help them reach commercialization.[39] By helping to incubate the growth of major domestic cleantech manufacturing capacity in the US, these regulatory measures will both reduce demand for Canadian fossil fuels and present a large threat to the long-term competitiveness of the Canadian economy if Canada does not adopt a similarly ambitious green industrial policy.

The majority of fossil fuel demand growth currently comes from emerging markets in Asia, driven in particular by China. However, the energy transition in China is occurring very rapidly, and as a net energy importer China has a long-term strategic

interest in helping the world shift away from fossil fuels. China is on track to hit its renewable target in 2025, 5 years ahead of schedule, while the Chinese government plans to peak fossil fuel demand by 2030, a feasible timeline given that demand for fossil fuels in industry and the built environment already peaked in 2014 and 2017 respectively.[40] China now produces as much renewable energy each year as all the electricity that is produced in Mexico and Canada combined.[41]

China also has the largest and fastest-growing EV market in the world,[42] representing 26% of all new car sales, a proportion which China aims to increase to 40% by 2030.[43] In light of these shifts, predictions that China will be the buyer of last resort for Canadian energy in a lower carbon world look increasingly misguided.

The energy transition in Europe offers an illuminating precedent for the dynamics that are soon to become evident in the rest of the world. The decline of fossil fuel demand in Europe began 15 years ago, and all sectors except transportation now derive at least 50% of their final energy supply from clean sources.[44] The EU is also accelerating its clean investments, targeting a 400% increase in solar capacity by 2030, a 300% increase in heat pumps, and a 1000% increase in EV sales.[45] Without these renewed targets, fossil fuel demand in the EU would have already fallen 30% by 2030, but with the proposed policy measures in place, a 60% collapse in demand is now on the table. As an early mover in the decarbonization of energy, Europe offers an example of what's in store for jurisdictions that seek to transform their energy system to achieve environmental, security, and affordability goals.

Canada is significantly exposed to stranded asset risk.

Canada alone is likely to face over $100 billion in asset stranding as a result of plausible changes in expectations about the effects of global climate policy.

The pace of the clean energy transition, coupled with the exponential increase in the ambition of climate policy regimes around the world, expose Canada to a high degree of stranded asset risk. According to the Canadian Climate Institute, 70% of Canada's goods exports and 60% of our foreign direct investment derive from sectors that are transition-vulnerable.[46] More disturbingly, a climate stress test performed on the combined value of TSX-listed companies found that losses to Canadian companies were double those of firms listed in the MSCI All Country World Index.[47] Given the non-linear nature of energy transitions as outlined in the previous section, a sudden repricing event triggered by changing expectations related to future fossil fuel demand could erase billions of dollars from the Canadian financial system.

Estimates of stranded asset risk vary in their methodology, but all are alarming. To remain within a 1.5 degree carbon budget with a 50% probability, 60% of oil and natural gas reserves and 90% of coal reserves must remain in the ground.[48] According to a relatively conservative forecast, half of the world's fossil fuel assets could become worthless as early as 2036, erasing $1.4 trillion for investors located primarily in OECD countries.[49]

This is a comparatively small sum relative to the figures reported in the IPCC's sixth Assessment Report, which identified stranded asset figures between $4 to $11-trillion over the next 30-years. Canada alone is likely to face over $100 billion in asset stranding as a result of plausible changes in expectations about the effects of global climate policy.[50] This represents 31% of the $325 billion market capitalization of all oil and gas issuers listed on the TSX as at September 2022, or 35% of the book value of the oil and gas properties for the same firms for the 2021 fiscal year (see Annex A). These values are on par with earlier estimates from the International Institute for Sustainable Development tabulating stranded asset risk at $207 billion of oil and gas public equity value.[51] Other models find a 50% drop in the net present value of oil assets that enter production between 2019 and 2025.[52]

The Bank of Canada and the Office of the Superintendent of Financial Institutions estimate even more pessimistically that the oil and gas sector could see an 80-90% devaluation of equity assets between 2020 and 2050, and that the Canadian economy more generally could experience an 8-10% decline in GDP as a result of carbon pricing and declining demand.

Despite the overwhelming likelihood of these negative macroeconomic shocks, Canadian energy companies do not currently believe that their assets will be stranded on the pathway to a low carbon world.[53] This is because incumbent industries in the process of getting disrupted typically underestimate the scale of non-linear change until it is too late to profitably pivot. Stranded assets occur when assets that are built with the expectations of growth suddenly face an environment where growth dries up, disproportionately affecting assets at the top of the cost curve and leaving survivors to contend with overcapacity issues and collapsing prices.[54]

In the context of the energy transition, this problem is even more acute because renewable technologies experience declining costs while fossil fuel producers actually see costs increase over time as the cheapest resources are extracted first and only high-cost options remain.[55] The rapid stranding of fossil fuel assets in the European electricity sector after the 2008 financial crisis provides the most salient example of what happens when the scale of renewable energy adoption is underestimated, leading to a context of countless asset impairments in which many recently constructed power plants had to be quickly decommissioned.[56] A similar dynamic occured in the US coal sector, in which firms were projecting growth even as their industry was poised to collapse.[57]

Macroeconomic implications of fossil fuel decline

If not managed appropriately, the decline of fossil fuels will have major negative macroeconomic consequences for Canada. The International Institute for Sustainable Development modeled a scenario of low international oil prices ($55/bbl USD for Brent crude oil), and identified the following negative impacts:[1]

- GDP from the oil and gas sector: Average decrease of $4.4 billion per year out to 2050;
- Employment in oil and gas: Average loss of 6,300 full-time equivalent (FTE) jobs per year out to 2050;
- Investment in oil and gas: Drops by just over $2 billion per year;
- Royalties from oil sands: Drop by an average of just under $2 billion per year;
- Alberta-wide investment: Drops by an average of $2.9 billion per year;
- Provincial tax revenues: Average decrease of just under $1 billion per year;
- Federal tax revenues: Average decrease of $1.4 billion per year.

These estimations are comparatively optimistic given that crude oil prices of $55 per barrel are significantly higher than the forecasts given in the IEA's NZE scenario ($25/bbl), as well as the forecasts used by other international oil majors to calculate the future net revenues associated with their proved and probable reserves (see Figure 5). The majority of low-carbon transition scenarios typically estimate a decline in oil prices to US$25–45 per barrel by 2050.[2]

1 Cosbey, 2021.

2 X. Hubert Rioux. A Closer Look at the Carbon Footprint of Canadian Bank Portfolios. Oxfam Quebec, https://oxfam.qc.ca/wp-content/uploads/2022-canada-banks-carbon-footprint-report.pdf.

The rapid retirement of fossil assets is also intensified by a feedback loop in which the costs of capital rise over time as investors exit the industry, firms face capital declines, and costs go up even further.

Canadian upstream emissions intensity remains 41% higher than the global average.

The stranded asset dynamic is particularly relevant for Canada, which is home to fossil assets that are both comparatively expensive and emissions-intensive relative to international peers. New oil sands production requires the highest prices of any type globally by a wide margin, which is why the sector has seen greenfield development vanish.[58] Canadian upstream emissions intensity remains 41% higher than the global average, and three times as intense as Saudi Arabia, a record which makes Canada the fourth most emissions-intensive producer in the world.[59] Moreover, the industry's claims to be reducing emissions intensity are contrary to the evidence; data from the Canadian Energy Centre, a pro-oil lobbying group, shows that the emissions intensity of Canadian oil actually increased 3% between 2010 and 2020.[60]

In addition, the already restrictive funding environment faced by Canadian energy firms is likely to get even worse after a 2019 decision by the Supreme Court of Canada that fossil fuel producers are obligated to fulfill environmental obligations (i.e. the reclamation of abandoned wells or tailings ponds) over the repayment of debts to creditors, a decision which will likely raise their cost of capital.[61] Considering these inauspicious factors, it is likely that Canadian oil will be among the first casualties of the transition to a low-carbon economy.

In fact, there is already concrete evidence that asset impairments in Canadian energy have occurred as a result of misalignment with international climate goals. In 2020, the French company TotalEnergies wrote down over $7 billion of properties in the oil sands, labelling its holdings at Fort Hills and Surmond as "stranded assets".[62] In doing so, Total joined a growing contingent of international firms and investors moving out of the oil sands for fear that such projects are inconsistent with long-term strategies. The list of actors moving to divest from the oil sands is substantial, including major pension funds in the United Kingdom, Ireland, Norway, Sweden, and New York, banks like HSBC, BNP Paribas Group, Norges Bank, ING, European Investment Bank, and France's Société Générale, institutional investors such as BlackRock and NN Group, and insurers such as AXA, Swiss RE, and Zurich Insurance.[63] In withdrawing its application for the Frontier oil sands project, Teck Resources stated that "investors and customers are increasingly looking for jurisdictions to have a framework in place that reconciles resource development and climate change," a framework which is notably absent in Canada.[64]

Despite this, the Canadian government appears to be doubling down on its attempt to safeguard the industry and guarantee fossil fuel path dependence. Between 2018 and 2020, Canada provided 14 times more fossil fuel finance than support for renewables,[65] funds which were almost entirely delivered through Export Development Canada to the tune of $13.6 billion per year.[66] Canada's support to the unprofitable Trans Mountain Expansion Project (TMX) provides an egregious example of the

misuse of public funds, and serves as a harbinger for the kind of future support that might be necessary to bail out fossil fuel companies once they become uneconomic. Canada continues to provide public money to expand pipeline capacity at a time when the Canada Energy Regulator acknowledges that excess capacity exceeds available supply even under the least stringent climate policy scenarios.[67] Despite declaring that no more public funds will be provided to the project, Ottawa will spend another $750 million on TMX in 2022, followed by a further $800 million the following year.[68] An opaque ownership structure allows TMX to declare a profit on paper even when the project's debt to Canadians will reach $17 billion by the end of next year, and when the government's own analysis predicts that the project will not become profitable for another 100 years.[69] This case of privatized profit and socialized loss provides a stark picture of what is guaranteed to happen in Canada, if our energy transition is not managed in an orderly way. The climate model developed by Oxford INET demonstrates that it is possible to replace the current energy system without excessive asset stranding, but this can only occur if the transformation of our energy system begins as soon as possible.[70]

Canadian energy firms are falling far behind.

Canadian producers are on track to expand annual oil and gas production by 30% by 2030, resulting in a 25% increase in associated annual carbon emissions.

Despite the rapidly accelerating pace of the global energy transition, there is not a single Canadian energy producer that has begun to shift capital expenditures in a way that will enable the transition to a future dominated by renewable power, energy storage, electrified transport, and green hydrogen. While large Canadian oil firms have paid lip service to the idea of reaching "net-zero" emissions, their decarbonization strategies are dead-ends that rely on speculative carbon capture technologies as a means to lock in a high degree of fossil fuel dependence. Rather than adjusting capital allocation to meet changing global demand, Canadian producers are on track to expand annual oil and gas production by 30% by 2030, resulting in a 25% increase in associated annual carbon emissions (see Figure 2).[71]

There is not a single Canadian energy company that has committed to halt exploration or approval of new extraction projects, or set long-term goals for phase-out and managed decline in a way that is compatible with global climate goals.[72] The Oil Sands Pathways to Net Zero initiative, an industry-led body ostensibly striving for energy sector decarbonization, does not require companies to reduce their Scope 3 emissions (i.e. the emissions associated with the products' end use), despite the fact that Scope 3 typically accounts for over 80% of a company's actual GHG emissions.[73]

No company has announced a Scope 3 emissions target, while only one firm (Suncor) reports on Scope 3 emissions at all. Given these gaps, the oil and gas sector alone will cause Canada to overshoot its Paris agreement target of a 40% reduction by 2030, and assuming a business as usual scenario, energy sector emissions will cause Canada to exceed its 2050 net-zero target by a margin of 94%.[74] The CEO of the Canadian Association of Petroleum Producers (CAPP) has stated publicly his belief that oil and gas demand will continue to rise for decades, and at CAPP's annual conference in 2019 the theme was about ensuring long-term supply growth.[75]

By adhering so stubbornly to the status quo, Canadian energy firms are increasingly departing from the norms and best prac-

Methodological problems in climate modelling

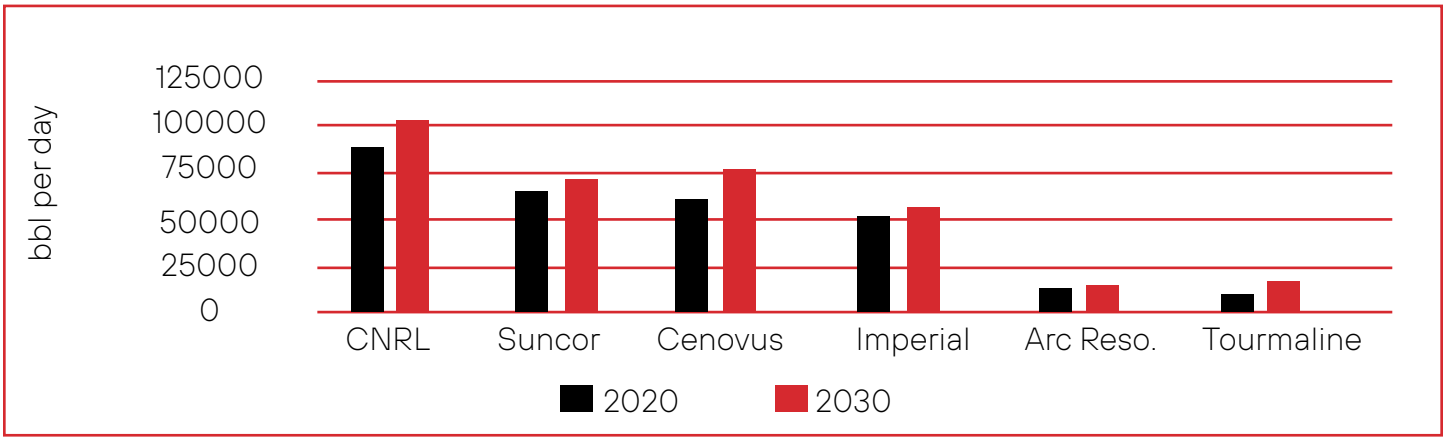
A common problem in energy-economy models is their inability to model non-linear change, particularly the learning curves associated with clean energy deployment. One reason for this inability is that most organizations rely on "general equilibrium models" to predict the long-term consequences of climate change, an approach embedded in the assumptions of neoclassical economics which posits that a general market equilibrium can be reached and that agents are rational actors with perfect foresight. Non-equilibrium models, such as the E3ME model developed by Cambridge Econometrics, do not share these assumptions, and are better at predicting the non-linear feedback loops and interaction effects associated both with accelerated technology adoption curves and social tipping points.

These models do not assume optimizing behaviour or the full use of resources, and allow for real-world inefficiencies.[1] The study by Semieniuk et al. relies on the E3ME model to calculate its stranded asset figure of $100 billion for Canada. More work is needed to convince Canadian financial institutions and regulators of the need to use non-equilibrium climate models which accurately represent the pace of change that is necessary to meet climate goals.

1 Bowdrey, R., & Hidi, J. (2022, March 2). Under the bonnet: Different economic engines that drive climate change scenario models. The Actuary. Retrieved October 31, 2022, from https://www.theactuary.com/2022/03/01/under-bonnet-different-economic-engines-drive-climate-change-scenario-models.

tices set by their international peers, particularly energy firms based in Europe. As demonstrated by the comparative analysis in Figure 3, European firms such as BP, Total, and Eni have made public commitments to decline oil production, adopted net-zero targets that are inclusive of Scope 3 emissions, and committed to drastically increasing capital expenditures on renewable power in a bid to transition into clean energy providers.

FIGURE 2: Expansion Plans at Canadian Energy Firms[76]



While there is only a single Canadian firm that has begun allocating capital to renewable energy (Suncor, at 1% of total capex), major European firms have begun spending significant sums on renewable energy acquisitions, and are targeting a green capex ratio of 50% by 2030 (see Figure 3 and 4).

FIGURE 3: Comparative Analysis of Canadian vs. European Majors

Canadian vs. European majors	Production and expansion plans	Capital allocation targets for renewables	Renewable energy targets (GW)	Net zero by 2050 targets inclusive of Scope 3
CNRL	Increase oil production by 9% by 2030	None	None	No
Suncor	Increase oil production by 9% by 2030	None	None	No
Cenovus	Increase oil production by 22% by 2030	None	None	No
BP	Reduce oil production by 40% by 2030 (relative to a 2019 baseline)	By 2030, 50% of capital expenditures will be allocated to renewable energy	Generate 50 gigawatts of renewable power by 2050	Yes; net zero life cycle emissions by 2050
Total	Peak oil production before 2030; decrease petroleum sales to 30% of sales by 2030 (from 55% today)	Invest 25% of capital expenditures in renewables over the period 2021-2025	Generate 100 gigawatts of renewable power by 2030	Yes; reduce Scope 3 emissions by 30% by 2030 (relative to 2015)
Eni	Peak oil production by 2025	By 2030, 50% of capital expenditures will be allocated to renewable energy	Generate 55 gigawatts of renewable power by 2050	Yes; reduce Scope 3 emissions by 80% by 2050

These differences make sense when considering the divergent assumptions that go into economically rationalizing these production planning decisions. While Canadian firms project oil prices that remain over $80 per barrel in real terms by mid-century, European firms such as BP and Eni are predicting oil prices will decline to $45 per barrel or lower (see Figure 5, with further information in Annex B). Total is unique in projecting a future oil price that is directly aligned with the IEA's NZE scenario (at $25 per barrel by 2050), which is significant in that this is the figure used by Total to estimate the future value of its reserves as outlined in its annual report. As indicated by this analysis, it is only in Europe that energy firms have begun preparing for an oil supply curve with production in the range of $18-35 per barrel, which has been recognized as the limit

required to stay within the goals of the Paris agreement.[77]

FIGURE 4: Green vs, Brown Capex

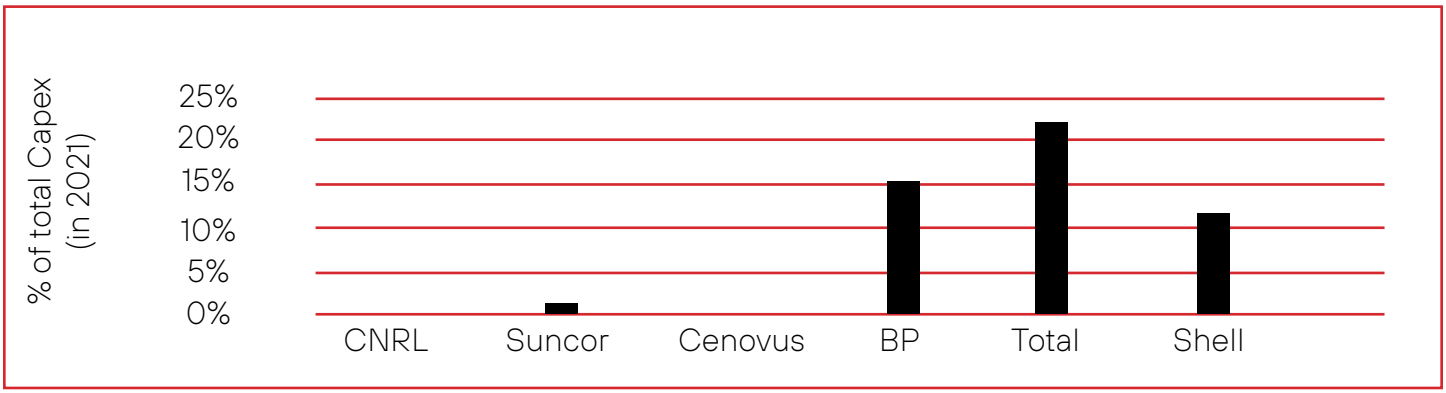
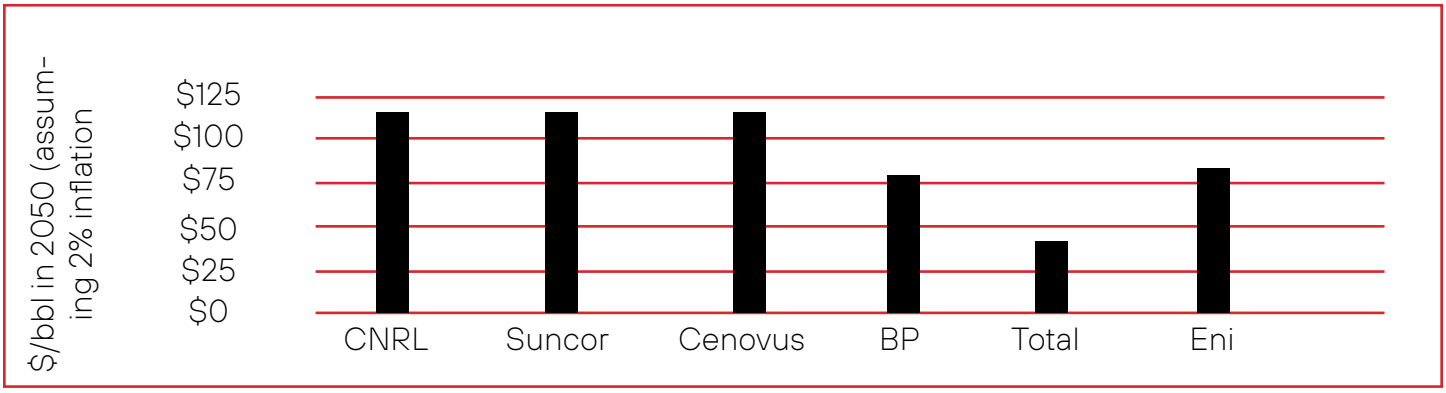


FIGURE 5: Oil Price Assumptions



In preparing for the low-carbon transition, we must be wary of strategies that lead to short-term, incremental emissions reductions while locking in large quantities of emissions in the long-term. The issue with an over-reliance on carbon capture and storage is that it is designed to maintain the viability of fossil fuel infrastructure that will have to be decommissioned in the long-term. While many observers see carbon capture as a vital part of an "all of the above" strategy, the concern is that we are caught between two competing futures: one is a world of high oil prices, high fossil fuel demand, and high use of carbon capture (CCUS) and negative emissions technologies (NETs), while another is a world of low oil prices and low demand for CCUS and NETs given the preponderance of low-carbon electricity. Canadian energy companies are hoping for the first future to prevail, while global economic trends suggest that the second future will soon be within reach. As the Canadian Climate Institute recognizes in its report on net-zero pathways for Canada, we must differentiate between multiple different energy futures, one characterized by "Fossil fuels and negative emissions", and the other by "Electrification and hydrogen".[78] The second option is the one that represents the most significant departure from present conditions, which is why it is fiercely resisted by industry.

The Science-Based Targets Initiative indicates that there are two central strategies oil and gas firms can use to transition to the low-carbon economy: one is that they can become an energy company, diversifying to other forms of low-carbon energy, while another is that they can become a "circular carbon company", transitioning to a circular economy model based around the recapture of carbon dioxide through the use of CCUS and NETs.[79] Given the comparative analysis in Figure 3, it appears as though Canadian and European energy companies are evolving along these two separate pathways. The problem with the "circular carbon company" pathway is that it does not actually reduce stranded asset risk; renewables are quickly becoming cheaper than fossil fuels, and because CCUS will simply add costs to the oil and gas sector, this will only serve to make fossil fuels even less competitive in a low-carbon world. Understanding this, the circular carbon narrative is a strategy by the fossil fuel industry to create path dependence on a high emissions future.

Carbon capture is an important tool for reducing carbon emissions in hard-to-abate sectors (i.e. heavy industry). However, the IEA estimates that reaching net-zero globally only requires around six gigatonnes of carbon capture, or approximately 15% of today's emissions.[80] CCUS should only be used instead of abatement actions in circumstances where technological alternatives and low-carbon business models are not yet proven or readily available. CCUS currently suffers from considerable technological challenges, and CCUS technologies do not yet exist at a scale that would allow large emitters to feasibly

trap and sequester the majority of their emissions.[81] The IPCC estimates that CCUS is the most expensive decarbonization measure with the lowest potential for emissions reductions at a global level.[82] In fact, some carbon capture plants emit more carbon than they capture; a literature review of 200 research papers on carbon capture and industrial carbon removal found them to result in net CO2 additions, not reductions.[83] By the end of 2020, more than 80% of US CCUS projects had failed.[84] Most importantly, carbon capture technologies must not be used by oil and gas firms as a way to avoid transforming their businesses into clean energy companies.

A literature review of 200 research papers on carbon capture and industrial carbon removal found them to result in net CO2 additions, not reductions.

O&G companies' profits are expected to reach a staggering $152 billion this year, which means that they have more than enough cash on hand to fund their own transition.

Many CCUS facilities are currently used to create pressurized CO2 which is then used for 'enhanced oil recovery' (EOR), wherein the CO2 is injected into existing oil and gas reservoirs to extract even more energy. Over 80% of captured carbonto date has been used for EOR in a in a way that merely reinforces fossil fuel dependence.[85] It is the unequivocal truth that there is not and will never be such a thing as "net zero" oil.

In Canada, CCUS has a long record of failure. While the government has provided $5.8 billion in total to carbon capture projects, these facilities currently only capture 0.05% of Canada's emissions, over 70% of which is used for EOR.[86] The much-discussed Quest carbon capture plant operated by Shell actually emits more carbon than it is capturing.[87] A study by the Office of the Auditor General found that 27 of the projects funded through the Onshore Program of the Emissions Reduction Fund led to an increase in oil or gas production.[88] Despite this history of failed promises, energy companies continue to tout carbon capture as the only solution, and they are requiring that the government use public money to pay for it. In 2021, energy firms spent less than 1% of their capital expenditures on CCUS, as they expect to receive $50 billion in public funds to pay for the majority of carbon capture projects.[89]

Carbon offsets and negative emissions technologies (NETs)

Many integrated assessment models rely on significant levels of negative emissions, or strategies that aim to remove carbon from the atmosphere through either biological or engineered means. The danger of relying excessively on NETs is that there is a risk of companies using them to avoid other actions that abate emissions at source or prevent them from happening in the first place, an effect known as "mitigation deterrence". The IPCC warns that carbon removal "deployed at scale is unproven, and reliance on such technology is a major risk in the ability to limit warming to 1.5°C" owing to "multiple feasibility and sustainability concerns."[1] Bioenergy with carbon capture and storage (BECCS) is one prominent NET that involves planting industrial-scale forests to be burned and used for energy, with the resulting emissions being captured at source. However, just a third of today's fossil fuel emissions through BECCS would require using half of the world's total crop-growing area, thus causing massive competition for land and raising concerns about significant biodiversity loss.[2] Another speculative carbon removal technology known as direct air capture (DAC), would require a carbon price far above what current carbon markets have delivered, and would also require roughly 10 gigawatts of power.[3] It is anticipated that both negative emissions technologies, if deployed at scale, would have minimum estimated costs of $89-535 trillion USD this century, making them a highly uncertain gamble with large feasibility concerns.[4] Most importantly, delaying emissions reductions in the short-term will exacerbate climate impacts and place a huge burden on future generations to remove excess carbon dioxide.

1 Tong, D. Big Oil's Reality Check, Oil Change International (September 2020), http://priceofoil.org/content/uploads/2020/09/OCI-Big-Oil-Reality-Check-vF.pdf.

2 Ibid

3 Compagnon, 2021.

4 Hansen, J. et al. Young people's burden: requirement of negative CO2 emissions. Earth System Dynamics (2017), https://esd.copernicus.org/articles/8/577/2017/.

O&G companies' profits are expected to reach a staggering $152 billion this year, which means that they have more than enough cash on hand to fund their own transition.[90] However, most of this money is simply returned to shareholders; in 2021, CNRL spent a paltry $84 million on emissions reductions, while lavishing shareholders with a $14 billion payout.[91] The Oil Sands Pathways to Net Zero Alliance has committed to investing $24 billion in emissions reductions projects by 2030, a figure which represents merely 2% of annual profits based on 2022 data.[92] Despite this, oil firms continue to charge that a 50% CCUS tax credit is insufficient to incentivize investment.[93]

The Canadian oil and gas sector is an industry in decline, as evidenced by the chronic disappearance of jobs and declining rates of investment. Jobs in the sector are down by more than 50,000 from their 2014 peak,[94] and in 2019 firms used their tax cut from the Albertan government to automate away another 3,500 jobs.[95] There is a convincing argument to be made that these firms are interested in CCUS not as a strategy to reduce emissions, but mainly as a way to continue accessing extremely low royalty rates by allowing them to claim that completed projects are actually still "in construction", based on the idiosyncrasies of Alberta's royalty regime. As these companies continue to make enormous profits while socializing the environmental and social costs of their operations and contributing less and less to the overall economy, there is no longer an argument for public money in the form of enormous subsidies, tax credits, and ultra-low royalties to be given to these firms.

Canada can either continue to subsidize the expansion of fossil fuels, fund CCUS projects to lock-in stranded assets, and then use even more public money to bail them out when they fail, or it can use public policy to transform these companies for a more profitable clean energy future that will ultimately cost the public less money.

Canadian financial institutions are not doing enough.

Canada is lagging behind its peers when it comes to investment in the clean economy.

Most major Canadian banks and institutional investors have committed to some kind of net-zero target. The largest 5 Canadian banks are all signatories of the Net-Zero Banking Alliance, and have committed to reporting their climate strategies under the framework of the Task Force on Climate-Related Financial Disclosures (TCFD). At the same time, the big 5 banks have provided $698.82 billion to the fossil fuel sector since 2015,[96] and over the past year alone the banks doubled their financing of the oil sands.[97] Shareholders at the five largest banks overwhelmingly rejected calls to hold annual "say-on-climate" shareholder votes, with an average of 80% of shareholders voting against these motions.[98] The financed emissions of the eight largest banks in Canada reached approximately 1.9 gigatonnes in 2020, which is 2.5 times the size of Canada's annual emissions.[99] If these eight banks were a sovereign country, they would be the fifth largest emitter in the world.[100] Canadian pension plans are scarcely performing any better, given that CDPQ and OTPP are currently the only funds that have made public commitments to achieving net-zero portfolio emissions by 2050.[101] The Canada Pension Plan has increased its ownership in fossil fuel companies since 2016, and while CDPQ has decreased its ownership share over time, it still owns 52% more shares than CPPIB.[102]

Canada is lagging behind its peers when it comes to investment in the clean economy. Canada requires approximately $70 billion per year to fund green activities in order to reach its net-zero commitments, but it currently invests only $10 billion per year.[103] The growth rate of renewable energy in Canada is among the lowest of G20 countries.[104] Only 9% of Canadian businesses use clean technologies, and many firms in the cleantech sector still struggle to attract financing.[105] Canadian cleantech firms are frequently purchased by foreign buyers, harming the creation of a domestic cleantech ecosystem. At the same time as international investors are exiting the Canadian energy sector, Canadian banks are doubling down on fossil fuel funding when they really should be putting their money into solutions.

As seen in Figure 6, the sustainable loan books of major Canadian banks pale in comparison to the scale of their overall fossil fuel financing.[106] Only one firm, the Bank of Montreal, provides marginally more funding to sustainable activities than to fossil fuels.

FIGURE 6: Green vs. Brown Financing

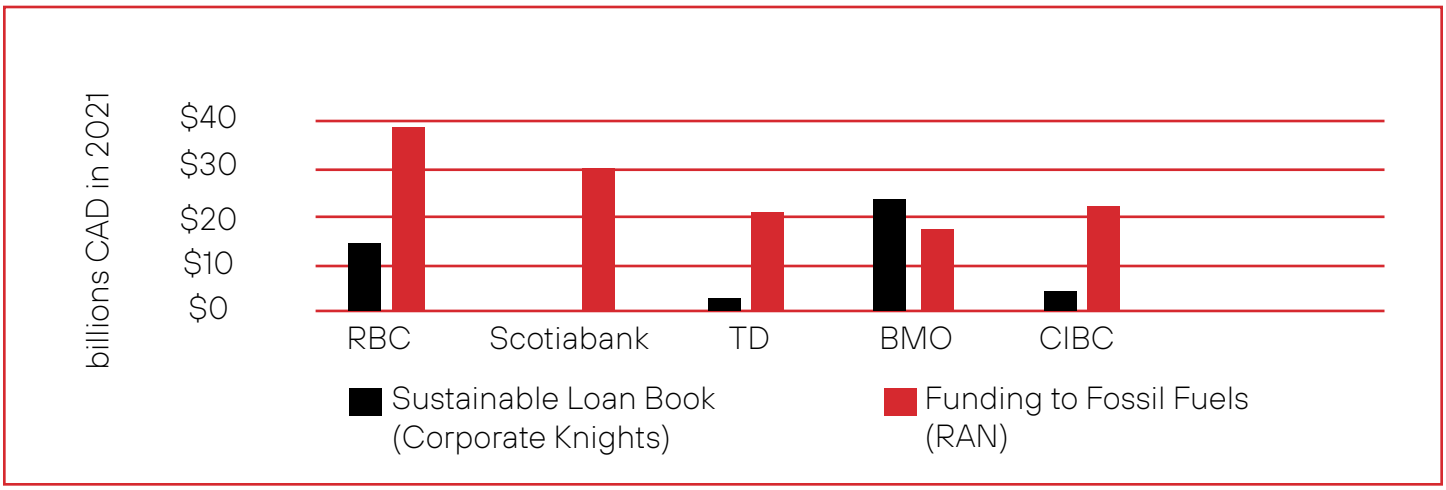
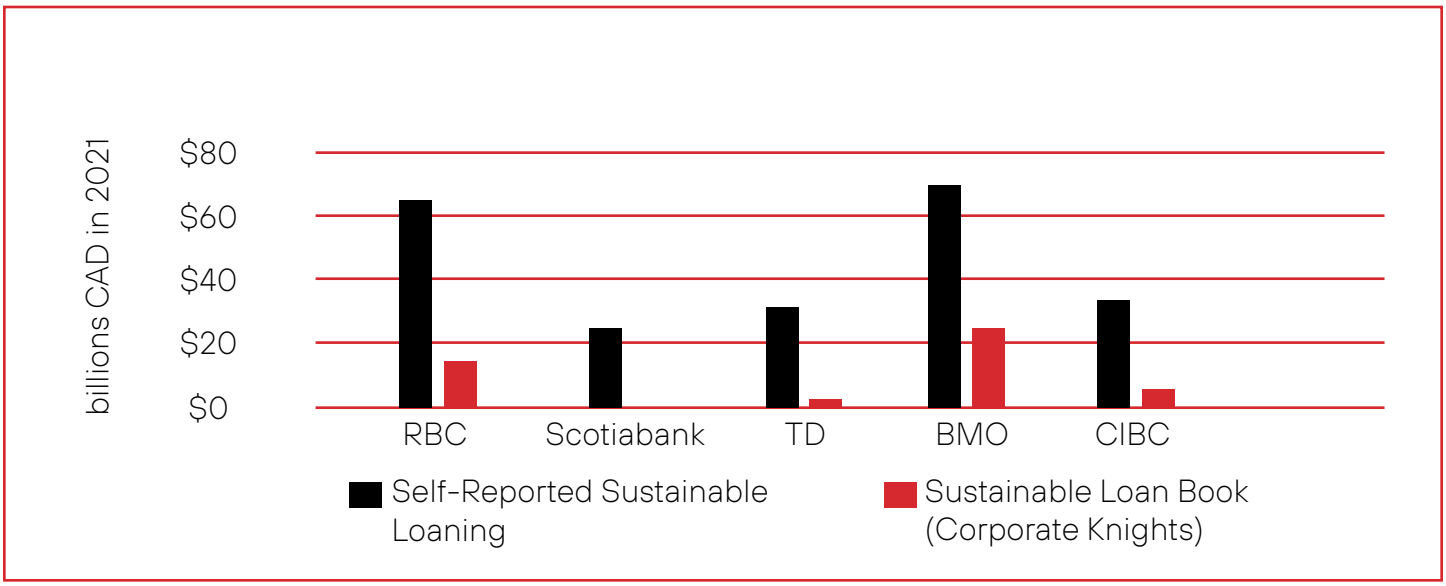


FIGURE 7: Self-Reported vs. External Data



Additionally, the largest banks overstate the size of their investment in climate solutions, as evidenced by Figure 7 which compares self-reported data appearing in impact reports with the total of sustainable revenues as identified in the Sustainable Banking Revenues Ranking developed by Corporate Knights and The Banker.[107] These external rankings provide an estimation of the total sustainable revenues earned by each firm that meet the eligibility criteria outlined in the Corporate Knights Sustainable Economy Taxonomy, which offers a more robust, objective, and comparable measure of what activities qualify as truly "green".[108]

As of spring 2022, none of the largest eight Canadian banks have yet disclosed their total financed (i.e. Scope 3) emissions, let alone released targets to reduce their financed emissions.[109] All of these banks use carbon intensity targets for their net-zero plans, which is a relative measure that allows emissions to grow even if targets are met, and none of these targets are 1.5 degree aligned. Despite making public proclamations as to the importance of net-zero investing, banks are also lobbying financial regulators to delay regulation and new disclosure requirements, as outlined in reporting by Carl Meyer.[110] According to the Oil and Gas Policy Tracker developed by Reclaim Finance, Canadian banks score zero on all metrics related to oil and gas phase-out commitments or the exclusion of clients that have oil and gas expansion plans.[111]

As demonstrated by the IEA, a 1.5 degree future is still within reach, but achieving it will require an immense shift in global capital markets. Clean energy investment must rise to $4 trillion in the NZE scenario, up from $1.3 trillion today, and the ratio of brown to green spending must rise from 2:3 today to 1:5 by 2030.[112] Financial institutions thus have a pivotal choice to make: they can either start investing immediately to make international climate goals a reality, or they can lock us into a high-carbon future.

Policy recommendations:

A three-pronged policy approach is required to transform the Canadian economy to prepare for a climate-safe future. The three central elements of this program include:

- Regulation to align the financial system with a 1.5 degree future, including mandatory climate transition planning for all reporting entities;
- Improved integration between fiscal and monetary policy to coordinate the green transition, particularly with green central banking and green industrial policy;
- A robust just transition framework.

1. Sustainable Finance Regulation

Current initiatives to standardize climate-related disclosures by reporting entities in Canada will be insufficient to catalyze the systemic transformation that is necessary to meet our climate goals. As Shawn McCarthy notes in The Globe and Mail, "Canada's go-slow approach is being overtaken by international developments that could leave the country's financial sector operating under rules formulated by foreign decision makers and Canadian corporations at a disadvantage in attracting global capital."[113] We must move beyond disclosure towards demonstrating alignment; there must be clear guidance around science-based transition plans, Scope 3 target-setting and 1.5 degree pathways, and more. Relying exclusively on disclosure is insufficient, as it assumes that with better information, capital flows will shift automatically, which ignores the fact that institutional actors are not apolitical but instead have a vested interest in maintaining the status quo regime. Simply relying on disclosure and information-sharing to move markets is akin to asking firms to self-regulate, when the only real solution is strong public policy.

Newly proposed rules do not currently go far enough. The Canadian Securities Association has released new disclosure rules which are not stringent enough to require organizations to demonstrate true climate alignment. Absent from the proposed National Instrument 51-107 is a requirement for transition planning, while the proposed standard should require firms to report strategies, targets, and metrics irrespective of materiality (as opposed to the current draft's focus on single materiality).[114] The rules about emissions disclosure should be made strictly mandatory for all entities, not just on a "comply or explain" basis. The newly proposed OSFI B-15 Draft Guidelines on Climate Risk Management are also insufficient; they lack a double materiality lens, and therefore focus entirely on risks and not impacts, and there is no requirement that transition plans be 1.5 degree aligned, or that scenario analysis be publicly disclosed. Proposed timelines are also insufficient; Canada aims to mandate TCFD implementation by 2024, which is too late to get organizations aligned with a 1.5 degree timeline.[115]

The recently proposed Climate-Aligned Finance Act (Bill S-243) is a landmark piece of legislation with the potential to address these concerns and align Canada's financial system with our national climate commitments. It is meant to reduce the systemic risk to the economy posed by the threat of stranded assets, but also to create the regulatory guardrails and legal safe harbour that will provide the certainty and clarity needed for truly sustainable investment strategies.

The Climate-Aligned Finance Act includes seven central measures:

1. Establishing a duty for directors, officers and administrators to align entities with climate commitments;
2. Aligning purposes, including market oversight by OSFI, with climate commitments;
3. Obligating the development of action plans, targets and progress reports on meeting climate commitments through annual reporting requirements;
4. Ensuring climate expertise on certain boards of directors and avoiding conflicts of interest;
5. Making capital adequacy requirements proportional to microprudential and macroprudential climate risks generated by financial institutions;
6. Requiring a government action plan to align financial products with climate commitments;
7. Mandating timely public review processes on implementation progress to ensure iterative learning.[116]

The Climate-Aligned Finance Act would aid dramatically in the growth of the domestic Canadian cleantech sector, particularly by creating clear market signals and removing barriers to clean investment. Through strong policy, the Act will create a long-term view of risks and opportunities, stimulate demand creation, carbon competitiveness, and technology adoption. In particular, the Climate-Aligned Finance Act can help reduce barriers to investment by addressing long capital stock turnover timelines, improving technical feasibility, knowledge, and skill, reducing high costs and uncertain returns, and removing government policy uncertainty.[117]

2. Green Central Banking and Industrial Policy

Coordinating the green transition to reach 1.5 degrees requires a degree of foresight and planning that will not be possible if the process is simply left to the discretion of market processes. Rather, governments must intervene in markets in a way that consciously unites monetary and fiscal policy with the overall goal of shifting money from high to low carbon activities. One of the most effective ways to do this is to combine options for green central banking, such as greening the collateral framework and introducing dirty penalizing factors for high-carbon sectors, with a coordinated green industrial policy that uses public investment to accelerate cleantech development and crowd-in private sector contributions.

Central banks are increasingly recognizing that climate change presents a systemic risk to the financial system, particularly due to the abrupt and non-linear nature of these risks. However, central banks' current paradigm vis-à-vis climate change is one of market-led decarbonisation. They have embraced a de-risking approach by targeting prices of relatively "dirty" or "green" existing credit.[118] However this credit guidance is very much contingent on financial markets' response, creating an opportunity for circumvention and arbitrage. In particular, higher relative interest rates for dirty credits are unlikely to have any influence on so-called 'shadow banks' or hedge funds and private equity actors that create credit independent of supervisory and regulatory oversight. Higher relative interest rates for dirty credit are likely to attract alpha-seeking shadow lenders, which in this case aren't subject to the same shareholder or regulatory pressures.[119] The success of this risk-based approach is thus contingent on private sector will, and on confidence in market efficiency, which can easily lead to greenwashing. Risk-based approaches are also unable to account for the radical uncertainty and non-linear processes associated with both socio-ecological feedback loops and green innovation.

There are a suite of alternative policy instruments that central banks and financial regulators could use to limit stranded asset risk by winding down fossil fuel investments and accelerating green investments. These policies can be grouped under the auspices of a "green allocative credit policy" regime that sees the use of market-shaping tools, such as differentiated risk and capital requirements or outright activity prohibitions, as an underlying prerequisite for preserving financial stability (see Figure 8).[120] Within this approach, central banks abandon the notion of market neutrality, the commitment to monetary dominance, and instead impose regulations to align financial flows with net-zero climate targets and green industrial strategy. Such a regime would be designed to address a number of key concerns with the market-led approach, including the potential for regulatory arbitrage, the shadow banking loophole, the presence of unquantifiable uncertainty, the threat of systemic greenwashing, and political economy questions surrounding the privatization of infrastructure. Through the use of sector-specific green targets on price and conditions of credit, as well as sector-specific targets on quantity of credit or credit growth, financial regulators can work to align their policy toolkits with government climate targets in a way that sees net-zero alignment as a core function of addressing climate risk. As economist Katie Kedward writes, "instead of conceptualising the green transition as a static efficiency optimisation problem requiring only price corrections – as is implicit within the risk-based framework – alternative approaches frame decarbonisation as a 'wicked problem' involving dynamic structural change, encompassing multiple sectors and agents, supply and demand dynamics, lock-in effects, and uniquely predicated upon the complexities of rapidly deploying and diffusing technological innovation."[121]

Several proposals, both coercive and incentive-based, are accessible for policymakers to begin implementing:[122]

1. Adjusting collateral frameworks to make them reflective of environmental risks, including increasing haircuts on carbon-backed collateral assets;
2. Imposing 'ceiling' and 'floor' refinancing rates for green and brown lending;
3. Applying higher capital requirements for institutional holders of fossil fuel equity, bonds, and related ETFs and for institutional allocations to hedge and private equity funds targeting fossil fuel assets;
4. Introducing mandatory exclusion of fossil fuel assets from indexes marketed as ESG;
5. Introducing minimum lending quotas and ratios for sectors which urgently need accelerated green credit;
6. Ensuring that fossil fuel borrowers cannot access 'backdoor' financing through shadow lenders, by banning the securitization of loans issued by shadow balance sheets.

FIGURE 8: Green Allocative Credit Policy

Options for a green allocative credit policy regime (Kedward et al 2022)	Banking Sector	Institutional Capital
Direct	• Interest rate floors and ceilings • Subsidized credit for households/ SMEs/priority sectors • Portfolio restrictions: outright bans financing certain sectors/assets • Credit quotas • Lending ratios • Large-scale public investment (e.g. through systemically important banks) • Favourable loan-to-value /debt-to-income ratios	• Portfolio restrictions, including outright bans on financing certain sectors/alternative assets, or 100% repo haircuts on dirty collateral • Mandatory exclusion of dirty assets from (ESG) indexes for passive investment • Ineligibility of certain assets for securitisation • Forced sale of dirty assets to a state 'bad bank'
Indirect	• Capital requirement adjustments • Reserve requirement adjustments • Credit guarantees • Dirty-penalizing factors for global systemically important banks • Large exposure limits • Countercyclical capital buffer • Sector-targeted refinancing lines • Collateral haircut adjustments • Tilting in asset purchase programmes	• Capital requirements for allocations to dirty (alternative) assets • Punitive leverage ratio • Collateral haircut adjustments • Margin requirement adjustments

3. Just Transition Framework

A strong just transition framework is necessary to ensure the participation of all communities in the transformation of the Canadian energy system, particularly those most affected by the transition to a low-carbon economy. Without a strong system to ensure equity and accountability, it is likely that the social disruptions caused by an abrupt and unmanaged transition will prevent the realization of Canada's climate goals in the long-term. Unfortunately, there has been little progress on the just transition legislation that was promised in the fall of 2021.[123] Considering this, Canada must renew its efforts to develop a federal just transition planning process as soon as possible.

The federal government must create a formal governance structure to coordinate the just transition at a federal level, involving the explicit input of all relevant federal ministries who must be assigned specific roles and responsibilities to support the just transition at a national level. As outlined by the Canadian Centre for Policy Alternatives, this could take the form of an official Just Transition Commission to oversee the transition.[124] Rather than relying primarily on the Ministry of Natural Resources, as recommended by the Task Force on Just Transition for the coal sector,[125] the government should make sure to involve all departments in the transition planning process. As part of this governance structure, the government must develop a just transition mandate with clear timelines by which to achieve key objectives in the transition for affected communities, including a federal implementation plan, governance structure, and measuring and monitoring system.

The aforementioned governance structure must meaningfully engage with key stakeholders affected by the phase-out of fossil fuels. A meaningful consultation process is necessary to ensure that all affected communities feel like they have a stake in the transition, and are committed to the transition planning process.

This engagement will involve convening conversations with stakeholders from all key groups, including employees and unions, municipal governments, Indigenous communities, companies and associations, financial institutions, and much more. In establishing this process, Canada should take inspiration from the five-part dialogue implemented in New Zealand after the introduction of a ban on new oil and gas permitting, particularly concerning the economic health of the Taranaki region, where most oil and gas projects are concentrated. Canada should particularly hope to emulate New Zealand's success in integrating the voices and perspectives of the First Peoples of New Zealand (the Māori people) into its just transition planning framework.[126]

Building on the suggestions of the Canadian Centre for Policy Alternatives, the Canadian government should implement a number of programs to guarantee the economic well-being of communities adversely affected by the transition. These could include:

1. The introduction of a Just Transition Benefit to support workers in affected communities;
2. The establishment of an Economic Diversification Crown Corporation to invest in affected communities;
3. The creation of a Just Transition Training Fund to help re-skill affected workers and expand training infrastructure through public colleges, labour union training centres, and job sites across the country, particularly in a way that prioritizes the inclusion of historically marginalized groups.

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Annex A

Company	Market Capitalization (CAD Sept 2022)	Book Value of Reserves (millions CAD)
Canadian Natural Resources Limited	$71,657,485,448.00	$66,286.00
Suncor Energy Inc.	$52,860,648,984.00	$55,374.00
Cenovus Energy Inc.	$41,643,944,075.00	$27,706.00
Imperial Oil Limited	$37,173,431,961.00	$30,487.00
Tourmaline Oil Corp.	$24,172,958,945.00	$13,463.00
Ovintiv Inc.	$15,938,179,658.00	$8,761.00
ARC Resources Ltd.	$10,864,626,676.00	$9,230.00
Whitecap Resources Inc.	$5,337,504,191.00	$6,438.33
Vermilion Energy Inc.	$4,834,943,979.00	$5,057.49
Crescent Point Energy Corp.	$4,770,508,057.00	$7,689.10
MEG Energy Corp.	$4,705,003,980.00	$5,979.00
Enerplus Corporation	$4,531,351,537.00	$1,589.19
PrairieSky Royalty Ltd.	$4,253,087,183.00	$1,789.70
Paramount Resources Ltd.	$3,465,514,969.00	$2,799.90
Baytex Energy Corp.	$3,226,009,802.00	$4,637.20
Topaz Energy Corp.	$3,001,136,397.00	$1,510.74
Birchcliff Energy Ltd.	$2,689,470,344.00	$2,848.05
Parex Resources Inc.	$2,234,223,296.00	$1,432.45
NuVista Energy Ltd.	$2,221,020,758.00	$2,300.34
Freehold Royalties Ltd.	$2,166,200,813.00	$1,007.30
Peyto Exploration & Development Corp.	$1,885,429,410.00	$3,639.83
Advantage Energy Ltd.	$1,853,482,889.00	$1,847.39
Tamarack Valley Energy Ltd.	$1,824,139,750.00	$2,238.64
Spartan Delta Corp.	$1,594,616,043.00	$1,481.08
International Petroleum Corporation	$1,506,254,434.00	$1,231.76
Athabasca Oil Corporation	$1,246,526,042.00	$1,319.39
Africa Oil Corp.	$1,222,617,021.00	$246.28
Headwater Exploration Inc.	$1,209,332,970.00	$339.28
Cardinal Energy Ltd.	$1,128,903,252.00	$1,019.51
Kelt Exploration Ltd.	$1,000,024,932.00	$851.56
Frontera Energy Corporation	$875,128,484.00	$2,182.71

Obsidian Energy Ltd.	$818,591,565.00	$1,342.10
Crew Energy Inc.	$806,901,228.00	$1,448.52
Surge Energy Inc.	$735,044,753.00	$1,216.56
Pipestone Energy Corp.	$690,340,398.00	$835.24
Gran Tierra Energy Inc.	$623,412,079.00	$991.45
Pine Cliff Energy Ltd.	$597,896,904.00	$294.07
Canacol Energy Ltd.	$319,344,182.00	$418.81
i3 Energy plc	$310,886,765.00	$383.89
Gear Energy Ltd.	$294,686,009.00	$263.65
TransGlobe Energy Corporation	$270,117,863.00	$223.14
Journey Energy Inc.	$248,322,188.00	$313.88
Bonterra Energy Corp	$246,676,802.00	$1,144.63
Touchstone Exploration Inc.	$242,844,124.00	$77.68
Petrus Resources Ltd.	$238,025,865.00	$239.25
InPlay Oil Corp.	$230,932,398.00	$346.41
Yangarra Resources Ltd.	$201,408,692.00	$620.20
Pieridae Energy Limited	$150,758,132.00	$528.37
Rubellite Energy Inc.	$129,698,098.00	$72.66
Forza Petroleum Limited	$99,445,954.00	$595.25
Questerre Energy Corporation	$98,558,642.00	$177.64
Kolibri Global Energy Inc.	$69,451,046.00	$186.46
Perpetual Energy Inc.	$65,259,897.00	$153.62
Tenaz Energy Corp.	$42,251,150.00	$47.90
Valeura Energy Inc.	$39,396,170.00	$58.32
Bengal Energy Ltd.	$33,971,295.00	$28.12
Prairie Provident Resources Inc.	$25,363,770.00	NA
Condor Energies Inc.	$14,463,499.00	$0.60
TOTAL	**$324,737,755,748.00**	**$284,791.66**

Annex B

Projected price of Brent crude in 2050 (2% inflation)	CNRL	Suncor	Cenovus	BP	TotalEnergies	Eni
2020				$45.00		$46.00
2021				$45.90		$46.92
2022				$46.82	$25.00	$47.86
2023				$47.75	$25.50	$48.82
2024				$48.71	$26.01	$49.79
2025				$49.68	$26.53	$50.79
2026	$72.44			$50.68	$27.06	$51.80
2027	$73.89			$51.69	$27.60	$52.84
2028	$75.37			$52.72	$28.15	$53.90
2029	$76.87			$53.78	$28.72	$54.97
2030	$78.41			$54.85	$29.29	$56.07
2031	$79.98			$55.95	$29.88	$57.20
2032	$81.58		$81.57	$57.07	$30.47	$58.34
2033	$83.21		$83.20	$58.21	$31.08	$59.51
2034	$84.88		$84.87	$59.38	$31.71	$60.70
2035	$86.57		$86.56	$60.56	$32.34	$61.91
2036	$88.30	$88.30	$88.29	$61.78	$32.99	$63.15
2037	$90.07	$90.07	$90.06	$63.01	$33.65	$64.41
2038	$91.87	$91.87	$91.86	$64.27	$34.32	$65.70
2039	$93.71	$93.71	$93.70	$65.56	$35.01	$67.01
2040	$95.58	$95.58	$95.57	$66.87	$35.71	$68.35
2041	$97.49	$97.49	$97.48	$68.20	$36.42	$69.72
2042	$99.44	$99.44	$99.43	$69.57	$37.15	$71.12
2043	$101.43	$101.43	$101.42	$70.96	$37.89	$72.54
2044	$103.46	$103.46	$103.45	$72.38	$38.65	$73.99
2045	$105.53	$105.53	$105.52	$73.83	$39.42	$75.47
2046	$107.64	$107.64	$107.63	$75.30	$40.21	$76.98
2047	$109.79	$109.79	$109.78	$76.81	$41.02	$78.52
2048	$111.99	$111.99	$111.98	$78.35	$41.84	$80.09
2049	$114.23	$114.23	$114.22	$79.91	$42.67	$81.69
2050	**$116.52**	**$116.51**	**$116.50**	**$81.51**	**$43.53**	**$83.32**

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