Creating a Canadian Advantage

Policies to help Canada compete for low-carbon investment

WORKING PAPER

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CLEAN PROSPERITY

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About Clean Prosperity and The Transition Accelerator

Clean Prosperity is a Canadian climate policy organization. We advocate for practical climate solutions that reduce emissions and grow the economy. Learn more at CleanProsperity.ca.

The Transition Accelerator is a pan-Canadian organization that works to identify and advance viable pathways to Canada's 2050 climate targets. Learn more at TransitionAccelerator.ca.

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Abbreviations

45V/Q/X	Sections of the *United States Internal Revenue Code* on clean-energy tax credits
CCfD	Carbon contract for difference
CCS	Carbon capture and storage
CCUS	Carbon capture, utilisation and storage
DAC	Direct air capture
IRA	*Inflation Reduction Act*
ITC	Investment tax credit
LCFS	Low-carbon fuel standard
PPA	Power purchase agreement
PTC	Production tax credit
RINs	Renewable identification numbers
SAF	Sustainable aviation fuel
TIER	Technology Innovation and Emissions Reduction (Regulation)

Introduction

There is a risk that Canada could miss out on the huge opportunities available in the low-carbon transition because our investment environment is less attractive than that in the United States.

In particular, the US *Inflation Reduction Act* (IRA) has opened up a wide gap between the revenue available from public-policy sources for new low-carbon technology deployment in Canada versus the US.

In this working paper, we analyze the differences in policy-based economic incentives for decarbonization in Canada and the US along two dimensions:

1. The bankable gap: This is the difference between economic incentives in the US and Canada that are clear *ex-ante*. Tax credits are the main focus of the bankable gap.

2. The total incentive gap: This takes into consideration a broader set of economic incentives — both bankable revenue streams like tax credits, and less certain revenue sources, like Canadian carbon-credit sales or grant programs.

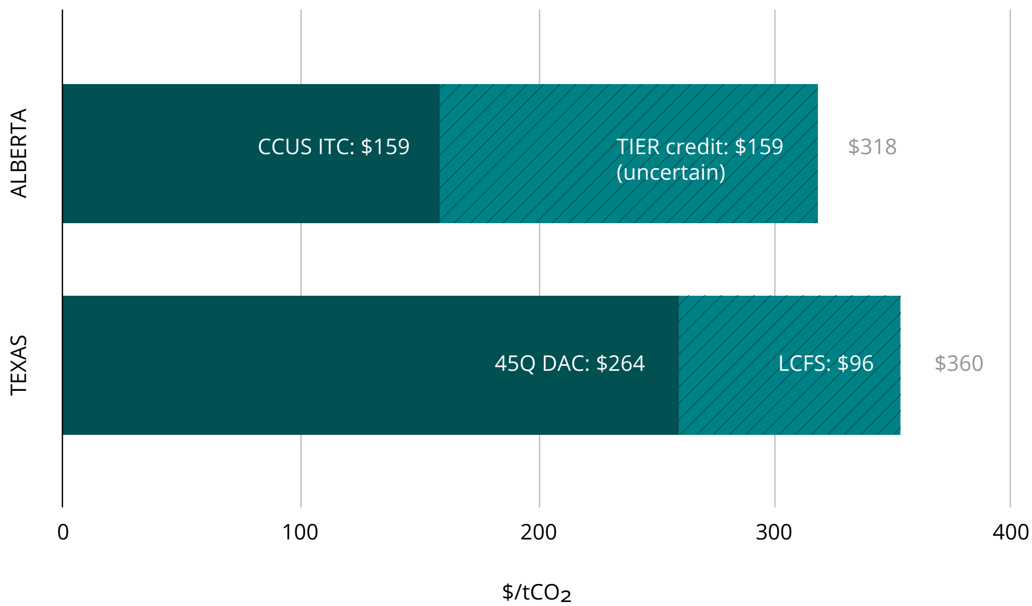
This working paper looks at seven low-carbon technology cases and recommends two policy options to close the gap: a systematic narrowing of revenue gaps by converting uncertain carbon market revenues into bankable revenues, using a policy like contracts for difference; and the strategic deployment of production tax credits as part of an industrial policy push in high priority sectors.

This working paper reports the preliminary findings of an ongoing research project to analyze the differences in policy-based economic incentives for decarbonization in Canada and the US. These findings may be refined as the research evolves.

All currency amounts in this working paper are in Canadian dollars, except where otherwise noted. For the assumptions underlying the analysis in this paper, see the appendix.

1. Direct air capture (DAC)

FIGURE 1: Average gross revenue from policy sources for hypothetical 1 $MtCO_2$ DAC project, 2025-2034 (\$ per tonne of captured CO_2)

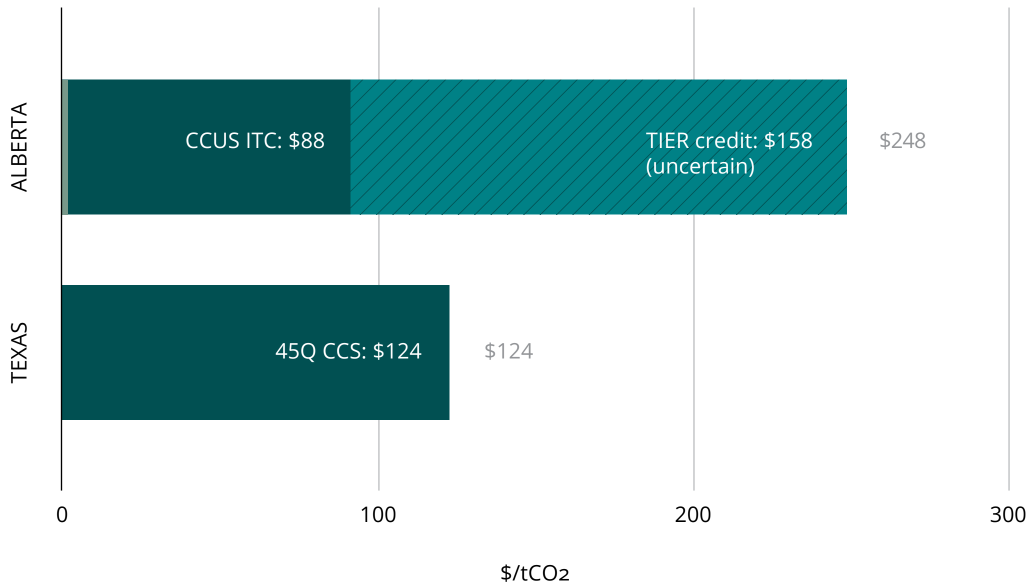


The bankable gap — the gap between certain revenue from public policy sources — for proponents of the same 1 $MtCO_2$ DAC project in Alberta and Texas is \$105/tCO_2 on average over a 10-year period. That's 40% less revenue per tonne in Alberta versus Texas.

Even when we consider the total incentive gap — which assumes a best-case scenario for Canada in which Alberta offset credits earn on average 95% of the headline carbon price — the average revenue per tonne of captured CO_2 is still 16% lower for a DAC plant in Alberta (\$318/tCO_2) compared to the same plant in Texas (\$360/tCO_2), a gap of \$42/tCO_2. The Texas figures include an estimated value of credits available via the California Low-Carbon Fuel Standard (LCFS).

2. Carbon capture and storage (CCS)

FIGURE 2: Average gross revenue from policy sources for hypothetical 1 $MtCO_2$ Cement CCS project, 2025-2034 ($ per tonne of captured CO_2)[1]



The bankable gap for proponents of equivalent 1 $MtCO_2$ CCS projects attached to cement plants in Alberta and Texas is $36/$tCO_2$ on average over a 10-year period. That's 29% less in Alberta.

If we consider total incentives, the average revenue per tonne of captured CO_2 could actually be twice as high in Alberta ($248/$tCO_2$), versus a comparable facility in Texas ($124/$tCO_2$). But this additional revenue is uncertain, and depends on both the continued increase in the federal carbon price, and a TIER[2] system which ensures that demand for credits consistently exceeds supply.

1 Includes a negligible $2/tCO2 for avoided compliance costs in Alberta, unlabelled in the figure.

2 TIER is the Technology Innovation and Emissions Reduction Regulation, Alberta's industrial carbon-pricing system.

3. Blue hydrogen

FIGURE 3: Average gross revenue from policy sources for hypothetical 525 million kgH_2/year autothermal reforming project, 2023-2032
($ per kg of hydrogen)

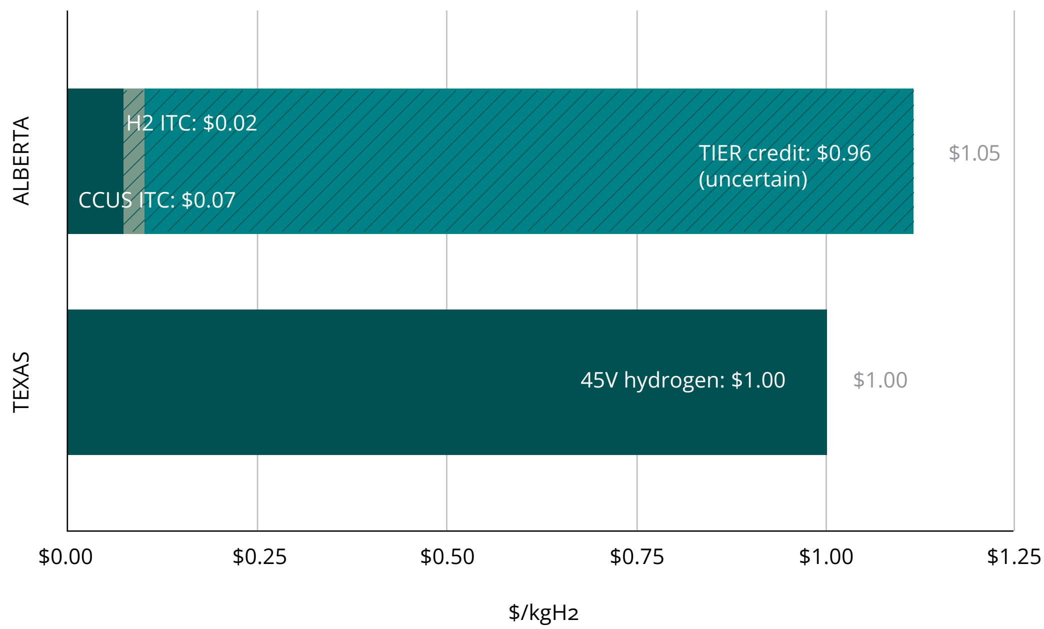
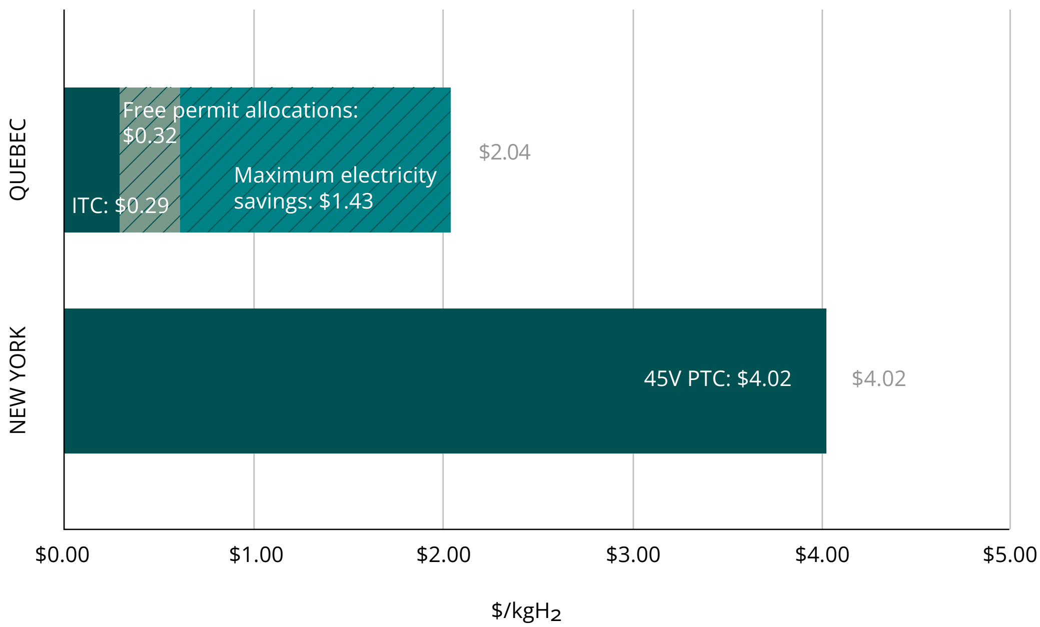


Figure 3 illustrates the gap between comparable facilities producing hydrogen via autothermal reformation in Texas and Alberta. Canada's carbon capture, utilisation and storage (CCUS) investment tax credit (ITC) is worth $0.07/kg$H_2$ per year. The bankable gap between that amount and the IRA's 45V production tax credit (PTC) is $0.93 per kilogram of hydrogen. That would be worth almost $500 million a year to a facility producing 525 million kilograms of hydrogen annually.

Allowing Canadian producers to stack the hydrogen and CCUS investment tax credits (note: the US does not allow stacking of the corresponding 45V and 45Q production tax credits) would add another $0.02/kg$H_2$ of revenue to the Alberta project. If Alberta TIER credits traded at 95% of the federal carbon price, this would deliver an additional average production tax credit equivalent of $0.96/kg$H_2$ over the period 2023-2032, for a total of $1.05/kg$H_2$. This would close the total incentive gap.

4. Green hydrogen

FIGURE 4: Average gross revenue from policy and other sources for Hypothetical 686,000 kgH2/year green hydrogen project, 2023-2032
($ per kg of hydrogen)



Our analysis compares policy-source revenue earned by hypothetical green-hydrogen plants in Quebec and New York[3]. The IRA's 45V clean-hydrogen PTC is worth $4.02/kgH2 per year over 10 years. Canada's ITC delivers $0.29/kgH2 in this project. Sites with existing obligations under Quebec's cap-and-trade system could also receive free allocation of emission units worth $0.32/kgH2. However, many greenfield projects would not be eligible for this revenue source. Thus, for new investments, the bankable gap is $3.73/kgH2.

It's worth considering another factor beyond policy-source revenue in this example — Quebec's cheap, clean electricity. But this still doesn't close the gap with a New York green-hydrogen producer. The difference in electricity prices between Quebec and a green power purchase agreement (PPA) in the US would reduce the US producer's revenue advantage to $1.43/kgH2 on average over ten years. This would narrow the gap, but still leave a very substantial $2.30/kgH2 gap remaining. With renewable-energy incentives in the IRA likely to drive down PPA prices, the gap will probably widen further.

3 Hydrogen is currently expensive and inefficient to transport over longer distances, so North American markets are likely to be regional. A project considering setting up in Quebec would more likely view New York or other nearby northeast states, rather than California, as alternatives.

5. Sustainable aviation fuel (SAF)

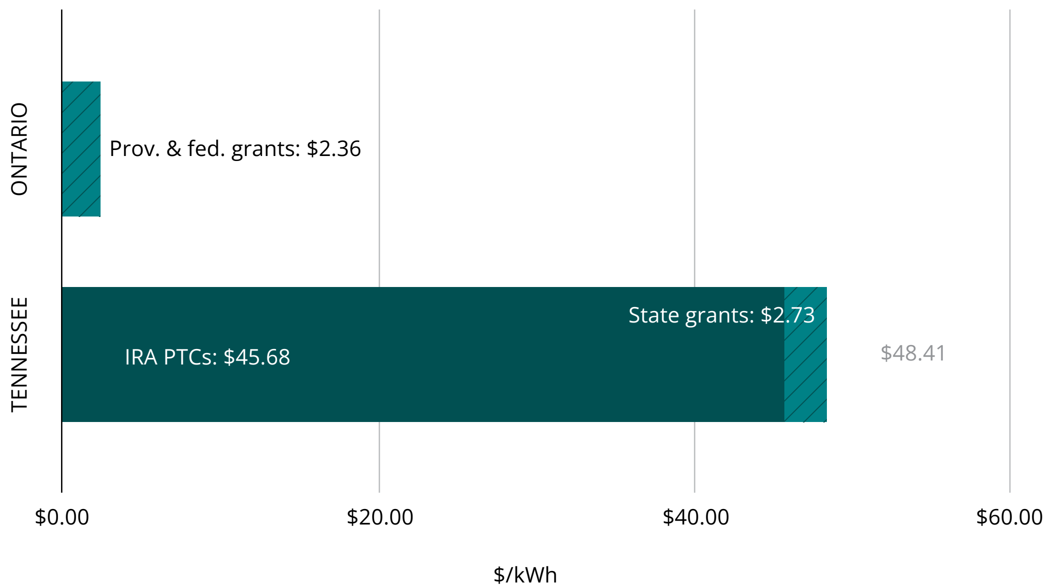
FIGURE 5: Bankable revenue from government sources for hypothetical gasification with forest residues project, 150 million litres of SAF/year, 2023-2027 ($ per litre of SAF produced)

Considering comparable projects producing sustainable aviation fuel in California and BC, the bankable gap is equal to the value of US production tax credits for SAF, which total $0.58 per litre over the first five years. But since Congress only authorized the credit for five years, the 10-year average bankable gap would decline to $0.29 per litre.

It is difficult to calculate the total incentive gap for SAF because Canadian fuel-standard markets (British Columbia's low carbon fuel standard and the national Clean Fuel Regulations) are not mature. Even if we make optimistic assumptions about the prices in those markets, revenue from California low-carbon fuel standard and RINs credits increases the total incentive gap to an average of $0.74 per litre for the period 2023-2032 — even if we assume that the US tax credits are not extended. In part, this is due to a fuel charge that applies to the non-SAF portion of the jet fuel blend.

6. Battery manufacturing

FIGURE 6: Average gross revenue from policy sources for 45 GWh/year hypothetical battery production facilities, 2024-2033 ($ per kWh of battery capacity produced)



Section 45X of the IRA contains a list of 13 targeted manufacturing production tax credits. One of the most striking of these is a US$35/kWh incentive for battery cells and a US$10/kWh incentive for modules. This benefit is reduced by 25% per year beginning in 2030.

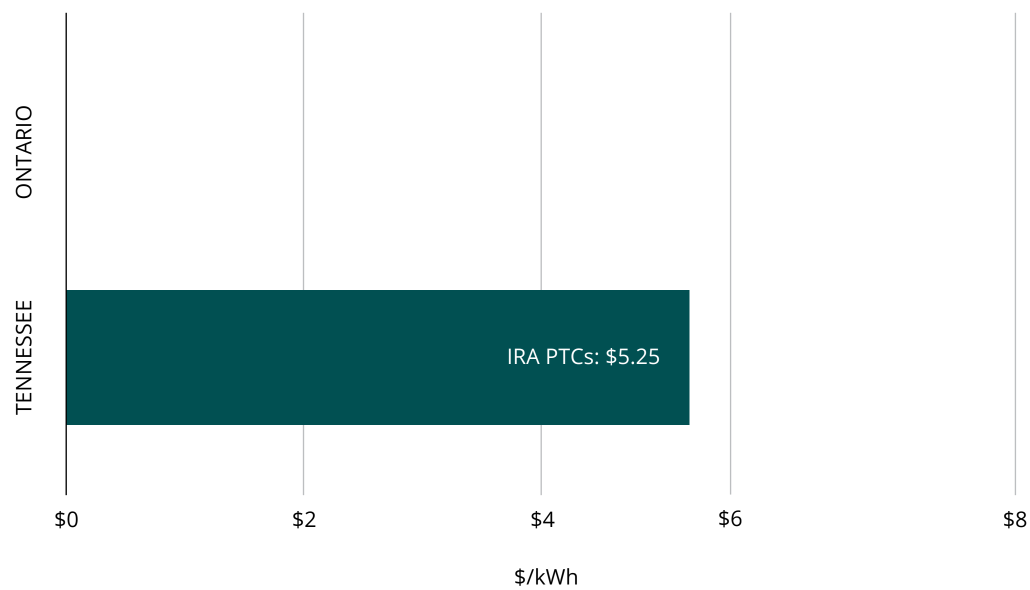
The impact of these two credits is that a combined cell and module manufacturing plant in Ontario, for example, would have a bankable gap compared to a similar plant in Tennessee of $45.68/kWh between 2024 and 2033. For a factory producing 45 GWh of battery capacity per year, the IRA's PTCs would generate on average $2.06 billion a year for 10 years.[4]

4 By contrast, a hypothetical Canadian 30% ITC amortized over 10 years would generate $167.5 million per year, assuming the total capital expenditure of the plant was approximately $5.58 billion. This would be equivalent to $3.72 per kWh — still nowhere close to the value provided by the IRA's PTCs.

The gap between the Canadian and American jurisdictions remains relatively similar after estimates of Canadian federal and provincial grants, and US state grants are factored into the analysis of the total incentive gap. For example, government grants and direct incentives were similar for the recently announced Stellantis plant in Windsor and the Ford Blue Oval City plant in Tennessee.

The IRA's advanced manufacturing tax credits also cover critical minerals (10% of production costs) and electrode active materials (10% of production costs).[5] The latter credit covers cathode active materials (see Figure 7), anode active materials, electrolyte salts, and more. For producers making nickel sulphate, the IRA's critical minerals credit is likely to be worth at least $0.40/kWh or $500/tonne. This bankable gap is less of a concern for nickel than for lithium because nickel supply is constrained and so there will be ample demand for Canadian supply. Lithium is more widely available and the US is home to high-quality deposits. For lithium, the credit is likely to be worth at least $0.50/kWh or $670/tonne, giving US lithium producers a significant advantage.

FIGURE 7: Average gross revenue from policy sources for hypothetical cathode active material production ($ per kWh of battery capacity produced)



Canada has already staked out a key position in the North American cathode active material market and is seeking to become a supplier of choice. The IRA threatens these investments by creating a bankable gap. For cathode active materials, the IRA credits could be worth up to $5.25 per kWh. For anode active materials, the credits could be worth up to $2.00 per kWh.

5 Credit values here rely on cost estimates. We take the US Department of Energy's average pack price ($153/kWh) and calculate cathode and anode cost based on International Energy Agency estimates of the share of the battery pack, reduced by standard internal rates of return to convert prices to costs. Production costs for mining credits are estimated directly from preliminary engineering assessments for US mining projects.

7. Large-scale solar energy

FIGURE 8: Average gross revenue from policy sources for a hypothetical 300 MW solar energy project, 2023-2053 ($ per MWh of electricity generated)

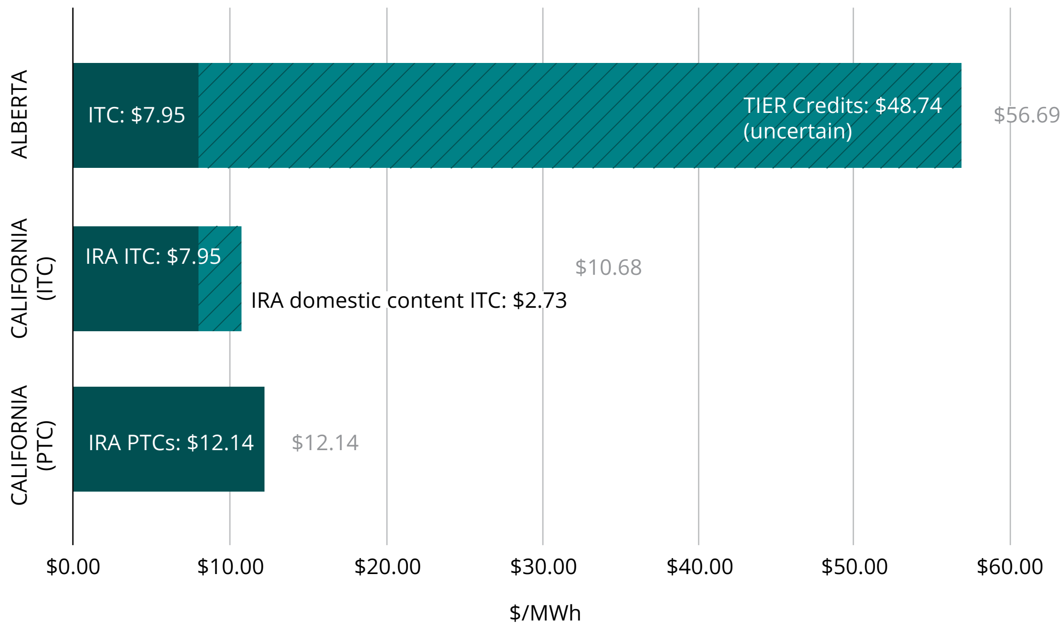


Figure 8 illustrates the gap between 300 MW commercial solar farms in Alberta and California. Canada's 30% ITC proposed in the 2022 Fall Economic Statement matches the IRA's ITC for solar projects, and is worth $7.95/MWh assuming a 20% capacity factor. The higher the capacity factor, the less the ITC is worth per MWh.[6]

The bankable gap emerges because the IRA offers producers the flexibility to choose between an ITC and a 10-year PTC worth US$26/MWh. We anticipate that the vast majority of producers would opt for the PTC, which opens up a bankable gap of $4.19/MWh. The IRA offers additional 10% ITC bonus credits for projects that satisfy domestic content requirements and other criteria. The domestic content credit is shown in Figure 7 for illustration; it would gain bankability over time as American supply chains reconfigure, opening up a bankable gap for ITCs as well.

6 For ease of comparability, we assume both projects operate at a 20% capacity factor. This is realistic for an Alberta project but very conservative for a California project, where a solar panel averages 28% capacity.

Credit generation under TIER could open up a wide total incentive gap in favour of Alberta-based solar producers, under a best-case scenario in which Alberta offset credits earn on average 95% of the headline carbon price and Canadian climate ambition drives the carbon price to $250/tonne in 2034. We estimate that Alberta TIER credits generated by a project of this scale are worth an average of $25.6 million per year or $48.74/MWh. Conversely, state-level incentives for commercial-scale solar in California are limited. Electricity generation is excluded from the state's cap-and-trade program, and the state's renewables portfolio standard does not contain a carve-out for solar energy. Voluntary programs are not considered here.

Beyond the bankable gap, additional factors make California a more favourable investment destination. Its solar resources are much higher quality than Alberta's. Sacramento, the state's northernmost major city, averages 3,470 hours of sunshine per year; Medicine Hat — the sunniest city in Canada — averages 2,544 hours of sunshine per year. Electricity prices are dynamic in both jurisdictions, but California prices are generally higher. Average wholesale electricity prices in Alberta were $101/MWh in 2021, which is unusually high compared to historical norms. Monthly wholesale prices in Northern and Southern California typically return US$100/MWh, with prices often peaking at US$300/MWh or greater.

Conclusion:

Policy should close the bankable gap and open up strategic bankable advantages

The federal government should pursue two important actions in the near-term to help close the bankable gap between Canada and the US for new low-carbon technology deployment.

First, policymakers should immediately provide greater certainty about the future value of carbon credits and offsets within industrial pricing systems, such as Alberta's TIER market. This would narrow the bankable gap across many of the sectors and technologies discussed in this working paper. In cement CCS, blue hydrogen, and solar power generation, guaranteeing the future value of carbon credits could even create a bankable advantage for Alberta-based projects, versus similar projects in the United States.

We recommend that the government act through a broad program of carbon contracts for difference (CCfDs), or through forward purchases of carbon credits. Either option can provide a bankable signal to low-carbon project proponents, providing them the assurance they need to proceed with projects that will be in operation for decades. Furthermore, if designed effectively, these policy options impose no net financial cost on the government beyond the time and efforts of the public service. This policy should be announced as soon as feasible, ideally in the 2023 Federal Budget.

Second, policymakers should direct additional support, such as a production tax credit (PTC), towards strategic sectors where there is a strong case for a Canadian competitive advantage and outsized economic benefits. Combined with greater confidence in carbon markets, prudent use of PTCs could create a bankable *advantage* for Canada in these strategic sectors. We identify several such high-potential sectors below, including sustainable aviation fuels, direct air capture, and cathode production.

Recommendation: Narrow the bankable gap by making existing carbon pricing revenues bankable

Project proponents currently lack confidence that provincial carbon markets will be sufficiently stringent to support credit prices at levels close to the headline federal carbon price. Based solely on the expectation of softening demand for credits, proponents may choose not to proceed with the decarbonization projects needed to meet Canada's 2030 emissions target. Clean Prosperity's analysis indicates that there is significant risk of credit/offset oversupply in carbon markets prior to the 2027 midterm program review. Ensuring that credit prices rise in step with the headline carbon price will narrow the bankable gap for low-carbon projects across a wide range of sectors and technologies.

Policymakers have a short window of opportunity to provide a systematic, economy-wide signal about the future value of carbon credits. Dozens of industrial decarbonization projects yet to be built will be essential to reach Canada's 2030 target. In order to be operational by 2030, many of these projects realistically require final investment decisions within the next 24 months.

We recommend the federal government announce a program of contracts for difference to backstop carbon credit values in the upcoming budget. Through this program, the federal government would sign long-term CCfDs (e.g., 15 years) with low-carbon project proponents, at an agreed strike price. The government would commit to pay the project proponent the difference between that strike price and a market reference price (i.e., the average price of credits/offsets in a given year) if the market price fell below the strike price. In the opposite case, the project proponent would pay the difference to the government.

For example, if the average price of credits/offsets sold in the Alberta industrial-emitter system in 2025 was $80 and the federal government had signed a contract with an emitter at a strike price of $85 in 2025, then the government would pay out $5 per credit. If the average price of credits/offsets was $90 in 2025, the counterparty would owe the government $5 per credit.

The federal government could also consider administering CCfDs through a reverse auction mechanism, though this would reduce the upfront certainty provided to project proponents.[7]

Currently, industrial pricing systems in Canada do not collect or publish information about credit/offset sale values. Publishing this information would be a prerequisite to signing CCfDs. We recommend a voluntary program that incentivizes the provinces to act based on the prospect that their companies and economies will benefit from accessing these contracts for difference.

An alternative to contracts for difference — which would achieve the same result — is for government to use forward purchase agreements. Through forward purchase agreements, the federal government would enter into long-term contracts (i.e., at least 15 years) to purchase credits and/or offsets from industrial emitters and/or offset generators. This mechanism would help absorb surplus credits and ensure that a price floor is maintained. These credits could then be sold back into the market at a later date with the potential for profit (they could also be retired at significant cost).[8]

7 Reverse auction of contracts would enable price discovery and reduce economic inefficiencies. However, reverse auctions would likely need to be designed sector by sector.

8 Clean Prosperity has studied design considerations for backstopping carbon-credit markets in greater depth. A paper detailing the findings is available on request.

Recommendation: Close the bankable gap with targeted supports across strategic sectors and technologies

When combined with greater confidence in carbon markets, a limited set of PTCs could completely close the bankable gap in sectors where Canada possesses comparative advantages. In some cases, these PTCs could even open up a bankable advantage for Canada.

While several programs already offer targeted decarbonization support (e.g., Canada Growth Fund, the Net Zero Accelerator), these funding mechanisms are not bankable. They do not offer an automatic, dependable revenue stream and there is a high degree of uncertainty about whether any given decarbonization project will receive funding. Startups in particular may struggle to navigate the application processes for these programs. This lack of upfront certainty is particularly problematic for projects involving greenfield development where investors may be weighing the economic incentives available in Canada against those in the United States. Furthermore, even if the federal government offers CCfDs, it would not change the bankable gap for some low-carbon greenfield developers who do not qualify for participation in industrial emissions programs (e.g., greenfield renewable hydrogen projects in Quebec).

Canada lacks the fiscal firepower to compete dollar for dollar with the United States on PTCs. But even if it could, it might not make sense for Canada to simply copy US industrial policy. To create a "level playing field", Canada would be better off developing its own industrial strategy that matches incentives in high-priority areas, concedes a disadvantage in others, and seeks to open up bankable gaps in areas not covered by the IRA.

This more strategic approach would begin by identifying high-priority opportunity areas: industries where Canada can compete globally and which could produce significant economic benefits in the form of good jobs and manufacturing value added.[9] For these high potential industries, the data in this working paper can be used to highlight if and where additional economic support — beyond the contracts for difference recommended above — are merited.

9 For this working paper, we used the high-priority opportunity areas identified in this report by The Transition Accelerator and Smart Prosperity Institute: https://institute.smartprosperity.ca/publications/CanadasFuture

A preliminary matching of these two approaches leads us to recommend the following non-exhaustive list of technologies that merit consideration for PTCs:

Battery active materials

Canada's strategy in the electric vehicle (EV) supply chain is to leverage anchor investments in EV assembly and battery manufacturing into a full mines-to-mobility value chain. Canada may need to match the IRA's PTC for cells and modules in order to ensure that batteries are made here in Canada. But Canada's strategy should include incentives for upstream mining and midstream chemical processing.[10]

Matching or beating the IRA's PTC for battery components would support the midstream while providing demand-pull on Canadian minerals. The midstream is also crucial to building competitive and innovative battery-metals supply chains. A strong chemical processing sector will help Canada keep costs low and rapidly adapt our supply chains as battery chemistries change over a long transition.

Sustainable aviation fuels

Currently a net importer of aviation fuels, Canada has a robust biomass sector and expertise in green chemistry that could be leveraged into a strong biofuels industry. There is an opportunity to create complete feedstock-to-fuels value chains that could generate economic benefits in rural communities across the country.

The IRA's PTC for SAF and biofuels only runs for five years. Canada could offer a PTC at a lower level than the IRA does, but with a longer duration, and still create a bankable advantage.

Direct air capture (DAC)

The carbon dioxide removal industry will need to remove billions of tonnes of CO_2 from the atmosphere every year by 2050, according to the most recent report of the Intergovernmental Panel on Climate Change. With favourable geology, a strong R&D ecosystem and willing industry partners, Canada is well-positioned to be a major player in this new global industry — if we get our policy environment right.

10 For more details, see this report by the Transition Accelerator in conjunction with the Battery Metals Association of Canada, the Accelerate Alliance, and the Energy Futures Lab. https://transitionaccelerator.ca/roadmap-for-canadas-battery-value-chain/

A strong first step to capitalize on the opportunity available to Canada would be to offer a production tax credit that, in combination with mechanisms to support credit values in provincial carbon markets, could open up a bankable advantage over the United States.

Other sectors

In addition to the sectors we've identified in this analysis, there are other sectors that would be strong candidates for strategic support, such as mass timber, bioproducts, and agtech.[11]

To be successful in all the example areas above, incentives in these areas should be complemented by other elements of modern industrial strategy: clear targets and timetables; robust collaboration between industry, government, and other stakeholders; and the smart, efficient use of public finance.

11 Canada's cleantech industry features many innovative companies that seek to transform wood and other forms of biomass into high value-added products. These areas are not covered by the IRA but are crucial parts of a net-zero future. Mass timber presents an important opportunity to add value to our wood exports and create good jobs in or near forestry communities.

Appendix:

Modelling assumptions

This appendix outlines the major assumptions made in modelling the incentive gaps for low-carbon technology between Canada and the United States; however it is not an exhaustive list. For questions about the modelling methodology, please contact the authors.

US policy incentives

- All models assume that the IRA's prevailing-wage and apprenticeship requirements are satisfied, in order to maximize the value of US tax credits. Bonus credits for domestic content requirements and energy community requirements are not satisfied unless explicitly noted.
- DAC: 45Q production tax credit (PTC): $240 per tonne of captured CO_2, increasing at the rate of inflation from 2026 onwards (bankable)
- DAC: California Low-Carbon Fuel Standard (LCFS) credits: current spot price of $87 per tonne of captured CO_2, assumed to increase at the rate of inflation (not bankable)
- Hydrogen: IRA 45V production tax credit (bankable)
- SAF: IRA SAF addition to the Blender's tax credit (2023-2024); Clean Fuels Production Credit (2025-2027) (bankable)
- SAF: California Low-Carbon Fuel Standard (LCFS) credits: current spot price of $87 per tonne of avoided CO_2, assumed to increase at the rate of inflation (not bankable)
- SAF: Renewable Identification Number credits (RINs) at current price, assumed to increase at the rate of inflation (not bankable)
- Batteries: IRA cell ($35/kWh), module ($10/kWh), electrode active materials (10% of costs), and critical minerals (10% of costs) production tax credits (bankable)

Canadian policy incentives

- DAC: Investment tax credit (ITC) for carbon capture and storage: 60% of capital costs for direct air capture projects (bankable)
- CCS: Investment tax credit (ITC) for carbon capture and storage: 50% of capital costs for direct air capture projects (bankable)
- DAC, CCS, Hydrogen: Offset carbon credits for sale within a provincial industrial carbon pricing system like Alberta's TIER (not bankable: too much uncertainty about future credit values)
- SAF: BC LCFS, prices benchmarked to California LCFS. Clean Fuels Regulation, prices estimated at industry standard $300 per tonne of CO_2 (not bankable).
- SAF: Assuming no fuel charge on the carbon-free portion of the fuel under the federal carbon pricing system in a 50% SAF blend jet fuel (as indicated in draft changes; not bankable)

Other

- DAC, CCS, hydrogen, advanced manufacturing: Canadian ITC amortized over 10 years to match the duration of the PTC.
- DAC, CCS, hydrogen: Carbon credit value assumes an average spread of 5% between credit prices and the headline federal carbon price (optimistic scenario).
- DAC, CCS, hydrogen: Canadian federal carbon price increases at a rate of $20 per tonne per year from 2031 on, reflecting even greater climate ambition in years to come.