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No Bad Option

Comparing the economic impacts of Ontario carbon pricing scenarios

Hadrian Mertins-Kirkwood
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Introduction

Ontario's cap-and-trade system for pricing greenhouse gas (GHG) emissions was announced in April 2015 and came into effect in January 2017. The carbon pricing system, a key component of the province's response to climate change, recycles revenues generated from permit auctions into climate-related investments and programs. Those revenues and their associated spending are worth nearly $2 billion per year.

A carbon price is designed to encourage households, businesses and governments to consume fewer high-emitting products (especially fuels) and gradually shift to cheaper, cleaner alternatives. Energy consumers' response to the carbon pricing signal should result in lower overall emissions than Ontario would produce in the absence of a pricing policy.

The introduction of a federal carbon pricing backstop in 2018 means carbon pricing is here to stay in Ontario. This new federal regulation requires every province to implement a carbon pricing system that increases in stringency every year through 2022 or else the federal government will step in with a carbon tax mechanism of its own.

Although the cap-and-trade system currently in place does meet federal requirements, it is not Ontario's only option for complying with federal regulations. Some critics of the current emissions trading system have called for the province to transition to a revenue-neutral carbon tax instead. This alternative approach would change how carbon pricing revenues are collected and how they are spent. Consequently, the economic impacts could be very different than under a continuation of the current system.

This paper analyzes the economic impacts of these two competing visions for carbon pricing in Ontario: the current cap-and-trade system and climate program, and a revenue-neutral carbon tax. Using an input-output methodology, we compare the likely net impact of both systems on economic growth, employment and government revenues in the year 2020.*

We find that the economic impacts in either scenario are so small as to be negligible in the short term. The carbon prices on offer are simply not high enough to produce a significant economic impact. Nevertheless, both pricing systems can lead to meaningful reductions in GHG emissions. We conclude that a more stringent carbon price, whatever the mechanism, can play an important role in Ontario's shift to a low-carbon economy in the long term if complementary climate policies are put in place. We also suggest that targeted climate spending provides greater benefits, both economically and environmentally, than broad-based tax cuts.

What is carbon pricing?

Greenhouse gas (GHG) emissions from human activity are the main driver of anthropogenic (human-caused) climate change. Most of these emissions are directly or indirectly tied to the fossil fuel energy system, which includes the extraction, processing and consumption of oil, coal and natural gas. Without a dramatic reduction in GHG emissions worldwide — requiring a significant decline in fossil fuel use — the planet faces potentially catastrophic global warming by the end of the century.[1]

Reducing GHG emissions is a primary goal of climate policy, which encompasses a broad range of government measures to mitigate climate change and adapt to its consequences. Among the specific policy tools available to governments, carbon pricing is an increasingly popular measure worldwide. By the end of 2017, 42 countries had implemented or were planning to implement a carbon pricing mechanism, including major economies like the

* This paper addresses comparative economic impacts in one area of climate policy (i.e., carbon pricing options). This paper does not undertake a comprehensive assessment of Ontario's climate policy options or represent the full climate policy views of the Canadian Centre for Policy Alternatives or the Clean Economy Alliance.

TABLE 1 Simple matrix of carbon pricing options

		Carbon pricing mechanism: Carbon tax	Carbon pricing mechanism: Emissions trading system (cap-and-trade)
Revenue recycling mechanism	Targeted program spending	Carbon tax with climate plan (e.g., Alberta)	Emissions trading with climate plan (e.g., Ontario, Quebec)
Revenue recycling mechanism	Personal/corporate income tax cuts	Revenue-neutral carbon tax (e.g., British Columbia)	Revenue-neutral emissions trading

European Union and China.[2] With the introduction of a cap-and-trade system in January 2017, Ontario became the fourth Canadian province (alongside Alberta, British Columbia and Quebec) to implement some form of carbon pricing. The rest of the country must follow suit by the end of 2018 due to new federal carbon pricing regulations.

Carbon pricing works by increasing the cost of emitting greenhouse gasses, which discourages people and businesses from engaging in emissions-intensive activities. Typically, a carbon price is represented as a dollar cost per tonne of carbon dioxide equivalent (CO_2e). In addition to carbon dioxide, CO_2e accounts for a number of other greenhouse gasses such as methane.

Energy consumers have an incentive to shift away from energy sources and products that are emissions-intensive due to the increase in price. In the aggregate, these choices by businesses, governments and households to improve energy efficiency or transition to lower-cost, lower-emitting energy sources add up to a reduction in the economy's overall emissions. The effectiveness of carbon pricing in reducing GHG emissions is well-supported in theory. Empirical support, though mixed, is growing as more jurisdictions around the world experiment with pricing systems.[3]

When a government decides to implement carbon pricing it has to make two main decisions (see *Table 1*). First, which pricing system will be used? And, second, how will revenues be spent?

There are two basic pricing mechanisms to choose from: a carbon tax or an emissions trading system (i.e., a cap-and-trade system). Under a carbon tax the price on emissions is determined in advance. For example, British Columbia's carbon tax started at $10 per tonne of CO_2e in 2008 and increased by $5 per year through 2012. Carbon taxes have the advantage of being relatively simple and predictable for businesses and energy consumers to understand and respond to, but carbon taxes cannot guarantee emissions will fall at a predictable rate. In B.C.'s case, actual emissions in the province have stayed roughly flat over the past decade, which suggests the carbon price is either too low or the tax does not apply to enough of the province's economy.

Determining the "correct" price for a carbon tax is challenging because it depends on the perceived cost of additional GHG emissions — often referred to as the social cost of carbon — and the intended rate of emissions reductions. Environment and Climate Change Canada's central estimate of the social cost of carbon is approximately $40 per tonne today, rising to approximately $75 per tonne by 2050.[4] However, different Canadian estimates have suggested a carbon price of closer to $200 per tonne is necessary for Canada to meet its international commitments under the Paris Agreement.[5] Without adequately ambitious pricing, a carbon tax will not achieve the intended reductions on its own.

In an emissions trading system, total GHG reductions are fixed ("capped") but the price on emissions is flexible. Emissions trading systems have the advantage of ensuring GHG reduction targets are met because the price rises as high as necessary to comply with the cap. The cap itself is reduced at a predictable rate each year.

Among its disadvantages, emissions trading is more complex to administer and the price signal is less direct than under a carbon tax. Only certain regulated emitters must purchase emissions credits and much of the cost is passed on indirectly to consumers. In addition, since high-emitting industries are often engaged in international competition with jurisdictions that do not have carbon pricing, cap-and-trade systems may include free allowances to compensate those industries. Free allowances can address leakage concerns, but they weaken the carbon pricing signal for those industries.[6]

Emissions trading systems can be linked across jurisdictions to increase efficiency and lower costs. As of 2018, Ontario's cap-and-trade system is linked with Quebec's and California's through the Western Climate Initiative (WCI). A linked system allows carbon market participants to purchase and trade permits in other jurisdictions. It also allows firms to purchase carbon offsets in other jurisdictions and sectors instead of reducing emissions themselves. Emissions trading essentially allows emitters in one place to pay emitters in other places to reduce emissions on their behalf. In theory, the net impact on global GHG emissions is the same even if one jurisdiction or sector does not actually reduce emissions at all.

The option to trade permits or purchase carbon offsets elsewhere can slow efforts to reduce emissions at home, so relying excessively on inter-jurisdictional emissions trading in the short term can undermine long-term efforts to transition to a low-carbon economy. The efficacy of carbon offsets has also been called into question.[7] For example, loopholes in offsets markets have been used to double-count emissions reductions that already occurred or would have occured anyway in the absence of an offset.[8] These problems can be mitigated by limiting the volume of offsets permitted in the system and by encouraging high-quality domestic offsets.[9]

Ultimately, either carbon pricing system (or a hybrid of both) can send an effective signal to the market to reduce emissions, but both systems have their flaws. To achieve meaningful GHG reductions while transitioning to a low-carbon economy in the long term, carbon pricing alone is insufficient and strong complementary climate policies are necessary.[10]

The second major decision a government must make when adopting a carbon pricing system is what to do with the revenues it generates, which can be substantial under both a carbon tax and an emissions trading system. In Ontario's case, permit auctions under the cap-and-trade system generated roughly $1.9 billion for the government in 2017.[11]

Revenue recycling is important for two reasons. First, carbon pricing alone acts as a drag on the economy by increasing the cost of emissions-intensive economic activity.[12] Carbon pricing is also regressive, which means it imposes a larger relative burden on low-income households.[13] Putting carbon pricing revenues back into the economy can counteract many of the negative impacts. Second, the effective redistribution of revenues has the potential to drive greater economic growth and/or encourage further emissions reductions than pricing alone.

There are a number of approaches available to governments for recycling carbon pricing revenues, but they can generally be grouped into two categories: program spending and tax cuts.[14] Program spending refers to government investments into strategic sectors to reinforce climate initiatives. For example, under Quebec's Climate Change Action Plan more than $1.5 billion in cap-and-trade revenues will be spent over seven years on public transit infrastructure.[15] Targeted climate spending also has the advantage of accelerating the transition to a lower-carbon economy by supporting industries and activities that might not scale up quickly enough in the absence of government support (e.g., electric vehicle infrastructure).

Alternatively, governments can recycle carbon pricing revenues by reducing other taxes (typically income taxes). A carbon pricing system that offsets all revenues with corresponding tax cuts is revenue-neutral. By increasing the cost of higher-emitting economic activities and lowering the cost of all other economic activities, businesses and households should shift their spending toward cleaner alternatives, thereby supporting less emissions-intensive industries.

Revenue neutrality through tax cuts has a number of disadvantages, including a potentially regressive redistribution effect and a tendency to encourage short-term adaptations. Unless the carbon price is guaranteed to ramp up aggressively over the long term, the incentive is not strong enough to drive more transformative infrastructure investments. Short-term adaptations are problematic because delaying structural changes makes it more difficult and expensive to do so later on.[16]

In designing a carbon pricing system, a combination of revenue recycling approaches is possible. In Alberta, for example, carbon tax revenues are used primarily to invest in programs under the province's Climate Leadership Plan, but a portion of revenues are allocated to tax cuts and rebates. British Columbia, on the other hand, was for years required by law to offset all carbon pricing revenues with tax cuts, but that law was recently changed to permit targeted climate spending. Ultimately, the design of any system will reflect the political and economic context of the jurisdiction.

Two scenarios for carbon pricing in Ontario

Given the variety of potential policy designs, we limit our economic analysis of Ontario's carbon pricing options to a comparison of the existing cap-and-trade system with a revenue-neutral carbon tax. The latter approach would replace the cap-and-trade system with a carbon pricing mechanism modelled on the federal backstop policy (though administered by the province). In this second scenario, the Climate Change Action Plan is also cancelled and all revenues are redirected toward tax cuts.

Scenario 1: Cap-and-trade system and Climate Change Action Plan

The province of Ontario has a long history of climate plans and programs, but it wasn't until 2015 that the government committed to implementing carbon pricing.[17] The system was established as Ontario Regulation 144/16 under the 2016 *Climate Change Mitigation and Low-carbon Economy Act* and the first compliance period began in January 2017. Ontario's system was linked with the cap-and-trade systems in Quebec and California in January 2018 through the Western Climate Initiative.

Large final emitters (facilities emitting at least 25,000 tonnes of CO_2e per year), natural gas distributors, fuel distributors and electricity importers are required to participate in cap-and-trade. Facilities emitting at least 10,000 tonnes can participate voluntarily. Most energy consumers, such as drivers and homeowners, cannot participate directly, but they pay the carbon price indirectly as the costs are passed on by carbon market participants. For example, gasoline distributors may increase the price of gasoline to compensate for the carbon price they are required to pay.

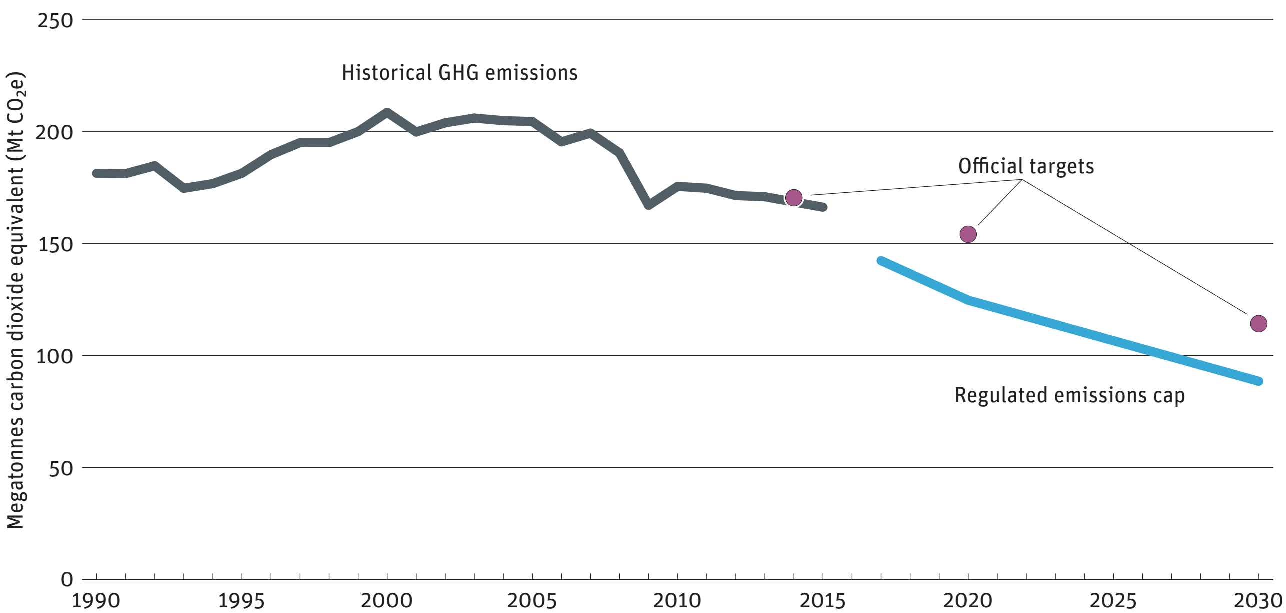
Four times per year, the WCI auctions off emissions allowances to carbon market participants in Ontario, Quebec and California. Participants can also trade permits amongst themselves. At the end of each compliance period, regulated emitters must have enough permits to cover all of their emissions to avoid paying significant penalties.[18] The first compliance period is 2017–2020 and the first "true up" to validate compliance will occur in 2021.

Notably, many large emitters in Ontario (as in Quebec and California) are eligible for free allowances. These are distributed by governments to minimize the impacts of carbon pricing on the competitiveness of industries more exposed to international markets. Free allowances are described as a transitional measure, but they are only being phased out at a rate of 4.57% per year and only for certain combustion emissions (i.e., not for all industrial processes).[19] In practice, that means almost all large final emitters in Ontario do not need to participate in permit auctions, although they may still pay the carbon price indirectly through the fuels they consume.

Ontario's cap on emissions was set at 142 megatonnes in the first year.[20] The cap is lowered each year so that by 2020 it will be 125 Mt and, by 2030, 88 Mt (see *Figure 1*). These caps are even lower than the province's GHG emission reduction targets because not all sectors are covered by the cap-and-trade system. Certain sectors, such as agriculture and forestry, are not covered by the carbon price but are subject to other programs and regulations designed to reduce emissions.

In the first year, Ontario generated $1.9 billion from permit auctions at an average price of $18.22 per tonne. By law, Ontario's revenues from cap-and-trade auctions can only be spent on initiatives that are "reasonably likely to reduce, or support the reduction of, greenhouse gas."[21] Those initiatives are outlined in the province's Five Year Climate Change Action Plan (CCAP).

FIGURE 1 Ontario greenhouse gas (GHG) emissions, caps and targets



Source Environment and Climate Change Canada, "National and Provincial/Territorial Greenhouse Gas Emission Tables," Environment Canada Data and Ontario Regulation 144/16, s. 54.

Among other initiatives in the plan, the province allocates $1 billion dollars to increasing industrial adoption of low-carbon technologies. Other actions include support for electric vehicle infrastructure, funding for regional rail deployment, and energy efficiency programs for homes and buildings.

Altogether, the plan describes between $6 billion and $8.3 billion in spending by 2020 depending on the revenues generated by the cap-and-trade system. Based on the first year of permit auctions, total spending will likely fall roughly in the middle of that range.

Scenario 2: Revenue-neutral carbon tax hybrid

Ontario could, at a certain administrative cost, abandon the cap-and-trade system and the Climate Change Action Plan and implement the federal government's backstop carbon pricing system. The federal proposal is a hybrid carbon levy and output-based pricing system modelled on Alberta's carbon tax.

In this hybrid system, a simple carbon tax applies to the consumption of fuels like gasoline and natural gas. The price starts at $10 per tonne of CO_2e in 2018 and increases by $10 per year through 2022. Major industrial emitters (those emitting at least 50,000 tonnes of CO_2e per year) are subject to an output-based pricing system instead. In the output-based pricing system, companies must only pay the carbon price on emissions that exceed an industrywide emissions intensity standard. By default, that standard is 70% of the production-weighted national average.[22] In other words, for each industry overall, only 30% of emissions will initially be subject to pricing. The potential emissions reductions from heavy industry are consequently smaller under this hybrid system than they would be in a simple carbon tax scenario.

In Ontario's case, about 100 facilities responsible for a quarter of the province's emissions may be covered by the output-based system.[23] Smaller industrial emitters can opt into this system rather than pay the carbon levy. Most of the remainder of emissions, including from vehicle transportation and home heating, are covered by the carbon tax. As in cap-and-trade, a small portion of emissions, such as fuel used by farmers, are not subject to pricing.[24]

In this analysis we assume the government will also cancel the Climate Change Action Plan and redirect 100% of carbon pricing revenues toward income tax cuts. For the sake of simplicity, we assume that all revenues will be recycled specifically into personal income tax cuts, although corporate tax cuts are also possible in the event a government pursued this option.

Methodology

We compare the economic impact of the two preceding scenarios using Statistics Canada's input-output multipliers. Input-output analysis has a number of limitations (e.g., it ignores the effect of scale and some interactions between sectors), but it permits direct macroeconomic comparisons of different scenarios on an industry-by-industry basis.

For each scenario, we first estimate what total carbon pricing revenues will be and then distribute the revenue between the industries that will be impacted either positively or negatively. The multipliers produce estimates of the economic impact in each sector. The totals are added together to determine the net economic impact for the province.

We look only at the net economic impacts of each scenario in the year 2020 in this analysis. Since 2020 is the final year of the Climate Change Action Plan, it is difficult to predict how cap-and-trade revenues will be spent in subsequent years. Cumulative comparisons (e.g., for the 2015–2020 period) are also problematic because the two scenarios have different starting points. Limiting the analysis to 2020 provides the greatest degree of comparative validity and permits us to present all data on an intuitive, annual basis.

A detailed methodology is available in the appendix.

Results of economic impact analysis

The net impacts of either scenario on the Ontario economy are extremely small. The results in all three measures (GDP, employment and net government revenues) are not measurably different from zero.

With that caveat in mind, there are some relative differences between the two scenarios that are worth highlighting. First, the carbon tax scenario is more economically disruptive in general, although this is mostly due to a higher carbon price and not necessarily to the design of the system. The price in the carbon tax scenario ($30 per tonne of CO_2e) is higher than the price in the cap-and-trade scenario (approximately $18 per tonne), which results in greater revenue generation ($2.7 billion versus $1.6 billion). Since all revenues are recycled, the carbon tax scenario also puts more money back into the economy. Broadly speaking, more money out and more money in forces greater adaptations from the economy.

The present analysis looks only at the year 2020, but in subsequent years the revenue gap would be even larger. In 2022, when the carbon tax rises to $50 per tonne, total pricing revenues may approach $5 billion compared to less than $2 billion under the current cap-and-trade system.[25]

Second, the cap-and-trade scenario has a more positive impact on GDP and employment than the carbon tax scenario. Under the Climate Change Action Plan, all of the GDP costs in certain industries are offset by gains in other industries. Although there is no net economic change, more jobs are created than lost under the plan. In the carbon-tax-plus-tax-cuts scenario, both the GDP and employment impacts are slightly negative overall.

These differences have less to do with the pricing mechanism and more to do with the revenue recycling choice. Program spending in the cap-and-trade scenario has a more positive economic impact than tax cuts in the carbon tax scenario, which is consistent with a large body of research showing greater economic benefits from direct investment compared to income tax reductions.[26] Nevertheless, the differences between the two spending scenarios are close enough to be considered negligible given the size of the Ontario economy. For context, Ontario's GDP exceeds $700 billion and total employment is greater than seven million. Changes on the order of a few million dollars or a few thousand jobs amount to rounding errors.

These findings are consistent with a recent study by economist Dave Sawyer of EnviroEconomics, which finds a net negative GDP impact of less than 0.05% in either carbon pricing scenario.[27] Economist Trevor Tombe has also compared the two scenarios on the basis of household expenses and finds a generally small impact depending on how revenues are recycled.[28]

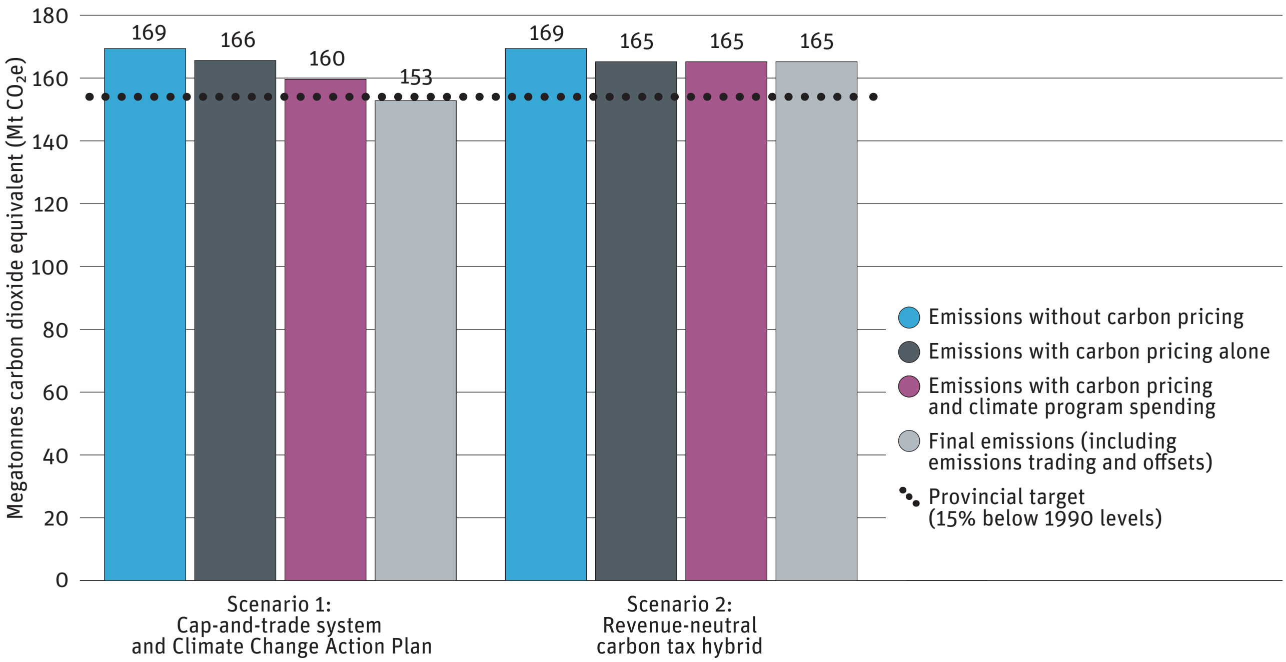
The negligible net economic impact of either scenario should come as little surprise given the limited ambition of both carbon pricing systems. At \$18 or \$30 per tonne of CO_2e (or even at \$50 per tonne), the total revenues collected as a share of Ontario's economy are very small. Moreover, since 100% of carbon pricing revenues are recycled right back into the economy in either scenario, economic benefits are created that roughly offset the costs. Indeed, this is exactly how carbon pricing is supposed to work: capital is shifted from more emissions-intensive activities to less emissions-intensive activities without changing the total size of the economy.

Given these findings, perhaps the more important question is whether either scenario achieves significant emissions reductions. Projections from the government of Ontario and independent modelling by Sawyer suggest important differences between the current cap-and-trade system and a revenue-neutral carbon tax in terms of their capacity to reduce total GHG emissions (see *Figure 2*).

Through pricing alone, both scenarios are expected to achieve emissions reductions of approximately three to four megatonnes of CO_2e (2%) in 2020. Ontario's GHG emissions reduction target for 2020 is 154 Mt, so on this measure both scenarios miss the mark by about 11 Mt (7%). However, program spending under the Climate Change Action Plan is projected to reduce emissions further, which is not the case under the tax-cut plan. If revenue recycling is included, the cap-and-trade scenario achieves roughly twice the reductions of the carbon tax scenario.

The cap-and-trade scenario still falls short of the target if only domestic reductions are accounted for, but the system requires market participants to make up the shortfall by purchasing emissions permits and carbon offsets from WCI partners. In effect, to reach the emissions cap Ontario firms must pay firms in Quebec and California to reduce emission on their behalf. Purchasing permits and offsets in other jurisdictions is not a sustainable economic solution if Ontario intends to transition to a low-carbon economy in the long-term. Still, provided such purchases are legitimate and limited

FIGURE 2 Ontario GHG emissions in 2020 under two carbon pricing scenarios



Source Author's calculations based on Ontario's Climate Change Action Plan and Dave Sawyer's "A better trade-off analysis of Ontario carbon pricing choices."

they can reasonably fill the province's emission reduction gap. In this way the cap-and-trade system is guaranteed to meet Ontario's 2020 climate goal.

The revenue-neutral carbon tax scenario, on the other hand, does not include spending, emissions trading or carbon offsets to make up the gap with provincial emissions reduction targets. As discussed above, a carbon tax alone will only drive deep emissions reductions if it is correctly priced with broad coverage. In this case, $30 per tonne is simply too low, especially when exceptions are made for major industrial emitters. Under the federal backstop the price will increase to $50 per tonne by 2022, which will help reduce emissions further, but unless the price ramps up well beyond 2022 it is unlikely to be sufficient for Ontario to achieve its longer-term climate goals.

To be clear, the shortfall in the second scenario is not a flaw of carbon taxation. For a carbon tax to work in Ontario, however, either the price must be much higher or revenues must be recycled into complementary climate policies — or a combination of both. Spending carbon revenues on tax cuts fails to maximize the policy's emission reduction potential.

Conclusions

This paper presents an economic impact analysis of two carbon pricing scenarios in the province of Ontario. The first scenario (the status quo) is an emissions trading system where revenues are recycled into climate-related programs. The second scenario (based on the federal carbon pricing backstop) is a carbon tax hybrid where revenues are recycled into personal income tax cuts.

We find that the economic impacts of either scenario are negligible in the year 2020. Neither system has a measurable net impact on economic growth, employment or government revenues in the province of Ontario.

Despite their minimal economic impacts, both systems achieve meaningful greenhouse gas emission reductions, which lends support to carbon pricing as an effective climate policy tool. The carbon tax scenario results in slightly greater emissions reductions as a direct effect of pricing, but the existing cap-and-trade system achieves greater emissions reductions overall. Crucially, program spending in the cap-and-trade scenario creates additional emissions reductions that do not result from personal income tax cuts in the carbon tax scenario.

Neither system reduces emissions far enough to meet Ontario's 2020 climate target directly, but the cap-and-trade system gets over the line through the purchase of permits and carbon offsets from Quebec and California.

Based on the preceding analysis, we conclude that no clear economic justification exists for switching from the current cap-and-trade system and Climate Change Action Plan to a revenue-neutral carbon tax system. First, since the economic impacts are similarly negligible in both scenarios, switching pricing systems will incur unnecessary costs. Second, the current cap-and-trade system and climate plan achieve greater emissions reductions overall than the carbon-tax-and-tax-cuts scenario (even if carbon offsets and permits from other WCI jurisdictions are discounted). Third, targeted program spending produces greater overall economic and environmental benefits than tax cuts. Importantly, climate spending can be strategically directed toward long-term investments in the low-carbon economy that would not occur organically through tax cuts.

Ultimately, there is no bad option for Ontario when it comes to carbon pricing provided emissions are priced high enough to drive systemic changes and complementary climate policies are also put in place. If these conditions are met, a carbon pricing system can play an important role in helping the province achieve its climate objectives.

Appendix

THIS ANALYSIS USES Ontario-specific input-output industry multipliers published by Statistics Canada.[29] We use the "total in-province" multipliers for each industry.

We estimate two additional sets of provincial multipliers based on Finance Canada's national multipliers: "personal income tax measures" and "measures for modest- and low-income households."[30] To arrive at our estimates, we begin with the Ontario "all industries" multipliers and adjust them based on the national fiscal multipliers. We further adjust them based on the household savings rate in Ontario compared to the rest of Canada.

To each set of industry multipliers in our model we add baseline data on the industry's real GDP (in 2015 dollars), employment and reported GHG emissions.[31] The GHG data come from Environment Canada's Greenhouse Gas Emissions Reporting Program, which collects data on all Ontario facilities that emit more than 10,000 tonnes of CO_2e.[32] Data for 2015 are used in all cases because it is the latest year for which comparable figures are available.

For each scenario, we estimate total carbon pricing revenues (and therefore total spending) for 2020. For the cap-and-trade scenario, we divide the average of the Climate Change Action Plan's low and high spending estimates over the length of the plan and adjust for inflation to arrive at $1.6 billion in real 2015 dollars. For the carbon tax scenario, we use the total revenue outputs from Dave Sawyer's analysis (adjusted for inflation) to arrive at $2.7 billion in real 2015 dollars. Sawyer uses a General Equilibrium Emissions Model that makes a number of assumptions about how households and businesses will respond to carbon pricing, so those assumptions are incorporated into our model.

For the cap-and-trade scenario, each spending item in the CCAP is assigned an industry from the input-output model. For example, the expansion of regional rail is coded as BS23C1 (Transportation engineering construction). We limit each line item to a single industry, which is a limitation of the model, but the lack of specificity in the plan itself is a more significant barrier to greater precision.

For the revenue-neutral carbon tax scenario, the economic impact of a personal income tax reduction is estimated through the personal income tax multiplier described above.

Total spending in each industry is run through the assigned multipliers to generate the impact on Ontario's real GDP, government revenue and number of jobs in each industry in the year 2020. Outputs are added together to determine the total positive impact of revenue recycling in each scenario.

Estimating the negative economic impacts of carbon pricing in each scenario is a two-step process. First, we use the GHG reporting data to identify total CO_2e emissions from each industry. For example, major emitters in the manufacturing sector accounted for 18% of all emissions in Ontario in 2015, so we assume initially that the sector will bear the cost (either directly or indirectly) of 18% of carbon pricing revenues.

However, in neither carbon pricing scenario do major emitters face the full carbon price, so a second step is required. To gauge free allowances under the cap-and-trade system, we estimate only 7% of emissions from heavy industry will be covered in 2020 (reflecting the 4.57% annual phase-out of certain free allowances). Energy distributors are exempt from free allowances, so they pay the full price for their emissions in the model. In the carbon tax scenario, we estimate 30% of industrial emissions will be covered by the tax (reflecting an emissions-intensity performance standard set at 70% of average industrial emissions).

Once major emitters are accounted for, the remainder of carbon pricing revenues are assigned to the "all industries" category. In other words, most of the cost of carbon pricing (roughly 93%) is distributed relatively evenly throughout all sectors of the economy in either scenario.

The total cost of carbon pricing in each industry is run through the assigned multipliers to generate the impact on Ontario's real GDP, government revenue and number of jobs in each industry. Outputs are added together to determine the total negative impact of carbon pricing in each scenario.

The negative subtotals are subtracted from the positive subtotals to determine net economic impacts in the year 2020. These sums are divided by the baseline totals for real GDP, employment and government revenues to calculate the percentage change under each scenario.

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