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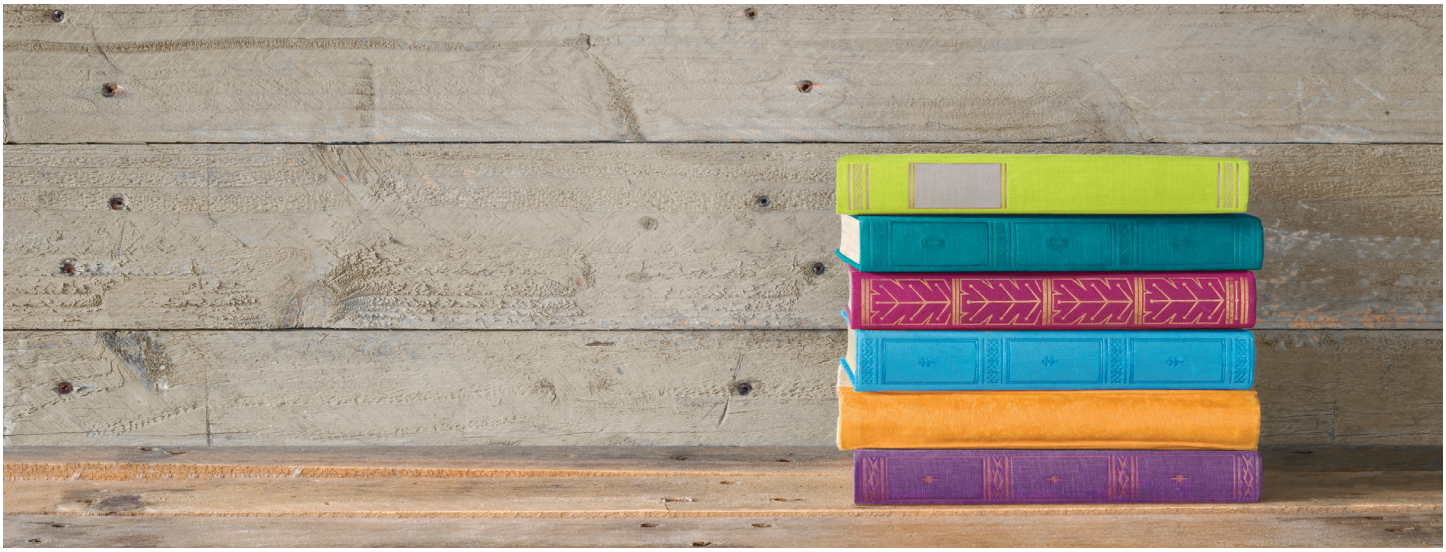
Options and Trade-offs in Recycling Carbon Pricing Revenues

April 2016



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EXECUTIVE SUMMARY

The primary objective of carbon pricing is to reduce greenhouse gas (GHG) emissions. A carbon price creates financial incentives for businesses and households to adjust their current consumption and investment patterns, and also to adopt and develop cleaner technologies in the future.

But the price is only half the story. Carbon pricing policies can generate substantial revenue for the provincial governments involved. How this revenue is recycled back to the economy has important implications for both economic and environmental performance.

Carbon pricing gives governments choices around revenue use

Carbon pricing revenue presents governments with many options, but also with the need to choose among them. With only a limited amount available, any revenue used for one option means less is available for others. Should revenue be used to reduce existing tax rates? Should it be transferred directly to households? Should it be used to address transitional challenges from pricing carbon, such as industrial competitiveness? Should it be used to invest in government priorities such as infrastructure, clean technology, or debt reduction? Or should it be used for multiple purposes to achieve multiple objectives?

These choices and trade-offs apply for any government implementing carbon pricing. This report, however, focuses on revenue recycling by Canada's provincial governments, which are currently moving forward with carbon pricing. Even if the federal government were to implement carbon pricing in the future, pragmatism may well require revenue to be returned to the province in which it was generated, thus placing the focus back onto the provincial use of revenues.

There isn't a single right answer to the question of how a province can best recycle its revenue. Different stakeholders have diverse perspectives. And each province has its own unique circumstances and context. Carbon pricing thus creates an opportunity for provinces to customize policy according to their own priorities and an opportunity to carve out broad support for smart policy to reduce GHG emissions.

This report develops a framework for governments examining how to recycle their carbon pricing revenues. Its goal is to consider the leading options for governments in recycling this revenue, the trade-offs among different recycling options, and how the specific economic context of different provinces will likely influence their ultimate choices. Four main conclusions emerge from our research.

Carbon pricing is the way forward for Canada, but it generates two clear challenges

As we argued in *The Way Forward*, carbon pricing makes economic sense for Canadian provinces. It reduces GHG emissions at the lowest possible cost, contributing to global efforts to avoid costly impacts of climate change. Carbon pricing can also help position Canada to better compete in carbon-constrained international markets by sparking low-carbon innovation. Finally, by representing a transparent and credible climate policy, and one known to be effective, carbon pricing may help to secure crucial market access for our abundant and valuable natural resources.

At the same time, however, carbon pricing by Canadian provinces poses two clear challenges. The first is related to the fact that carbon pricing invariably leads to changes in product prices. In particular, the price of carbon-intensive energy will increase. Since it is usual that lower-income households spend a higher fraction of their income on energy-related products than do households with higher incomes, carbon pricing has the potential to be regressive and thus unfair. While carbon pricing is not necessarily regressive, this possibility is more likely in provinces with electricity-generation systems based on the burning of coal and other fossil fuels (Canada's Ecofiscal Commission, 2016). When designing carbon pricing policies, provincial governments must pay close attention to the different impacts on households of different incomes.

The second challenge follows from the fact that different jurisdictions are not equally far down the road of carbon pricing, and differences between carbon prices across jurisdictions can create problems. Specifically, a more aggressive carbon pricing policy in any one Canadian province can lead to competitiveness pressures for businesses in that province, especially ones that are both emissions intensive and actively competing with firms from jurisdictions with a lower carbon price (Canada's Ecofiscal Commission, 2015a). Provinces must therefore be mindful of carbon policies in other jurisdictions—including other provinces—when designing their own carbon pricing policies. And governments must also begin considering how to coordinate provincial policies into a coherent pan-Canadian carbon price.

Revenue recycling can address fairness and competitiveness challenges

Yet these two challenges need not be obstacles to designing and implementing carbon pricing policies. In particular, well-designed policy—which includes the careful recycling of revenue—can effectively address both challenges.

Providing low-income households with direct transfers—as British Columbia does through rebates delivered in parallel with GST rebates, for example—can address fairness concerns while still providing low-income households with an incentive to reduce emissions. Indeed, analysis of B.C.'s carbon tax suggests that when the tax and associated revenue recycling (including tax cuts and transfers to households) are considered together, the policy is actually progressive, meaning low-income households face a smaller proportionate burden than higher-income households (Beck et al., 2015).

Similarly, for those industries most exposed to competitiveness pressures, the provision of well-designed transitional support can combine incentives to reduce GHG emissions with incentives to maintain economic activity in the home province. Specifically, support that is linked to firms' current level of activity can offset any incentives to move facilities to other jurisdictions with lower carbon prices, without undermining incentives for reducing emissions. In this way, carbon pricing within any one province need not lead to the "leakage" of economic activity and corresponding emissions.

Revenue recycling can also support economic and environmental objectives

The analysis in this report shows how carbon pricing can reduce GHG emissions without adversely affecting the economy, no matter what approach governments take to recycling revenue. Yet revenue recycling can also support both environmental and economic objectives.

Some approaches to revenue recycling can generate significant economic benefits. Reducing existing income taxes, for example, can improve how efficiently the economy uses labour and capital, and this can lead to greater productivity and stronger economic growth. Well-chosen investments in public infrastructure can also improve productivity, again driving growth and prosperity. For provinces with high levels of public debt, using revenue to reduce debt could lead to long-term economic benefits, partly by avoiding the need for future increases in growth-retarding income taxes.

Other approaches to revenue recycling can lead to reductions in GHG emissions, beyond those generated by the carbon price. Such reductions could be achieved by using carbon revenue to invest in research and development related to new technologies and production processes; or the funds could be invested to improve the adoption of superior technologies. These approaches can complement an existing carbon price by targeting specific barriers and easing firms' adjustment to the carbon price.

Provinces can customize revenue recycling to achieve their own distinct priorities

This report further explores the provincial differences we first considered in *The Way Forward*. These differences—in economic structure, energy mixes, and policy context—provide provinces with a strong justification for designing and implementing their own carbon pricing policies. Revenue recycling is an opportunity to tailor carbon pricing policy to a province's unique circumstances.

Some provinces are more exposed to competitiveness pressures created by carbon pricing (e.g., Alberta and Saskatchewan). Fairness concerns are heightened in provinces with carbon-intensive electricity systems (e.g., Alberta and Nova Scotia). Some provinces have much higher provincial debt (e.g., Quebec and Ontario), while others face more immediate fiscal challenges (e.g., Alberta). Still others have economic challenges associated with high income-tax rates (e.g., Quebec and Nova Scotia). Additional investments in emissions-reducing technology can make it possible to achieve ambitious targets (e.g., British Columbia and Ontario); technology investments could also be justified to improve the long-term performance of emissions-intensive sectors (e.g., Alberta and B.C.).

How should provinces manage these trade-offs? In this report, we do not provide detailed, prescriptive recommendations to provinces: each one is best situated to make its own choices about revenue recycling. Instead, we provide broader guidance on the factors that policymakers should examine when considering trade-offs and making revenue-recycling choices.

Our recommendations are as follows:

RECOMMENDATION #1: Governments should use revenue recycling to address fairness and competitiveness concerns around carbon pricing.

Carbon pricing is the economically sensible way forward for Canadian provinces. Challenges associated with pricing carbon—disproportionate costs for low-income households and competitiveness pressures for vulnerable industries—should not preclude implementing carbon pricing policies. These issues can be effectively addressed through well-designed revenue recycling. Our earlier recommendations therefore still hold: provinces without broad carbon pricing should implement it; provinces with existing policies should gradually increase the carbon price.

RECOMMENDATION #2: Governments should clearly define their objectives for revenue recycling.

Achieving multiple objectives usually requires multiple policy instruments. Pricing carbon has the primary objective of reducing GHG emissions, but the associated revenue can be recycled to achieve additional objectives. Different provinces will have different objectives, depending on their unique provincial context and priorities.

Given that only a finite level of revenue will be available for each province, not all objectives can be achieved through the recycling of carbon pricing revenue. Governments must always confront the reality of scarcity; the need to make difficult choices is the nature of their business. Identifying the government's priorities is a crucial first step in defining appropriate province-specific approaches to revenue recycling.

Not only are there multiple objectives, there are multiple approaches to revenue recycling. Yet no single revenue-recycling approach is a clear winner across all dimensions and for all provinces. Optimal revenue recycling within any province will depend on the relative weights placed on the different objectives, and these weights will naturally depend on the provincial context.

RECOMMENDATION #3: Governments should use a portfolio of approaches to revenue recycling.

Genuine trade-offs exist across the different approaches to revenue recycling. No single approach examined here can improve household fairness, address business competitiveness, and improve broad economic and environmental performance as well. Some methods of recycling are good for economic growth but have little effect on GHG emissions; other approaches are good for addressing household fairness but do not help to protect business competitiveness. Still others successfully address the competitiveness issue but weaken the reductions in GHG emissions. Multiple priorities can justify multiple approaches to revenue recycling.

At the same time, achieving more along one dimension invariably means achieving less along another. Further, the scale of revenue recycling matters, particularly for some approaches. Significant benefits from infrastructure or clean-technology investments, for example, are only likely to be realized through larger investments.

Using only a small percentage of carbon revenue to reduce taxes could lead to imperceptible changes in tax rates. As a result, prioritization is critical. Governments cannot expect to achieve all objectives using carbon revenue.

Provincial priorities will naturally vary. Choosing priorities is the task of governments, and beyond the mandate of the Ecofiscal Commission. However, our analysis of the various recycling options, when combined with the various provincial contexts, allows us to identify the possible higher, moderate, and lower priorities for each of five Canadian provinces. These assessments are shown in the table below.

Possible Revenue-Recycling Priorities for Five Canadian Provinces

	British Columbia	Alberta	Ontario	Quebec	Nova Scotia
Household Transfers	Moderate priority	Higher priority	Lower priority	Lower priority	Higher priority
Personal and Corporate Income-Tax Cuts	Lower priority	Lower priority	Lower priority	Higher priority	Higher priority
Investments in Low-Carbon Technology	Higher priority	Higher priority	Higher priority	Moderate priority	Moderate priority
Investments in Infrastructure	Moderate priority	Moderate priority	Moderate priority	Higher priority	Moderate priority
Reduction of Public Debt	Lower priority	Lower priority	Moderate priority	Moderate priority	Lower priority
Transitional Support to Industry	Moderate priority	Higher priority	Lower priority	Lower priority	Moderate priority

RECOMMENDATION #4: Revenue-recycling priorities should be adjusted over time.

Provincial priorities generally change over time, and revenue-recycling approaches should similarly evolve. Some changes in circumstances will be predictable, while others will be unexpected. Like other fiscal decisions, revenue-recycling choices can and should be revisited periodically.

Competitiveness pressures, for example, will predictably change over time. In the long term, other jurisdictions will begin to implement comparable carbon policies to achieve their own international obligations. As a result, comparable carbon prices will lead to a level playing field in international markets, thus reducing the need for provinces to provide transitional support to industries.

In the longer term, total revenue from carbon pricing will eventually begin to decline. As emitters respond to the price by finding ways to reduce their GHG emissions, the revenue base for the carbon pricing policy will decline (whereas in the short term, the price of carbon will likely rise by a greater proportion than the decline in total emissions). Revenue-recycling decisions must account for this long-term change in total carbon revenues.

In selecting their approach to revenue recycling, provincial governments should consider carefully the trade-offs of each available option. This report provides a framework with which to do so. We all stand to benefit when our provincial governments choose wisely.

CONTENTS

1 INTRODUCTION

The primary objective of carbon pricing is to reduce greenhouse gas (GHG) emissions.

Carbon pricing creates financial incentives for households and businesses to adjust their current consumption, production, and investment patterns, and also to adopt and develop new and less GHG-emitting technologies in the future.

At the same time, carbon pricing policies—whether through a carbon tax, a cap-and-trade system, or a hybrid of the two—can generate substantial revenue for the provincial governments involved. The revenue provides governments with many options, but also with the need to choose among them. Revenue can be used to improve overall economic or environmental performance. It can also be used to address two key challenges sometimes seen as barriers to carbon pricing: household fairness and business competitiveness.

Governments will face difficult trade-offs when planning how to "recycle" these revenues back to the economy. The revenue generated by pricing carbon emissions is not unlimited, and thus it cannot be used to achieve all the objectives of a particular government. More revenue used to pursue one objective means less revenue available for pursuing others. As usual, governments need to establish their priorities.

This report develops a framework for governments examining how best to recycle their carbon pricing revenues. We examine some leading options for revenue recycling and discuss how well each one achieves several likely government objectives. We then apply this framework to the current economic context in five Canadian provinces to demonstrate how provincial governments can customize revenue recycling to fit their own circumstances.

This report is structured as follows. Section 2 identifies the likely scale of carbon pricing revenues in each province, given recent levels of GHG emissions. It then briefly reviews the two key challenges raised by carbon pricing: household fairness and business competitiveness. It also examines other economic and environmental objectives that might be pursued. Finally, the section closes by providing a set of five criteria with which various recycling options can be evaluated.

Six options for revenue recycling are reviewed in Section 3: providing transfers to households; reducing provincial income taxes; investing in the development of low-carbon technologies; investing in public infrastructure; reducing public debt; and providing transitional support to industry. Drawing on the research contained in specially commissioned position papers, we consider the advantages and disadvantages of these options in terms of our five evaluation criteria.

In Section 4, we continue to compare trade-offs across various approaches to revenue recycling by exploring new analyses developed specifically for this report. We use new economic modelling to examine the implications of different recycling options for GHG emissions, the impact on provincial income (as measured by GDP), the effects on business competitiveness, and the impact on household budgets. Our discussion also draws on new polling research showing how different recycling approaches might affect overall public support for carbon pricing policies.

In Section 5, we examine the economic and policy contexts of five Canadian provinces—British Columbia, Alberta, Ontario, Quebec, and Nova Scotia. These provinces illustrate the variation in provincial contexts across Canada in terms of size, economic structure, existing policy, and emissions profiles. For each province, with its own unique context, we examine the trade-offs of the various options for revenue recycling. We identify the likely higher-priority and lower-priority recycling options for each of the five provinces.

Section 6 concludes with a summary of our main findings and policy recommendations for Canadian provinces.

2 THE IMPORTANCE OF REVENUE RECYCLING

Recycling the revenue generated by a carbon pricing policy provides an opportunity to address specific challenges created by the policy, such as household fairness and business competitiveness, as well as an opportunity to improve economic and environmental outcomes more broadly.

Given the scale of revenues that could be generated from such policies, recycling these revenues back to the economy could have significant impacts. Table 1 estimates the revenue that would be generated in each province if GHG emissions from fossil fuel combustion in 2013 were covered by a carbon price of $30/tonne—a policy similar in stringency and coverage to British Columbia's current carbon tax.

Table 1: Estimated Provincial Carbon Pricing Revenue at $30/tonne Based on 2013 GHG Emissions

	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL
GHG emissions in 2013 (Mt CO_2e)	62.8	267.0	74.8	21.4	171.0	82.6	15.7	18.3	1.8	8.6
Share of emissions from stationary sources and transportation	74.7%	73.5%	61.9%	58.5%	75.8%	70.8%	82.1%	89.7%	72.7%	82.6%
Total provincial government revenue (CAD millions)	$1,407	$5,886	$1,389	$375	$3,888	$1,755	$387	$493	$39	$213
Carbon revenue as a share of government revenues in 2013-14	3%	13%	10%	3%	3%	2%	5%	6%	2%	3%

The carbon pricing revenues shown here assume that a $30/tonne carbon price is applied to 2013 provincial GHG combustion emissions. Including process emissions from large emitters (as per Quebec's and Ontario's cap-and-trade system) would increase coverage and revenue. Note that revenue is based on fiscal years, while emissions are based on calendar years.

Sources: Environment Canada, 2015; Department of Finance Canada, 2015.

These revenue estimates should be viewed as an upper bound of the annual revenues that would actually be generated. By raising the prices of carbon-intensive products, the carbon price would lead businesses and households to adjust their consumption and production patterns, thereby reducing GHG emissions. This is especially true over time. However, if provinces gradually raise their carbon prices in the years ahead, the revenue generated each year will increase. Especially for the first several years of the policy, the percentage increase in the carbon price would almost certainly exceed the percentage decline in emissions, thus increasing the overall carbon pricing revenue.[1]

2.1 MAKING CARBON PRICING POLICY FAIR

In a separate report on carbon pricing and household fairness, we explore the distributional impacts of carbon pricing policies on Canadian households (Canada's Ecofiscal Commission, 2016). We demonstrate that ensuring fairness in carbon pricing—so that it does not impose disproportionate costs on low-income households—is both an important and achievable objective. The following is a brief summary of our major findings.

Fairness concerns around carbon pricing should not be overstated

Households bear the costs of carbon prices in different ways, with different implications for fairness. A carbon price increases the cost of fossil fuels based on their carbon content, fuels used directly by households for transportation and home heating, such as gasoline and natural gas. A carbon price also creates indirect costs for households when prices of other goods increase based on the carbon emissions embedded in their supply chain, such as electricity generated by burning coal or natural gas, or costs of transportation for various inputs to the production process. In both cases, the change in price is precisely the point of the policy; it makes carbon-intensive products relatively more expensive, thereby creating incentives for consumers to switch to lower-carbon alternatives. These costs can present a problem in terms of fairness, however, because carbon costs tend to be a larger fraction of income for lower-income households than they are for higher-income households. That is, carbon pricing tends to be "regressive" when considering only the impact on the price of goods that households consume.

Carbon pricing might also lead to reductions in employment or investment income. If firms are unable to pass their carbon costs on to consumers in the form of higher prices for the goods and services they sell, there must be a negative impact on either profits or wages, or both. Lower wages mean less employment income for households; lower profits mean lower investment returns for owners (who are also households). These two sources of income matter most for higher-income households, meaning this effect reduces (or may even eliminate) the regressivity of carbon pricing (Dissou & Siddiqui, 2014). Beck et al. (2015), for example, find that when the effects on prices and incomes are considered together, British Columbia's carbon tax is progressive, meaning the impact is smaller for lower-income households than it is for higher-income ones. And this result applies to the impact of the policy before considering how the carbon pricing revenue is recycled.

Our empirical analysis finds that a $30/tonne carbon price in Canadian provinces creates very small carbon costs for households. Across different provinces and households of different incomes, the carbon cost is at most 2.1% of household income, and for most provinces and income groups it is less than 1%. Our analysis also shows carbon pricing to be mildly regressive, depending on the precise metric used. As we discuss below, however, whatever negative impacts do occur can be addressed through well-designed revenue recycling.

Fairness concerns vary across provinces

Both the overall household costs from carbon pricing and the distribution of these costs across households can differ between provinces. Two main factors matter in this regard. First, carbon pricing tends to generate larger household costs in the most emissions-intensive provinces; in these provinces, the carbon pricing either raises prices more or reduces income more than in those provinces that are less emissions intensive. Second, carbon pricing tends to be the most regressive in provinces that rely most heavily on coal-fired electricity; this is because lower-income households spend a larger fraction of their income on electricity-using products, whose prices rise the most in provinces with carbon-intensive electricity systems.

[1] For example, if the carbon price increases over the first decade from $30/tonne to $50/tonne, this is a 67% increase in price. As long as the percentage decline in GHG emissions is smaller than 67% over this period (as it almost surely would be), the total carbon pricing revenues would increase. As time progresses, the annual percentage increase in the carbon price will likely get smaller, while the annual percentage decline in emissions is more likely to increase. At some point in the future, therefore, overall carbon pricing revenues will level off and then begin to decline. But at least for the first several years of the policy, any province's carbon pricing revenues can be expected to increase each year.

Box 1: Can there be a "carbon advantage"?

This section of the report focuses on competitiveness pressures created by carbon pricing, but it is also important to recognize the opportunities for creating "carbon advantages" for Canadian firms.

As other jurisdictions implement their own ecofiscal policies, the global market for low-carbon innovations naturally grows. Implementing carbon pricing policies will make some domestic firms better positioned to compete in this emerging low-carbon global economy (NRTEE, 2012).

Advantages arise in several different ways. The most direct are from carbon-reducing sectors. Research by McKinsey & Company (2012), for example, suggests that Canadian firms could have increasingly valuable competitive advantages in sustainable resource development, carbon capture and storage, uranium mining and processing, and hydroelectricity expertise.

Competitive advantages could also come from those firms and industries better positioned to compete under carbon constraints as a result of their lower emissions intensity. One modelling analysis for Ontario, for example, finds that its electricity, pulp and paper, and food manufacturing sectors could have a carbon advantage relative to North American competitors in a carbon-constrained market (Sawyer, 2013).

Revenue recycling can ensure carbon policy is not regressive

Even if a carbon price on its own is regressive, the specifics of how the associated revenue is recycled will affect the overall fairness of the policy. If carefully designed, the carbon price and the revenue recycling can *together* be progressive.

Various approaches to revenue recycling can improve the policy's fairness. For example, to offset all or part of the carbon costs to lower-income households, provincial governments could provide tax-free quarterly payments, similar to the federal government's GST/HST tax credits. Other recycling options include income-tax cuts targeted at lower-income households or eliminating other provincial taxes. Our analysis in Section 4 suggests that less than 5% of provincial carbon pricing revenue would be required to fully offset the carbon costs for all households in the lowest income quintile, and less than 13% would be needed to do the same for all households in the lowest two income quintiles.

The impact of carbon pricing is similar for rural and urban areas

Other dimensions of fairness are also important to consider, including the incidence of carbon pricing on households residing in rural or small urban areas. Though perhaps surprisingly, our analysis suggests that household carbon costs do not vary significantly between households residing in large urban centres and those residing in small rural communities. However, to the extent that such different geographic impacts are an issue for a particular province, targeted transfers to households living in smaller or northern communities could easily be used to address this issue (Canada's Ecofiscal Commission, 2016).

2.2 ADDRESSING CHALLENGES OF BUSINESS COMPETITIVENESS

Despite the progress made at the UN climate summit in Paris in December 2015, the path toward global climate policy remains uneven. Though achieving significant reductions in global GHG emissions is now an objective formally shared by all countries, not all of them will implement carbon policy at the same pace or stringency. During this period of "uneven" policy adoption, Canadian provinces implementing carbon pricing may have more-stringent policies than other jurisdictions, and these policy differences may create pressures for business competitiveness.

We explore such competitiveness pressures in detail in a separate report (Canada's Ecofiscal Commission, 2015a). In short, we find that competitiveness issues should not be ignored; but neither should they preclude policymakers in Canada's provinces from

implementing carbon pricing policies. Well-designed policies can address the competitiveness challenge. Box 1 addresses the possibility that carbon pricing can also create advantages for some Canadian firms and industries.

Competitiveness pressures result from higher carbon prices domestically than abroad

Competitiveness pressures can arise when there is a higher carbon price in one Canadian province than in other jurisdictions—either foreign or Canadian. In short, these pressures come from carbon-price *differentials* between trading partners, not the absolute level of the carbon price. Under a uniform global carbon price, for example, there would be no competitive disadvantage between Canadian and foreign firms *caused by the carbon price*.[2]

Carbon-price differentials have both economic and environmental implications. Provinces with higher carbon prices might see some current or future production and investment move toward jurisdictions with weaker policy. In such cases, the result would be lost economic activity in the home jurisdiction. *Leakage* is the environmental side of the same coin. If the economic activity simply relocated to other jurisdictions and led to carbon emissions identical (or even larger) to what existed in the home jurisdiction, Canadian provinces would bear the economic costs of lost production or investment with no decline in global GHG emissions; from a global perspective, domestic carbon pricing would be pointless.

Competitiveness pressures are only significant for some emitters

Studies estimating the overall impacts of carbon pricing on business competitiveness—for proposed as well as historical policies in the European Union, the United States, and Canada—tend to find only small implications for the economy (e.g., Quirion & Hourcade, 2004; Aldy & Pizer, 2009; Reinaud, 2009; Barker et al., 2009; Morgenstern et al., 2007; NRTEE, 2009). Only a few specific sectors of the economy tend to be vulnerable. In particular, vulnerable sectors are both *emissions intensive* (i.e., they produce more GHGs per unit of output and thus have higher carbon costs) and *trade exposed* (i.e., they actively compete against businesses in and from other jurisdictions). Evidence in Canada is only now emerging; see Box 2 for a brief examination of the possible impact of British Columbia's carbon tax on that province's cement sector.

[2] A uniform global carbon price would drive a global adjustment away from carbon-intensive activities and would involve important transitional costs. But these costs of structural adjustment to a low-carbon world are distinct from the competitiveness pressures we emphasize here.

Box 2: The cement sector and the carbon tax in British Columbia

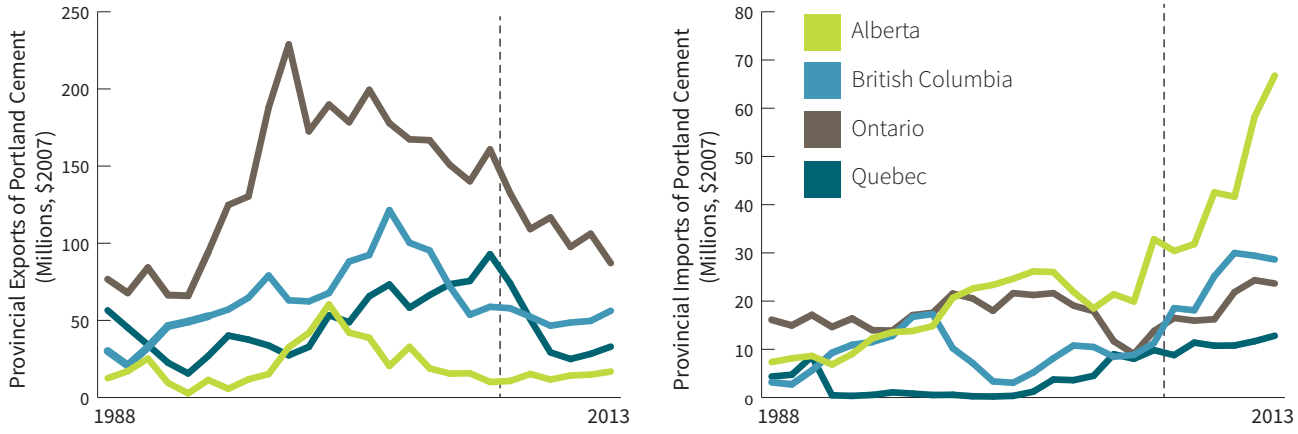
British Columbia's carbon tax provides an opportunity to compare the performance of vulnerable sectors in that province, especially as compared to the same sectors in provinces with lower carbon prices. B.C. introduced its carbon tax at $10/tonne in 2008, and by 2012, it was $30/tonne. Over the same period, Alberta, Ontario, and Quebec had either no or much lower carbon prices.

The cement sector is particularly emissions intensive owing to its production processes. It is also highly trade exposed, selling an undifferentiated product in international markets at prices largely beyond the influence of individual producers. These characteristics make B.C.'s cement sector a likely candidate to experience significant competitiveness challenges from that province's carbon tax.

If the B.C. carbon tax adversely affected the competitiveness of the local cement sector, two impacts would likely be evident in the data. First, imports of cement into the province would likely increase, since producers from outside the province (including those located in the state of Washington) could gain an advantage in the B.C. market. Second, cement exports from B.C. would decrease if the carbon price put local producers at a disadvantage relative to their out-of-province competitors.

The figures below compare imports and exports of Portland cement in four Canadian provinces. The dashed black line indicates the introduction of B.C.'s carbon tax in 2008.

Imports and Exports of Portland Cement in Four Canadian Provinces



Source: Statistics Canada, 2015b.

Exports are shown in the left-hand panel. B.C.'s cement exports did not decline after 2008, but instead were approximately constant for the next six years. In contrast, exports from Ontario and Quebec fell sharply after 2008, even though those provinces had carbon prices far below B.C.'s. These export data suggest that something other than carbon prices were driving the performance of Canadian cement exports.

Imports of cement are shown in the right-hand panel. B.C.'s cement imports did increase significantly after 2008. But so did cement imports into each of the other three provinces; Quebec's imports rose slightly, Ontario's increased roughly in line with B.C.'s, and Alberta's imports more than doubled. These patterns suggest that other

Box 2 continued

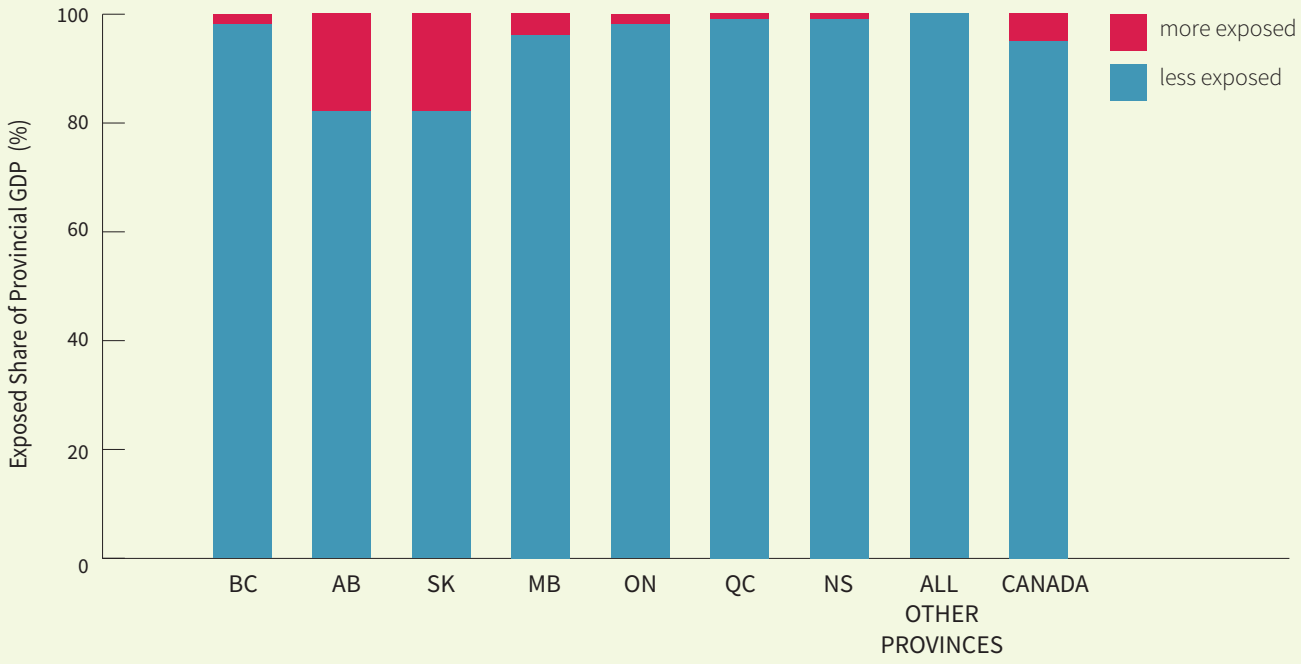
factors common across all provinces likely played a more important role than did the differences in carbon prices. Note also that in all four provinces, the increase in imports begins before the introduction of B.C.'s carbon tax.

This analysis is only preliminary, and does not account for the many possible factors that could explain the dynamics of cement imports and exports, such as the Canada–U.S. exchange rate, the overall level of business investment, or public spending on infrastructure. The data nonetheless suggest the difficulty in drawing a prima facie connection between B.C.'s carbon tax and that province's cement sector. Given the many factors that influence business competitiveness, the absence of a clear connection is perhaps unsurprising (Canada's Ecofiscal Commission, 2015a).

Competitiveness pressures vary significantly across provinces

Using a detailed sector-level economic model of provincial output and GHG emissions, we have assessed the vulnerability of different sectors in each province to the competitiveness pressures created by a $30/tonne provincial carbon price (Canada's Ecofiscal Commission, 2015a). This analysis identifies a sector as "more exposed" if its carbon cost is more than 5% of its GDP and its trade exposure is greater than 15%.[3] Figure 1 shows the share of provincial GDP coming from sectors deemed to be more exposed.

Figure 1: The Scale of Competitiveness Pressures for Canadian Provinces, 2015



The red part of each bar shows the share of GDP in each province coming from sectors with a carbon cost greater than 5% of GDP and a trade exposure greater than 15%. Based on a carbon price of $30/tonne of GHG emissions.

Source: Canada's Ecofiscal Commission and Navius Research.

[3] We consider a sector's carbon costs (assuming a $30/tonne carbon price) as a share of its GDP. Trade exposure for each sector is measured as the sum of imports and exports divided by the sum of production and imports. A sector with no exports or imports has a trade exposure equal to 0; a sector that exports all its output and has no imports has a trade exposure equal to 1. The thresholds used here (5% for carbon cost and 15% for trade exposure) parallel those in the U.S. Clean Energy and Security Act (H.R. 2454), proposed in 2009 (Western Climate Initiative, 2009).

The economic implications of competitiveness pressures are quite small for the country overall. Only 5% of the Canadian economy is more exposed as a result of carbon pricing. In fact, in most provinces, considerably less than 5% of economic activity is exposed to competitiveness pressures. The main reason for the lack of carbon exposure is that services and non-traded goods, both of which have very low carbon intensities, represent a huge share of modern, developed economies.

But there are notable differences across provinces. Alberta and Saskatchewan, in particular, have significant parts of their economies exposed to these competitiveness pressures; in both cases, 18% of provincial GDP is produced in sectors deemed to be more exposed.

Part of the explanation for the differences across provinces is the large differences in electricity systems. Provinces with low-carbon electricity generation—including those relying heavily on hydro power, such as British Columbia, Manitoba, Ontario, and Quebec—have much lower emissions and thus much lower carbon costs. Part of the explanation comes from different economic structures. Emissions-intensive industries make up a larger share of some provincial economies; Alberta and Saskatchewan, in particular, have large oil and gas sectors, emissions-intensive electricity generation, and significant chemical manufacturing sectors, and so their economies show greater vulnerability. And part of the explanation is policy. Some provinces have already implemented policies to reduce emissions intensity, such as B.C.'s carbon tax and Ontario's phase-out of its coal-fired electricity generators.

Our modelling exercise also shows that the scale of the overall competitiveness pressures is relatively insensitive to changes in the assumed carbon price. The share of the economy more exposed increases only modestly as this price increases. At $60/tonne, 7% of the economy is more exposed; at $90/tonne, 8% is more exposed; at $120/tonne, the exposure is around 10% of Canadian GDP.

Revenue recycling can address the competitiveness challenge

Design choices—and in particular, decisions around revenue recycling—can address concerns around competitiveness. It is possible to move forward on policy by providing support targeted at vulnerable firms and industries, particularly through free permits or rebates tied to production (Fischer & Fox, 2004, 2009a, 2009b; Rivers, 2010). In both cases, emitters still face economic incentives to reduce their GHG emissions, but have dampened incentives to reduce production or relocate their facilities to other jurisdictions.

Providing *transitional* support gives industrial emitters time to make necessary adjustments. But competitiveness pressures are likely to decline over time, as more jurisdictions implement carbon pricing, and as the market works by producing carbon-reducing innovation that emitters can adopt to reduce emissions at lower costs. Providing transitional support for vulnerable firms provides them with additional incentives to develop innovative solutions, but also limits the cost of providing this support.

We return to the issue of providing transitional support to vulnerable industries in sections 3 and 4.

2.3 IMPROVING THE ECONOMIC OR ENVIRONMENTAL PERFORMANCE OF CARBON PRICING

Suppose provincial governments use some part of their carbon pricing revenue to adequately address the challenges of household fairness and business competitiveness—but then still have some revenues left over. This is entirely possible, and perhaps even likely, given the probable scale of carbon pricing revenues we saw earlier in Table 1. In these situations, further recycling of revenues could be aimed at improving overall economic and environmental performance.

Revenue recycling can improve economic performance

The cost-effectiveness of carbon pricing policy is usually expressed in terms of the effect on overall economic activity (GDP) for achieving a given reduction in GHG emissions. As our modelling results show in *The Way Forward*, carbon pricing is a cost-effective climate policy, because its impact on GDP is less than what occurs when the same emissions reduction is achieved with the use of direct government regulations (Canada's Ecofiscal Commission, 2015b). But if the revenues from carbon pricing are recycled in specific ways, the overall impact on GDP can be reduced even further, thus improving the overall cost-effectiveness of the carbon pricing policy.

If revenue is recycled by reducing existing personal income-tax rates, for example, there would likely be positive impacts on labour supply and employment as well as, through this channel, economic activity. Reducing corporate income-tax rates would likely lead to greater private investment that, especially over time, would be expected to raise the growth rate of productivity and GDP (Parsons, 2008; IMF, 2015). And reducing sales taxes or payroll taxes could lead to similar positive economic impacts. Revenues could also be used to finance targeted investments in research and development or to finance critical public infrastructure; in both cases, wise choices by government could lead to improvements in overall productivity and growth.

Revenue recycling can improve environmental performance

Most of the environmental benefits of carbon pricing policy come from the carbon price itself, not the recycling of revenue. After all,

the main point of the carbon price is to adjust market incentives so that households and businesses change their behaviours in a way that reduces emissions and leads to the greater development and adoption of low-emissions technologies.

Yet carbon pricing revenues could be used to further improve environmental outcomes. If revenue is used to support further investments in emissions-reducing technology or in low-carbon infrastructure, it can drive additional emissions reductions, above and beyond those driven by the carbon price itself.

2.4 BROADENING SUPPORT FOR CARBON PRICING

Like any policy, carbon pricing is only practical if governments can successfully implement it. Revenue-recycling choices, however, can affect public attitudes for the policy, although admittedly in complex ways. Various parts of society have different preferred approaches for recycling revenue.

All the criteria discussed above interact with public attitudes. Ensuring that low-income households are not disadvantaged can improve acceptability, as can reducing business competitiveness pressures. The public may also look more favourably at policy that performs better—whether in terms of environmental or economic outcomes. The extent to which each of these factors matters more or less for public acceptability is often a function of the local provincial context. Still, *perceived* impacts may affect attitudes more than the impacts predicted by empirical studies.

Other factors also matter for public acceptability. In particular, the extent to which a revenue-recycling approach is transparent and understandable to the public can affect attitudes. Is the nature of the benefits from revenue recycling easily understood? And is it clear who is benefiting from the recycling? More transparency can improve acceptability.

Finally, it is not only implementing policy that matters, but also maintaining it over time. If future governments are likely to repeal a carbon pricing policy given public attitudes, the effectiveness of the price in changing emitters' behaviours is undermined. Revenue choices can affect the "durability" of the policy in the face of changes in the political winds.

2.5 SUMMARY: EVALUATION CRITERIA FOR REVENUE-RECYCLING OPTIONS

Carbon pricing can generate substantial provincial revenue for governments—revenue that provides many options. Revenue can be used to address challenges created directly by the carbon price, such as household fairness and business competitiveness. It can also be used to drive overall improvements in economic and environmental performance.

While carbon pricing will create new policy options for governments, it will also force governments to choose between these many options. Since the carbon pricing revenue will not be unlimited, the use of any revenue to pursue one objective means that less will be available to pursue others. Governments will therefore need to make difficult choices regarding how best to recycle this revenue, and understanding the associated trade-offs will be a crucial part of the process.

The objectives considered in this section provide five criteria for evaluating different options for revenue recycling, an evaluation that takes place in the next two sections of this report. Different recycling approaches perform better on some dimensions, but worse on others. To summarize, the five criteria are:

1. **Household Fairness.** Carbon pricing will raise the prices of carbon-intensive products and thereby affect household budgets; it may also reduce some household incomes. The impacts are unlikely to be evenly distributed across households. Some approaches to revenue recycling can offset these effects and improve the overall fairness of the policy.
2. **Business Competitiveness.** If Canadian provinces move ahead with more-stringent policy than have other jurisdictions, specific sectors of the economy might be exposed to competitiveness pressures. If domestic firms lose market share to international competitors, or relocate their production facilities, global GHG emissions may be unchanged even though domestic economic costs are incurred. Some forms of revenue recycling can effectively address this challenge.
3. **Economic Performance.** Given the probable scale of revenue generated by carbon pricing, some approaches to revenue recycling could have significant positive impacts on investment, productivity, and economic growth.
4. **Environmental Performance.** Some forms of revenue recycling could also lead to reductions in GHG emissions, beyond those associated with the carbon price itself.
5. **Public Acceptability.** Some forms of revenue recycling may garner more public support than others and thus make the overall implementation of the policy more feasible for government. In some ways, the first four criteria also affect acceptability: fair, low-cost, effective policy can improve public support. But transparency and durability are also key factors. We explore this issue more explicitly by considering new survey data on Canadian public opinion.

The next two sections explore different approaches to revenue recycling in terms of their relative performance across these five evaluation criteria.

3 APPROACHES TO REVENUE RECYCLING: THE CURRENT STATE OF KNOWLEDGE

Governments collect their revenues in many ways, and this revenue can be used to finance a wide variety of government programs and activities. For this reason, some commentators argue that carbon pricing revenues should simply be added to other government revenues, to be used for general purposes. From the perspective of this report, however, it is almost impossible to assess the costs and benefits of this approach. Instead, we consider several transparent, specific approaches to revenue recycling, and the costs and benefits associated with each.

Note that the available options for revenue recycling are independent of the specific carbon pricing instrument used by any provincial government. Whether a government chooses a carbon tax or a cap-and-trade system, revenue will be generated and will need to be recycled in some way.

Six key recycling options include:

1. Transferring revenue to households
2. Reducing existing tax rates
3. Investing in emissions-reducing innovation and technology
4. Investing in critical public infrastructure
5. Reducing government debt
6. Providing transitional support to industry

Any government could, of course, choose to use more than one of these options (or others not listed here). In this section, however, we examine each option separately. Each approach to recycling has different advantages and disadvantages; policymakers must consider these trade-offs carefully (Beck & Wigle, 2014).

Our discussion draws heavily on a series of position papers commissioned by the Ecofiscal Commission for the purposes of examining the benefits and costs of each recycling option (Lee, 2016; McKenzie, 2016; Osberg, 2016; Purdon et al., 2016; Partington & Sharpe, 2016; Wen, 2016). We focus here on why different approaches make the most sense in different contexts; see the papers themselves (at www.ecofiscal.ca/choosewisely) for more detail about how best to implement each of the recycling strategies.

3.1 TRANSFERRING REVENUE TO HOUSEHOLDS

Governments can give carbon pricing revenues directly back to individuals or households. These transfers could be distributed, for example, by issuing cheques of equal value to all residents of a province. If *all* revenue is recycled in this fashion, the policy amounts to what is often called a "carbon fee and dividend" (Osberg, 2016).

Providing households with such carbon dividends is probably the most economically neutral approach of recycling revenues. It neither

introduces new distortions nor removes existing ones from the economy. As a result, it will not drive additional emissions reductions, nor will it have substantial effects on labour supply or investment, or economic growth. Similarly, it will not directly alleviate any pressures on business competitiveness caused by the carbon price.

Transferring revenue to households is a progressive way of recycling revenue

In terms of household fairness, however, this approach holds significant advantages. The impact of a full carbon dividend is clear: households directly receive equal shares of the total carbon revenue. This approach is highly progressive, because dividend payments would make up a proportionally larger share of income for lower-income households.

A less extreme option along the same lines is to use a *portion* of revenue to provide more targeted transfers—but only to lower-income households. In this way, the transfers could eliminate the regressive direct impact of the carbon pricing policy. Rivers (2012) finds in the Canadian context that less than 10% of revenue from a $30/tonne carbon price would be required to avoid regressive impacts for the lowest-income households.

Finally, as Osberg (2016) argues, transferring revenue to individuals or households may also be fair in the broader sense that all individuals have equal ownership of the atmosphere; therefore, each should be compensated equally for emissions added to it, as long as each also pays for their own emissions.

Direct transfers to households may create a clear constituency for carbon pricing

Osberg (2016) also argues that using carbon pricing revenues to provide transfers to all households puts the focus of the policy on "good news." Regular cheques would be highly visible with clear and concrete benefits; the simplicity of this recycling approach, which can be easily communicated, is also an important benefit. Still, transfers do not necessarily improve public support. Harrison (2013) notes that British Columbia's "Climate Action Dividend," a one-time $100 transfer to B.C. residents, was "depicted as a cynical ploy to buy voters' support" and may also have distracted attention from income-tax reductions.

An approach in which *all* revenue is transferred to households is also highly transparent: carbon dividends are obviously a direct function of the carbon tax. Without the carbon price, the transfers would not exist. Such an approach is also explicitly revenue neutral for the provincial government. It does not lead to changes in the scale of government and could ameliorate concerns that governments will simply use carbon pricing as another means of expanding their size and reach.

3.2 REDUCING INCOME TAXES

Governments could recycle revenues by reducing personal or corporate income taxes. Under this approach, the carbon pricing policy would be a tax shift without a net increase in the overall tax burden. This approach is used with British Columbia's carbon tax, in combination with targeted transfers to low-income and rural households. Note that although our focus in this report is on reducing income taxes, similar arguments could be made for reducing sales or payroll taxes (Climate Leadership Team, 2015).

Reducing existing taxes is quite different from making direct transfers to households because of what economists call the "distortionary" effects of taxation. A direct transfer gives money to a household in a non-distortionary way—independent of its expenditure or income or work effort, and in a way that does not alter the relative prices faced by the household. In contrast, reductions in taxes (whether personal or corporate income taxes, or sales or payroll taxes) tend to change the relative prices and incentives faced by households and businesses, and thus lead to important changes in behaviour.

Tax reductions can be regressive

Using carbon pricing revenue to cut personal income-tax rates across the board would tend to make the policy *more* regressive. The benefits of these cuts would tend to be concentrated in households with higher incomes, which currently pay more income tax. The cuts in income-tax rates could be designed to be progressive, with larger rate reductions in the lower income-tax brackets, but because the households with the very lowest incomes pay no income tax at all, this approach may still end up being regressive (if not accompanied by other policies to address the regressivity, such as refundable tax credits).

Corporate income-tax cuts could lead to higher wages and profits, but the implications for fairness are unclear. Given that higher-income Canadians receive a greater share of their income from investments than do lower-income households, cuts to corporate tax rates could also exacerbate regressivity (Canada's Ecofiscal Commission, 2016). On the other hand, the longer-run result of corporate income-tax cuts is likely to include greater investment and productivity, both of which are likely to raise wages and other employment income.

Corporate tax reductions can address some competitiveness concerns

Reducing corporate income-tax rates across the board would stimulate investment and innovation for all firms and industries, and thus would improve competitiveness for all firms. But such an approach to revenue recycling would not be targeted to those specific firms and sectors most affected by the carbon pricing policy. As a result of being less targeted, general corporate tax cuts are not the most effective means for addressing these carbon competitiveness pressures.

Tax reductions are likely to improve economic growth

The core argument for using carbon pricing revenue to reduce existing income taxes (either personal or corporate) is the economic benefits that follow from such tax reductions. Income taxes affect behaviour by changing incentives. Lower personal income taxes provide incentives for greater work effort and greater saving, both of which influence long-run growth. Lower corporate income taxes provide incentives for more investment and innovation, which also drive long-run growth. Of all approaches to revenue recycling, reducing personal and business income taxes is likely to be the one most likely to improve productivity and economic growth (McKenzie, 2016).

Tax reductions are unlikely to affect GHG emissions significantly

Recycling revenue by reducing personal and corporate income taxes will likely stimulate consumption, production, and investment. Some of this increased economic activity will be associated with greater GHG emissions. But the carbon price itself provides a powerful economic and financial incentive for all new growth to be "cleaner"—expenditure on goods and services that are less emitting, and production of goods and services that rely on low-emitting energy sources and other inputs.

So, while we can confidently predict that the carbon pricing policy will lead to overall reductions in GHG emissions, especially over time, it is difficult to know how the cuts to income taxes, taken alone, would impact GHG emissions.

Cutting taxes can improve public support

British Columbia's experience offers insight on the public acceptance of tax reductions. The province's carbon tax was established as a revenue-neutral policy, with all revenue being used to finance reductions in corporate and personal income taxes. This revenue neutrality muted public opposition to the tax, particularly in the business community. It effectively changed the nature of the debate, being less about "a new tax" and more about a "shift" in the way taxes are collected. The commitment to revenue neutrality also helped to lock in the tax over the longer term, since removing the carbon tax would require reversing income-tax cuts (Harrison, 2013; Clean Energy Canada, 2015a).

The promise of revenue neutrality did not, however, eliminate all opposition to the policy in British Columbia. Changes in personal income taxes are not highly visible, and many voters may not have understood that revenue neutrality applied to the government, not individual household budgets (Clean Energy Canada, 2015a). Further, while income taxes were reduced broadly, the effects were not distributed exactly equally across all individuals, even when combined with targeted support for vulnerable groups. Some individuals (those who spend very little on energy, for example) benefited financially from the policy, while others were harmed. Finally, even though the B.C. government enshrined the policy's revenue neutrality into law, citizens may not fully trust this commitment. Future governments can adjust tax rates, as they can adjust the carbon pricing policy itself.

Box 3 recognizes some existing confusion with the term "revenue neutrality," and examines which of this report's six recycling options could be consistent with the concept.

Box 3: What does "revenue neutrality" really mean?

Discussions of carbon pricing often contain references to "revenue neutrality," but the term is not always used in a uniform manner. What does it really mean?

Every dollar of revenue generated by a carbon price will be used in some way by government—either for program spending, investments in public goods, making transfers to firms or households, reducing existing taxes, or retiring public debt. In other words, every dollar of carbon pricing revenue will be "recycled" in some way.

Not all of these recycling options are revenue neutral, however. Taking the words literally, a carbon pricing policy can only be revenue neutral if the net effect on the government's revenues is zero. So the new revenues generated by the carbon price must be fully offset by reductions in revenue from other sources, such as sales, payroll, or income taxes.

Not all of the six recycling options examined in this report are directly consistent with revenue neutrality. Reductions in existing tax rates could be designed to fully offset the higher revenues created by the carbon price. Investments in infrastructure or clean technology represent new spending; if carbon pricing revenue is used to finance these expenditures, the policy would not be revenue neutral. Transfers to households also appear as government expenditures, but since taxpayers receive this money directly, many commentators argue that they should be considered more like pure tax reductions.

The issue becomes more clouded in the case of support to industries provided through the granting of free permits or tax exemptions. In these cases, government revenue that would otherwise be generated by the carbon price is *forgone* through the policy details, and the provision of industrial support does not appear as government expenditures. The precise meaning of revenue neutrality in this situation is less clear.

3.3 INVESTING IN EMISSIONS-REDUCING INNOVATION AND TECHNOLOGY

Governments can recycle their carbon pricing revenues so as to provide additional incentives for reducing GHG emissions, as argued by Partington & Sharpe (2016). Government can support the adoption of existing low-carbon technologies; it can support the improvement of emerging technologies; and it can assist in the development of wholly new technologies. For example, Quebec's revenue recycling is directed at reducing emissions by supporting the adoption of energy-efficient equipment for buildings and vehicles, public transit, and green energy. It also supports research and innovation of new technologies to reduce emissions.

We noted at the outset that investments in technology have no clear implications for household fairness. While the development of cleaner technologies over the longer term will reduce the overall costs of any carbon pricing policy, it is unclear how these reduced costs would be distributed across households of different incomes.

In the longer term, investing in emissions-reducing technology could reduce competitiveness pressures

By reducing the costs associated with carbon pricing over the longer term, the development of cleaner technologies can reduce the overall costs of any carbon pricing policy (IEA, 2015). If technology investments can lead to more emissions reductions at lower cost, it can improve firms' emissions performance. Lowering firms' carbon costs helps to reduce pressures on business competitiveness.

In broader terms, these developments could also lead to opportunities in international markets for Canadian businesses; as other jurisdictions introduce or increase carbon prices, global demand for emissions-reducing technologies will continue to increase. These benefits will begin to accrue once the new technologies become better known and will grow over time, although their precise distribution among households and firms is not easy to predict.

Successful investments in low-carbon technology could improve economic performance

Economists have long identified the strong case for subsidizing research and development (Arrow, 1962). Firms tend to under-invest in research privately, because their competitors can also benefit from the resulting innovations. This "market failure" means that successful public investments in R&D can lead to overall economic benefits. More specifically in the context of carbon pricing, targeted investments can cost-effectively complement the direct effects of the carbon price (Fischer, 2009). Such investments could encourage the development of new technologies and processes that can lower the cost of emissions reductions. Similarly, investing carbon revenue in the dissemination of low-carbon technologies—for example, by selective subsidies on their adoption—can lead to improvements in costs and emissions performance via "learning by doing," and to broader adoption and greater emissions reductions (Jaffe et al., 2005).

On the other hand, direct investments not motivated by such market failures can be costly. Carbon pricing drives all potential emissions reductions that cost less than the price of carbon (on a per-tonne basis). Some direct investments that target specific emissions reductions may cost *more*, however, and thus undermine the cost-effectiveness of the carbon pricing policy as a whole. Some observers have argued, for example, that existing biofuel subsidies have driven emissions reductions at a cost of $200 to $430/tonne for ethanol and $205 to $580/tonne for biodiesel (Laan et al., 2009). Such high costs for emissions reductions suggest an inefficient use of public resources.

The success of this particular approach to revenue recycling depends on its being implemented well. Governments throughout the world have had many spectacular failures in attempting to encourage innovations of all sorts. But so have they had many spectacular successes. Indeed, Ruttan (2001) shows that every technology for which the United States was in the forefront at the end of the 20th century—including computers, the Internet, the jumbo jet, and robots—received significant public support during some phase of its development. So the issue is not whether governments usually fail or usually succeed in such enterprises, since they have certainly done both in large numbers in the past, but rather which specific design conditions make it more likely that such enterprises will succeed (Lipsey & Carlaw, 1996, 1998a, 1998b). These authors consider several cases of government successes and failures, and draw out implementation lessons for increasing the likelihood of success. For instance, bureaucrats should make investment choices only in close cooperation with private sector actors who are risking their own money in the enterprise.

Investments in low-carbon technology can drive additional emissions reductions

Complementarities between carbon pricing and technology investments can also lead to environmental benefits. As discussed above, successful investments in low-carbon technology can lower costs of abatement. This in turn can allow pricing policy to achieve deeper emissions reductions at a given price. It can also make more-stringent policy possible by lowering the costs of achieving a given level of emissions reductions.

Investments in low-carbon technologies can also be useful if the carbon price alone lacks sufficient stringency. For example, if political constraints prevent increases in the carbon price, and thus the price remains too low to drive the deep emissions reductions required over the longer term, investments in low-carbon technology make a useful contribution.

The Regional Greenhouse Gas Initiative (RGGI), a cap-and-trade system in the northeastern United States, takes this approach. Analysis suggests that RGGI has led to significant emissions reductions in member states, despite the low carbon price in the system (around $5/tonne in July 2015), in part because of these investments (Ramseur, 2015; Murray & Maniloff, 2015).

However, the impacts of technology investments can be muted if complementing a cap-and-trade system. Direct public investments in emissions-reducing technologies in sectors covered by an emissions cap (e.g., subsidies for renewable energy) might not lead to more emissions reductions, but instead to a lower price of carbon (Sijm, 2005).

Investments in technology can build constituencies for carbon pricing

Direct investment in low-carbon technology can make it easier to implement stringent carbon pricing by lowering the costs of technologies that reduce GHG emissions (IEA, 2015). This direct support for technology may help build coalitions that support carbon pricing, making it easier to implement policy—and easier to maintain robust policy over the longer term (Meekling et al., 2015). Emitters most affected by the costs of policy tend to be influential and well-organized opponents of policy. Investing in low-carbon technology, including renewable energy, can therefore help create a constituency that supports a carbon price (Wagner et al., 2015).

3.4 INVESTING IN CRITICAL PUBLIC INFRASTRUCTURE

Governments could use carbon pricing revenue to invest in public infrastructure, thus reaping the direct long-run benefits that typically come with such investments.

The range of possible infrastructure investments complicates identifying trade-offs. Depending on the nature of the specific investments chosen, economic and environmental benefits might result. Investments in public transit, for example, could drive both economic and environmental benefits. In contrast, new bridges might improve mobility and trade, but are unlikely to reduce GHG emissions.

It is also difficult to predict the impact investments in infrastructure will have on either household fairness or business competitiveness: much depends on the nature of the specific investments and the identity of the primary users. For example, lower-income households may benefit most from investments in public transit and roads, while higher-income households may benefit most from investments in cultural and sporting facilities. While some infrastructure investments—such as improved road networks and electricity grids—could improve business competitiveness overall, they are unlikely to deal adequately with the specific challenges created by carbon pricing, which apply most to the emissions-intensive and trade-exposed sectors. Finally, implementation can be challenging, given the potential politicization of the process for selecting infrastructure projects.

Infrastructure investments can generate sustained economic benefits

Perhaps the strongest argument for recycling carbon pricing revenues into infrastructure investments is that such investments can spur economy-wide productivity improvements that enhance long-term economic growth. Much physical infrastructure is an input for firms: they use roads, bridges, trains, and electricity grids to move goods and conduct business. As such, better infrastructure reduces transaction and transportation costs for economic activity (Centre for Spatial Economics, 2015). Some studies suggest that as much as half of productivity gains can be attributed to improvements in public infrastructure (Antunes et al., 2010; Gu & MacDonald, 2009; Harchaoui & Tarkhani, 2003).

Infrastructure investments can generate additional emissions reductions

Lee (2016) argues that some investments in public infrastructure can be an essential complement to a carbon pricing policy. Low-emissions public transit, high-speed electric rail, and charging networks for electric vehicles are examples of investments that would have a long-run effect of facilitating greater emissions reductions. Since public infrastructure is highly durable, often lasting for several decades, decisions taken now will have implications for GHG emissions for many years (NRTEE, 2012). Internationally, the International Energy Agency (2013) suggests that infrastructure decisions will be critical in keeping global temperature increases to two degrees Celsius above pre-industrial levels.

Infrastructure investments can build public support

A range of previous public opinion research suggests that new investment in public infrastructure is a priority for Canadians and thus a favoured use of carbon pricing revenue. In the context of British Columbia's carbon tax, local focus groups suggested a better public understanding of tangible measures like investments in public transit as opposed to more abstract choices, such as income-tax reductions (Daub & Galawan, 2012). Similarly, in polling research commissioned by the Pembina Institute, two-thirds of respondents support using B.C.'s carbon pricing revenue to "invest in projects that help to reduce pollution, like public transit and more energy-efficient buildings" (Horne et al., 2012).

3.5 REDUCING GOVERNMENT DEBT

Governments could use their carbon pricing revenue to reduce public debt. Several Canadian provinces have high and growing debt burdens, and in these cases, debt reduction could generate genuine benefits, particularly in terms of long-term economic growth and improved fairness across generations.

Using carbon pricing revenues to reduce existing government debt has no immediate implication for the household fairness of carbon pricing. This is because the repayment of the government's creditors, who are then free to reinvest these funds in alternative investments, has no predictable effect on households' budgets—and certainly no predictable effect across households of different income levels. Similarly, debt reduction is unlikely to have any immediate impact on business competitiveness pressures created by the carbon pricing policy. Most benefits from reducing debt occur over the longer term.

Reducing public debt is fair for future generations

Debt reduction matters most in terms of *intergenerational* fairness—that is, the treatment of and opportunities available for different generations (Wen, 2016; Foot & Venne, 2005). Public debt that exists today accumulated in the past, but it must be repaid in the future, by the generations that pay the necessary taxes at that time. If all government debt was incurred to finance long-lived investments,

there would likely be no problem of intergenerational equity; in this case, future generations benefit from the investments, and thus it is appropriate for those generations to pay some of the cost. But to the extent that government borrowing was mostly incurred to finance current program spending (as opposed to investment), it is unfair to expect future generations to face the burden of repayment. Using carbon pricing revenue to reduce public debt can thus alleviate issues of intergenerational equity by reducing the fiscal burden on future generations.

Reducing public debt can have long-term economic benefits

As argued by Wen (2016), high government debt can impose economic costs in two ways. First, high levels of public debt (relative to GDP) usually imply that debt-service costs are also quite high. As debt-service costs mount, governments typically find it necessary to raise taxes, for to avoid such tax increases implies that government debt rises even more quickly. If governments increase income taxes to finance the debt-service payments, there will be negative impacts on labour supply, investment, and long-term growth.

Second, very high levels of public debt can increase the perceived risk of the government's insolvency. When this occurs, borrowers in financial markets usually demand higher yields on government bonds, sufficient to offset the perceived riskiness of the asset. As the interest rates rise on government bonds, there is generally an associated increase in all other interest rates, with negative implications for economy-wide investment and long-term growth (IMF, 2009).

By using carbon pricing revenues to reduce public debt, governments can take actions to prevent getting into a high-debt situation in which these costs can occur, and in extreme cases, can become economically debilitating. At low levels of public indebtedness, however, such costs are unlikely to occur.

Debt reduction may have limited public appeal

In cases where public indebtedness is already very high, the economic case for debt reduction is quite powerful—as it was in Canada during the early 1990s. But even then the arguments in the previous few paragraphs are intangible and abstract for most people. Debt reduction also lacks an intuitive connection to GHG emissions reductions and the primary objective of the carbon price. The intangibility and long-term nature of the benefits from debt reduction explain why it typically garners little public support. Future generations—namely, those currently too young to vote, or perhaps not even born yet—will accrue the largest benefits of debt reduction, but are not surveyed in today's public opinion polls. Pure self-interest suggests that today's voters might prefer a different approach to revenue recycling (Wen, 2015).

3.6 PROVIDING TRANSITIONAL SUPPORT TO INDUSTRY

Governments could use carbon pricing revenues to ease the transition for the firms and industries whose competitiveness is most affected by the policy. By definition, this approach is temporary, and should be designed to phase out over time.

Providing such support to industry is unlikely to have any significant effect on household fairness—unless the support is provided to firms *not* facing a genuine challenge to their competitiveness. If firms are able to pass their carbon costs on to consumers in the form of higher prices, they are not good candidates for receiving transitional government support. If they are nonetheless provided such support, the likely effect is that business profits will increase overall; the carbon costs will be passed on to consumers, and the direct government support will generate windfall gains for the firms. In these cases, the higher profits could translate into higher investment income, a more important source of income for higher-income households (Jegou & Rubini, 2011). However, if government restricts such support to those firms and industries with genuine competitiveness challenges, this problem does not arise.

Transitional support to industry can address competitiveness challenges

The key rationale for providing transitional support is to alleviate competitiveness pressures for specific industries (Purdon et al., 2016). As we said earlier, these tend to be industries that are both emissions intensive and trade exposed.[4] In these cases, an effective form of support might involve the government *forgoing* revenues—for example, by providing free permits in a cap-and-trade system or by offering rebates of a carbon tax. In both situations, the support provides the firms in question with financial resources that reduce the *average* cost of compliance with the policy. At the same time, however, the firms still face a carbon price and thus continue to have an economic incentive *at the margin* to reduce GHG emissions.

[4] Not all firms in any given industry are equally exposed to these competitiveness pressures, and there are additional factors that determine the extent to which a firm or industry is genuinely exposed. See Canada's Ecofiscal Commission (2015a) for a discussion of the various other variables to be considered by governments when designing their carbon pricing policies.

Cap-and-trade systems—such as those in California and Quebec—can provide limited emissions permits for free based on production or emissions intensity, thus offsetting the competitiveness pressures created by the carbon price (Fischer & Fox, 2004, 2009a; Rivers, 2010). In the case of a carbon tax, the equivalent policy is a rebate to firms based on their production levels (Fischer & Fox, 2009b). In both cases, emitters still have incentives to reduce their GHG emissions, but have weakened incentives to reduce their production or to relocate their facilities to jurisdictions with lower carbon prices.[5] Addressing carbon competitiveness concerns is precisely the stated objective of the output-based allocations proposed for Alberta's new policy (Leach et al., 2015).

Transitional support to industry could reduce cost-effectiveness

Transitional support provided as a subsidy to production introduces additional economic distortions and inefficiencies (Tombe & Winter, 2015). Such support to industry will result in more output, particularly in emissions-intensive sectors, relative to other approaches to recycling revenue. This could increase the costs of achieving emissions reductions, though the overall effect on cost-effectiveness will depend on the extent of transitional support and also on the importance of the underlying competitiveness pressures (Purdon et al., 2016).

Policies of transitional support raise a concern if the perceived availability of free allocations or tax rebates leads to widespread lobbying of government by various groups seeking to receive special treatment. Providing transitional support to emitters that do not require it leads to no benefits in terms of reduced leakage of emissions, but less revenue available to drive other economic or environmental gains. Governments should recognize that free permits and tax rebates involve an opportunity cost, and only provide them when genuine competitiveness pressures are caused by the carbon pricing policy (Canada's Ecofiscal Commission, 2015a).

Transitional support to industry could weaken emissions reductions

Since transitional support to industry typically takes the form of incentives for production (e.g., free allocations or tax rebates based on output), one predicted effect is that output in the supported industries will be higher than would be the case under alternative recycling approaches. Other things being equal, this higher output suggests a greater level of GHG emissions. So, while the carbon price's direct effect is to reduce emissions, providing transitional support to industry can work in the opposite direction. It follows that such support measures need to be well designed and calibrated—to protect the industry's competitive position while also maintaining strong incentives to reduce emissions.

Transitional support to industry can generate support for carbon pricing

Industry voices seem to be more inclined to support carbon pricing policy when the system is designed to address the competitiveness challenge. Both Quebec and California have included free permits as part of their cap-and-trade systems (Purdon et al., 2016), and Ontario is likely to follow suit. Alberta's recent policy proposal has support from major oil sands companies, partly because the plan provides emissions-intensive firms with some free allocations based on output (Leach et al., 2015). These mechanisms can ensure firms can compete, while also providing them with incentives to improve emissions performance.

3.7 SUMMARY

All the revenue-recycling approaches we have considered have clear benefits. Providing dividends to households can improve the fairness of carbon pricing, and can also build public support for the policy. Reducing existing taxes can generate significant overall economic benefits and can also make the policy more politically durable. Investing in clean technology can drive additional emissions reductions, complementing the carbon pricing policy to make it more cost-effective, especially in the longer term. Investing in critical public infrastructure can boost long-term productivity, and may also enable additional emissions reductions. For jurisdictions with high public indebtedness, reducing government debt can generate long-term economic benefits and also improve fairness for future generations. Providing transitional support to industries can directly address the challenge of business competitiveness and improve support for the policy within the business sector.

The discussion in this section represents the current state of knowledge about the likely effects of various approaches to revenue recycling. But what does new research from the Ecofiscal Commission show?

[5] In both cases, emitters are still covered by the policy (i.e., they are not *exempted*), and so reducing one tonne of CO_2e means they can sell (or avoid purchasing) an additional permit or they can avoid paying the tax. The *marginal* price of carbon maintains the firms' incentive for reducing emissions. But by increasing firms' overall profits, providing rebates or free permits based on their output creates an additional incentive for production. Together, the two incentives mean that emitters can benefit by reducing emissions through improved performance rather than by reducing production.

4 COMPARING REVENUE-RECYCLING APPROACHES: NEW RESEARCH FINDINGS

To build on the previous section, we compare revenue-recycling options side by side using new modelling analysis, applying three different methodological approaches.

To explore the implications of different revenue-recycling approaches for household fairness, we use Statistics Canada's Social Policy Simulation Database and Model (SPSD/M) micro-simulation tax model. The model shows how households with different incomes are affected differently by the carbon price and by selected revenue-recycling choices, in particular, transfers to households and reductions in income-tax rates.

To compare environmental, economic, and competitiveness impacts, we use a Computable General Equilibrium (CGE) model, working in partnership with Navius Research.[6] Some approaches to revenue recycling cannot be easily incorporated into such a model, and others can be modelled only imperfectly.[7] Yet the modelling has the advantage of being an internally consistent, unifying framework for comparing the advantages and disadvantages of different approaches to revenue recycling for different provinces. While the model is less useful for predicting the absolute magnitude of outcome for each scenario, it is very useful in comparing the relative impacts between scenarios.

Finally, to compare how the general public views different recycling options, and how the options influence the overall support for carbon pricing, we draw on new public opinion polling commissioned for this report from Abacus Research (2015).

4.1 FAIRNESS IMPLICATIONS OF REVENUE-RECYCLING CHOICES

How governments use carbon pricing revenue has crucial implications for the costs to households as well as the distribution of these costs across households. In a separate report (Canada's Ecofiscal Commission, 2016), we quantify the distributional impacts of carbon pricing on Canadian households in Alberta, Manitoba, Ontario, and Nova Scotia. This section builds on these separate results by adding the impact of different revenue-recycling options. The results below, therefore, show the *combined effects* of carbon pricing and revenue recycling on household budgets.

[6] The CGE model uses provincial and sectoral data on output, trade, and GHG emissions. It has eight regions: British Columbia, Alberta, Saskatchewan, Ontario, Quebec, Nova Scotia, the Rest of Canada, and the United States. It has 38 distinct sectors, with particular detail for the energy system and the most emissions-intensive sectors. Workers can move between regions over time, and investment (capital) can freely move internationally. The model is "recursive dynamic" in the sense that it simulates in six-year time steps.

[7] Infrastructure, for example, is included in the model only to the extent that it is related to the energy system. As a result, using the revenue to fund more general productivity-improving infrastructure is beyond the scope of this model. It does have some ability, however, to model investments in emissions-reducing technologies. The model is specifically designed to consider responses to carbon-price signals, and so includes sector-level detail such as renewable electricity, substitution between energy and capital (energy-efficiency investments), and some specific technologies that can be subsidized under this revenue-recycling option, such as carbon capture and storage. It does not, however, consider how investment in R&D could drive the development of entirely new technologies.

As in our separate work on household distributional impacts, this analysis uses Statistics Canada's SPSD/M.[8] The model has detailed resolution regarding financial flows between governments and households, enabling it to realistically capture the implications of changes in taxes and government transfers. We model the immediate impact on household budgets of a $30/tonne carbon price in the provinces, under alternative revenue-recycling approaches.

We consider three recycling scenarios:

1. Fully offsetting the carbon cost to households in the lowest two income quintiles
2. Returning all carbon pricing revenues back to households as a dividend
3. Using all carbon pricing revenues to reduce income-tax rates

Policy can easily protect the lowest-income households

One way to design fair policy is to follow the "do no harm" principle, which states that carbon pricing should not make poor households poorer or push households into poverty (Stone, 2015). A practical way to implement this principle is to offset the full carbon cost to households in the lowest income quintiles with direct cash transfers. This approach is analogous to GST/HST rebates for low-income households, delivered as quarterly cheques. Under its carbon tax, for example, the B.C. government provides a quarterly "low income climate action tax credit" to eligible residents based on family size and household income.

Table 2 approximates the financial requirements of such an approach in terms of the percentage of each province's total carbon pricing revenue. Such a rebate could be carefully designed to target most vulnerable households without creating additional labour-market distortions.[9] We take an illustrative approach and consider transfers based on income quintiles. Offsetting the full cost of the policy to households in the lowest income quintile requires less than 5% of total revenue for all selected provinces. Fully offsetting the costs for households in the lowest two income quintiles requires less than 13% of provincial carbon pricing revenue. In both cases, and in all provinces, the lion's share of the carbon pricing revenue would still be available for other uses.

Table 2: Share of Carbon Pricing Revenues Required to "Do No Harm"

	Percentage of carbon pricing revenues required to fully compensate households	
Province	**First income quintile**	**First & second income quintile**
Alberta	3.2	9.5
Manitoba	4.4	12.6
Ontario	3.9	11.6
Nova Scotia	4.0	11.8

Table 2 presents the share of provincial carbon pricing revenues required to completely offset the total carbon costs to all households in the first and second income quintiles.

Source: Canada's Ecofiscal Commission, using Statistics Canada's Social Policy Simulation Model Version 22.0.

[8] We use the model version 22.0. For a more detailed description of the model, see Crisan et al. (2015).

[9] Abrupt thresholds for eligibility defined by a specific income level would create perverse incentives for households to maintain or reduce their income by working less or evading taxes. To avoid this problem, governments could design the transfer with declining benefit levels or claw-back rates.

Recycling all revenue to all households makes policy even more progressive

Alternatively, governments could recycle *all* provincial carbon pricing revenue to all households equally—also referred to as a "carbon dividend." The size of the transfer depends on the scale of carbon pricing revenue generated in each province. Based on our modelling, this method of recycling would provide households with cheques ranging from $706 per year (in Manitoba) to $3,634 per year (in Alberta).

Figure 2 shows the overall implications of this approach for households, assuming a $30/tonne carbon price. It shows the net financial impact of the carbon pricing policy, together with the revenue recycling, for Canadian households—across income quintiles and provinces. Panel A illustrates these net impacts as a share of annual household income; Panel B shows the net impacts as a share of annual household expenditures.[10]

Figure 2: Net Impact of Carbon Pricing With Dividend, by Province and Income Quintile

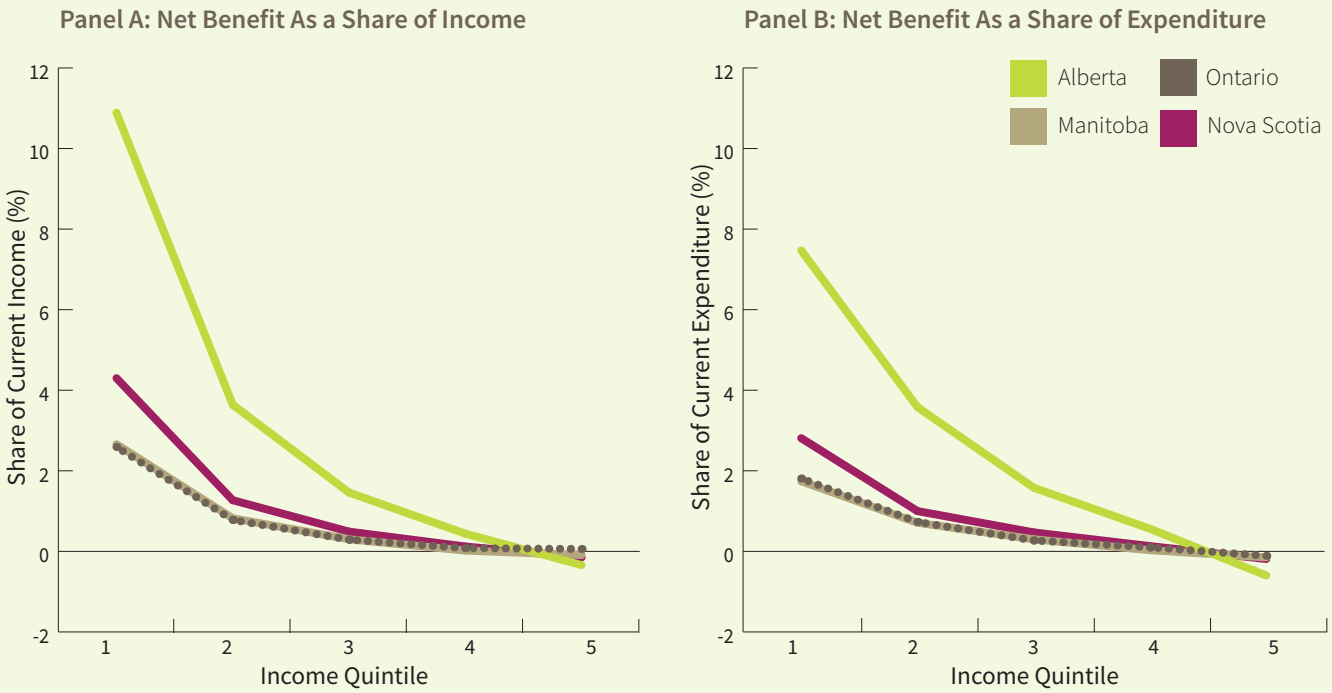


Figure 2 shows the net financial impact of carbon pricing when all carbon revenues are transferred back to households as direct transfers. All households receive the same dollar-value transfer. Panel A shows the net impact as a share of current household income; Panel B shows the net impact as a share of current household expenditures.

Source: Canada's Ecofiscal Commission, using Statistics Canada's Social Policy Simulation Model Version 22.0.

[10] We consider two different measures of the net impact—one as a share of annual household income and one as a share of annual household expenditure. The latter is a proxy for costs as a share of lifetime income, which many researchers view as a better indicator of the household's resources over its life cycle. See Canada's Ecofiscal Commission (2016) for more details.

As is evident from both panels of Figure 2, full recycling through dividends more than completely offsets the carbon cost for households in four of the five income quintiles. In other words, almost all households see an improvement in their financial situation as a result of carbon pricing and full revenue recycling with carbon dividends. Only in Manitoba and Ontario, and only for the households in the highest income quintile, is there a slightly negative net impact—but even then, the net effect is very close to zero. The net impact in Alberta is so much larger than in the other provinces because of the large volume of GHG emissions in that province; at $30/tonne, Alberta's emissions translate into large government revenues, which finance large transfers back to the households.[11]

Note also from Figure 2 that carbon pricing with this revenue-recycling approach makes the overall policy strongly progressive. Households in the lower income quintiles have greater net benefits (as a share of either their income or expenditures) than the households in the higher income quintiles. This is true for all four provinces considered, but the policy is most progressive in Alberta. Households in the lowest income quintile in Alberta would receive net benefits of almost 11% of their income; those in the highest income quintile would see a net cost of less than 0.5% of their income.

Income-tax cuts alone do not necessarily help the lowest-income households

Finally, using revenue recycling to reduce personal income taxes can also have an impact on household fairness. Like the dividend approach, reducing income taxes can reduce the carbon cost for all households. However, reductions in income taxes (or payroll taxes) tend to affect households with different income levels in different ways.

We consider a scenario in which all revenue generated by the $30/tonne carbon price is recycled by reducing the rate in the lowest personal income-tax bracket in each of the four provinces. Table 3 presents the original rate for the lowest income-tax bracket and the new rate after the revenue recycling. Given the greater share of total government revenues that Alberta can generate with a carbon price (see Table 1), its lowest tax rate would be reduced by about four percentage points. For the other three provinces, the rate falls by an amount closer to one percentage point.

Table 3: Revenue Recycling by Reducing the Lowest Provincial Income-Tax Rate

	Original lowest income-tax rate	New lowest income-tax rate
Alberta	10.0%	5.8%
Manitoba	10.8%	8.9%
Ontario	5.1%	3.6%
Nova Scotia	8.8%	5.8%

Table 3 shows the reductions in the lowest personal income-tax rate by recycling all carbon revenue in all four provinces, assuming a $30/tonne carbon price.

Source: Canada's Ecofiscal Commission, using Statistics Canada's Social Policy Simulation Model Version 22.0.

[11] In our analysis, emissions within the public sector do not generate net revenue for government. Also, the carbon costs associated with investment in physical capital do not get passed on immediately to consumers in the form of higher prices. In reality, these costs would be passed on to consumers in the future, but are omitted by our analysis, which is based on a snapshot in time. Our analysis does, however, capture the carbon costs in the consumption and export sectors, though some fraction of the export costs is assumed to be borne by consumers outside the province.

Figure 3 shows the net household impact of carbon pricing combined with these income-tax reductions, by income quintile and province. Panel A shows the net benefit as a share of annual household income; Panel B shows the net benefit as a share of annual household expenditures.

Figure 3: Net Impact of Carbon Pricing and Reduction in the Lowest Provincial Income-Tax Rate

Figure 3 shows the net impact on households of carbon pricing and recycling all revenue by reducing the lowest provincial income-tax rate. Panel A presents the net impact as a share of annual household income; Panel B shows the net impact as a share of annual household expenditures.

Source: Canada's Ecofiscal Commission, using Statistics Canada's Social Policy Simulation Model Version 22.0.

The combined impact of carbon pricing and income-tax reductions mostly follows a similar pattern for the four provinces. In particular, in all provinces, the lowest-income households benefit less from income-tax reductions, because they tend to have little or no taxable income. Income-tax cuts alone, therefore, do not offset carbon costs for low-income households, and—unlike the direct-transfer approach—do not address concerns about regressivity. These households should prefer a dividend approach to revenue recycling.

In Manitoba, Ontario, and Nova Scotia, households in middle-income quintiles experience a small net benefit, because a moderate share of their income comes from the lowest tax bracket. In contrast, households with higher incomes have a larger share of their income from higher tax brackets, and thus do not benefit as much from the income-tax cut considered here.

Alberta is the interesting exception, where higher-income households benefit most from the tax cut. This is because of Alberta's single tax rate that applies to all income levels, so the tax cut considered here is a tax cut for all households—and it is larger as a share of income for higher-income households.[12]

[12] In October 2015, Alberta added new tax brackets. However, since the new first bracket includes annual income up to $125,000 and thus covers a large share of high-earners' wages, these findings likely still hold.

4.2 COMPETITIVENESS IMPLICATIONS OF REVENUE-RECYCLING OPTIONS

To assess the impact of different revenue-recycling options on business competitiveness—and also on broader economic and environmental performance—we again use a CGE economic model, developed by Navius Research.

As shown in Table 4, we examine five revenue-recycling scenarios. Each one assumes that every province implements a carbon price that starts at $30/tonne in 2015, rises to $50/tonne by 2021, and reaches $100/tonne by 2027 (all prices in 2015 dollars). Since each province implements its own policy in our modelling exercise, all revenue is recycled back to the province in which it is generated. The only difference between the five scenarios is *how* the revenue is recycled.

Two general comments about the modelling exercise are in order. First, we only model a subset of the recycling options examined earlier. In particular, because the CGE model contains no government debt or public infrastructure, we cannot explore those recycling options with this analytical approach. In contrast, the CGE model is relatively well suited for examining the effects of transfers to households, income-tax reductions, transitional support to industries, and investments in low-emitting technologies.

Second, in each of our five recycling scenarios, we assume that one-third of the carbon pricing revenue is used to provide direct transfers back to households. This parallels the policy in British Columbia and ensures that the policy is fair for lower-income households. Only the remaining two-thirds of revenue is dedicated to the different recycling approaches defining each scenario. Table 4 describes all five recycling scenarios.

Table 4: Modelling Scenarios for Provincial Carbon Pricing and Revenue Recycling

Scenario	Description of Revenue Recycling
1. Household Transfers	All revenue used for household transfers
2. Corporate Income Tax	⅓ used for household transfers; ⅔ used for reductions in corporate income taxes
3. Personal Income Tax	⅓ used for household transfers; ⅔ used for reductions in personal income taxes
4. Transitional Support to Industry	⅓ used for household transfers; ⅔ used to provide support to industry through output-based subsidies
5. Technology Investment	⅓ used for household transfers; ⅔ used for investments in energy efficiency, renewable electricity, and targeted technologies that reduce GHG emissions

The first three scenarios are straightforward to model, with revenue used to transfer money to households directly or to reduce existing income-tax rates. Scenarios 4 and 5 require some additional explanation.

In scenario 4, revenue is returned to industries as a subsidy per unit of output, and distributed among sectors according to their historical emissions intensity. This recycling approach, therefore, provides more support to emissions-intensive sectors, which are more vulnerable to competitiveness pressures. This approach is analogous to both a cap-and-trade system with free "output-based allocations" (paralleling how some permits are allocated in Quebec's cap-and-trade system) and a carbon tax with rebates provided to industry based on output (similar to Alberta's new planned approach).

In scenario 5, revenue is used to subsidize renewable electricity and energy efficiency, as well as a few specific emissions-reducing technologies, such as carbon capture and storage, and landfill methane capture. Because CGE models do not include extensive technological detail, this scenario is only an approximation of how this general approach would be implemented in reality. Similarly, the model does not include any representation of innovation or research and development, so the scenario does not include investments in developing entirely new emissions-reducing innovations.

Modelling each recycling scenario generates results for all of the model's key variables—including total provincial GHG emissions and GDP for each sector in the province. In this section, we focus on the impact of the various recycling options on business competitiveness; in the next section, we examine more closely the impacts on provincial GDP and GHG emissions.

Revenue-recycling approaches affect the magnitude of competitiveness impacts

We can measure the magnitude of competitiveness impacts under alternative recycling approaches by decomposing the source of projected emissions reductions.

Firms and consumers can reduce their GHG emissions in various ways. They can directly adopt new technologies and practices; for example, by buying low-emissions vehicles or by switching to renewable electricity. They can switch to less carbon-intensive inputs, leading to emissions reductions elsewhere in the economy; for example, by using electricity rather than fossil fuel-powered equipment. Or they can reduce the overall level of production and consumption of goods and services, thus reducing emissions. In most cases, such emissions reductions in response to carbon pricing are exactly the point of the policy.

But reductions in GHG emissions can also come from a loss of competitiveness for Canadian businesses, which leads to a loss of market share to foreign rivals and maybe even to a closure of Canadian production facilities. Losses in competitiveness do not contribute cost-effectively to global emissions reductions. Indeed, there may be no global reduction at all. While the loss of competitiveness reduces GHG emissions in Canada, these emissions may simply "leak" out of Canada, only to reappear in another jurisdiction with weaker climate policy. The extent to which leakage undermines global emissions reductions depends on both the stringency of environmental policies and the availability of more-advanced production technologies in other jurisdictions.

Figure 4: The Source of Canadian Emissions Reductions for Five Revenue-Recycling Options

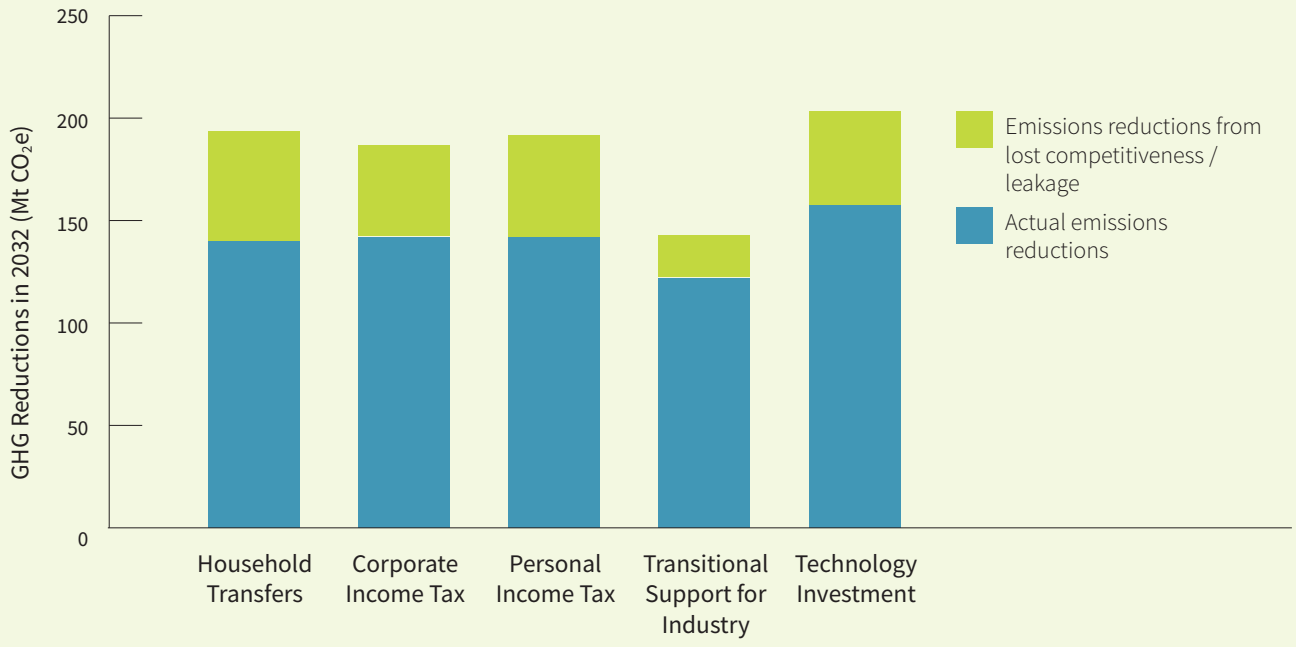


Figure 4 shows total emissions reductions in Canada by 2032, relative to the level that would otherwise occur with no change in current policies. For each recycling option, the figure also decomposes the reductions into two parts. The blue part is the cost-effective emissions reductions from adopting emissions-reducing technologies, switching to lower-carbon goods and services, and structural shifts between sectors. These are cost-effective global emissions reductions. The green part shows the reduction (leakage) in Canadian emissions due to competitiveness impacts of the policy. These reductions occur because of a shift of economic activity from Canada to some other jurisdiction and thus do not represent global emissions reductions.

Source: Economic modelling from Navius Research.

Total projected emissions reductions in 2032 (i.e., the final year of our model's simulation) are shown in Figure 4 for each revenue-recycling scenario.[13] For each scenario, the emissions reduction is decomposed into these two separate components. The largest part of each bar (shown in blue) represents the reduction in Canadian emissions that are also global reductions. The smaller part (shown in green) represents the emissions reductions due to lost competitiveness of Canadian business.[14]

It is clear from Figure 4 that the domestic emissions reduction due to loss of business competitiveness is very similar in four of the five recycling scenarios. But it is significantly smaller in the option that most directly addresses the competitiveness challenge. The scenario of transitional industrial support, which involves output-based subsidies, reduces the costs to the most emissions-intensive and trade-exposed sectors. By keeping output higher in these sectors than would occur with the other recycling scenarios, the output-based subsidies result in a smaller overall reduction in GHG emissions.[15]

More subtle differences emerge between the other approaches to revenue recycling. Providing transfers to households leads to the largest competitiveness impacts, since households, rather than firms, receive all the benefits from revenue recycling. Reductions in corporate income taxes, on the other hand, reduce the cost burden for firms more broadly across all firms.

These impacts present a crucial trade-off for policymakers. The emissions-intensive and trade-exposed sectors of the economy are the sectors most likely to be vulnerable to competitiveness pressures caused by the carbon price. If policy is designed to insulate industry from these pressures, the result will be smaller emissions reductions. On the other hand, if policy is designed to pursue more aggressive reductions and pay less attention to these exposed industries (e.g., if all revenue is transferred to households directly), the result will be a decline in local economic activity in these sectors—but with fewer reductions in *global* emissions.

Policy in the United States is a key factor for carbon competitiveness pressures

The nature of the competitiveness challenge stems from differential carbon pricing across jurisdictions: with a globally uniform carbon price, competitiveness pressures from carbon pricing would not exist, in any country.

For many Canadian businesses, it is the carbon pricing policy of our largest trading partner—the United States—that matters most for determining the scale of the competitiveness challenge for vulnerable sectors. In the modelling analysis presented above, all Canadian provinces move forward with carbon pricing policy, but the United States is assumed not to.[16]

This leads to an obvious question: To what extent would the harmonization of policy between Canada and the United States affect the magnitude of the competitiveness challenge?

To answer this question, we compare two modelling scenarios that differ only with respect to the degree of policy harmonization across the two countries. In the first scenario, all provinces implement a carbon price, while the United States does not. In the second scenario, all provinces implement a carbon price, and the United States implements an equivalent countrywide carbon price. In both scenarios, all jurisdictions are assumed to recycle their carbon pricing revenues using the second option in Table 4: one-third is used to provide household transfers and two-thirds is used to reduce corporate income taxes.

[13] Emissions reductions by 2032 are relative to the level of emissions that would have otherwise occurred in that year with current policies (as of 2014) in place. The final year in the model simulation is 2032, which moves in six-year time steps.

[14] This decomposition uses a Log Mean Divisia Index approach, drawing on trade data from model projections.

[15] In each of the five revenue-recycling scenarios, the most vulnerable sectors (those making up the green part of the bar) are similar. The oil and gas sector accounts for over half these emissions reductions; manufacturing accounts for about 40%.

[16] Our analysis includes the effects of the planned EPA regulations for coal-fired electricity generators in the United States. Interprovincial competitiveness concerns could also be an issue until carbon prices are harmonized across Canada. Our analysis does not capture these effects, since our modelling assumes that all provinces implement equivalent carbon pricing policies.

Figure 5: Canadian Emissions Reductions With and Without U.S. Policy Harmonization

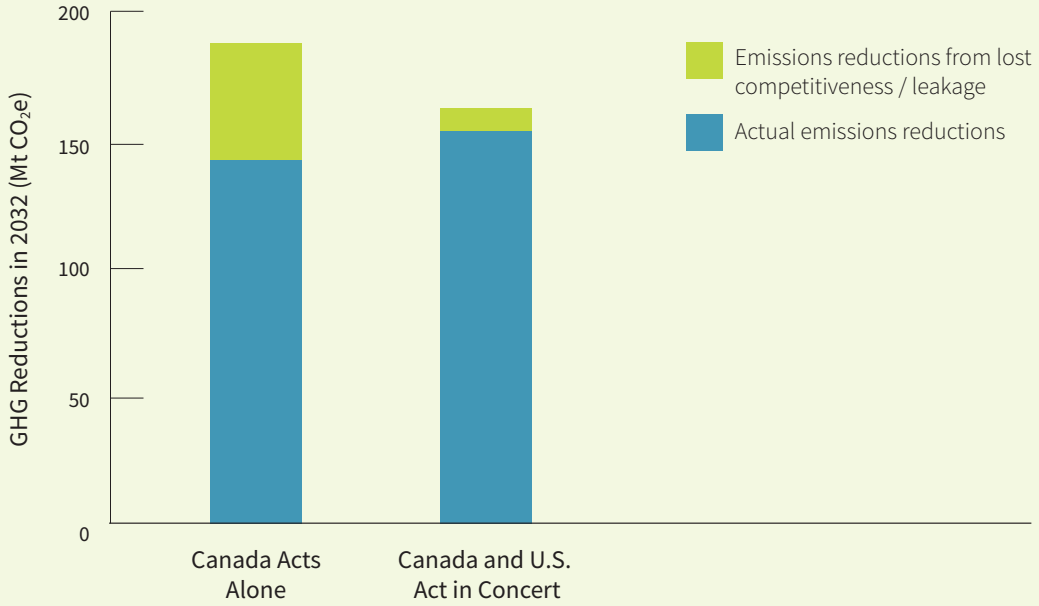


Figure 5 compares the predicted 2032 emissions reductions under two scenarios. In the first, Canada acts unilaterally; in the second, Canada and the United States implement equivalent carbon prices. In both cases, carbon revenue is recycled using option 2 in Table 4: one-third toward household transfers and two-thirds toward reductions in corporate income taxes. Competitiveness impacts are reduced substantially when carbon policy is harmonized between the two countries.

Source: Economic modelling from Navius Research.

Figure 5 shows the decomposition of emissions reductions for the two scenarios. As should be expected, competitiveness losses are significantly reduced under policy harmonization. At the same time, policy harmonization *increases* the amount of cost-effective emissions reductions that occur in Canada. In other words, if Canada and the United States act in concert, firms undertake a greater amount of direct abatement in Canada than occurs if the United States does not implement policy. With active policy in the United States, there is less loss of market share to U.S. firms, as well as less incentive to move Canadian production facilities, and more incentive to remain in Canada and to take profitable actions to reduce emissions.

4.3 ECONOMIC AND ENVIRONMENTAL IMPLICATIONS OF REVENUE-RECYCLING OPTIONS

As discussed in Section 3, revenue-recycling choices can influence broader economic and environmental performance. In particular, the approach to revenue recycling can affect the growth of national income (GDP) and the scale of GHG emissions reductions, even beyond those directly associated with the carbon price. The CGE economic model provides a framework with which to compare the impact on GDP and GHG emissions from the five revenue-recycling scenarios described in Table 4.

GDP impacts are similar across different revenue-recycling options

We compare average annual growth rates of real GDP from 2015 to 2032 under the five carbon pricing scenarios, each with a different approach to revenue recycling. Recall that these scenarios all assume a carbon price of $30/tonne in 2015, which then rises to $50/tonne by 2021 and to $100/tonne by 2027. Figure 6 shows the estimated average GDP growth rates in these five scenarios, together with the projected growth rate under the assumption that there is no change from current policies .

Figure 6: Average Annual GDP Growth Rates Under Alternative Recycling Options

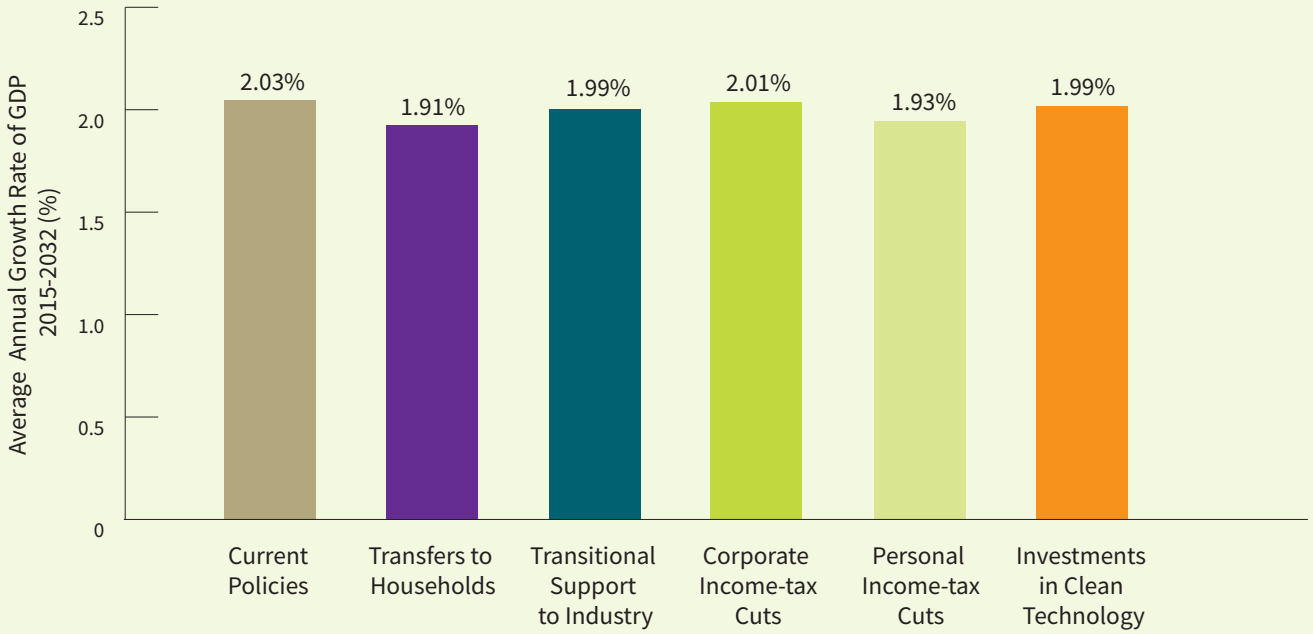


Figure 6 shows projected average annual growth of Canadian real GDP from 2015 to 2032, assuming no change in current policies. It also shows the projected average growth rate in five carbon pricing scenarios, which differ only by the approach to revenue recycling.

Source: Economic modelling from Navius Research.

The projected annual average growth rate of real GDP with current policies is just over 2%. The projected growth rate with carbon pricing is very slightly lower—typically by less than one-tenth of one percentage point per year—with only small variations across the various approaches to revenue recycling. Note that a sustained difference in growth rates of 0.05% per year leads to a difference in the level of GDP after 17 years of just 1.2%; so the negative GDP impact of carbon pricing is noticeable, but very small.

For two reasons, even these small impacts on GDP growth are likely to *overestimate* the costs of carbon pricing policy. First, the economic model focuses on the economic connection between domestic output, prices, and GHG emissions. But it is not designed to incorporate the wider (global) benefits of reducing emissions or the health-related benefits of reducing local air pollution, some of which would positively affect Canadian GDP (Parry et al., 2014). Second, like most macroeconomic models, our CGE model does not capture the long-run economic benefits from the innovation spurred by the carbon pricing policy, benefits that would typically take the form of higher per capita income and consumption.

The five carbon pricing scenarios in Figure 6 display small differences in the projected GDP growth rates. These differences illustrate the arguments we laid out in Section 3.

Providing transfers to households has the highest economic cost (the lowest GDP growth rate), because it does not reduce any existing distortion in the economy. While households have slightly higher incomes relative to what occurs in other revenue-recycling approaches, these transfers are roughly neutral in economic terms, and thus generate few benefits in terms of GDP growth.

In contrast to household transfers, reductions in income taxes come very close to fully offsetting the impact of carbon pricing on overall economic growth. Reducing corporate income taxes leads to the greatest economic benefits, given that these taxes are among the most distortionary. Because capital is highly mobile across jurisdictions, reductions in corporate taxes generally lead to

greater investment in the local economy, with clear implications for productivity and economic growth.[17] Labour is generally less mobile than capital and thus less sensitive to changes in tax rates. Reductions in personal income taxes generally spur employment and create growth benefits, but less so than for reductions in corporate taxes.

Other recycling approaches fall somewhere in the middle. Transitional support to industry that takes the form of output-based subsidies reduces leakage and maintains capital investment in Canada for relatively emissions-intensive industries. Recycling carbon pricing revenue by investing in low-emitting technologies provides support to those specific sectors. In both cases, the resulting GDP growth is slightly less than in the corporate tax scenario, but greater than in those scenarios that cut personal taxes or make direct transfers to households.

Revenue recycling can also affect the path of GHG emissions

In the context of Canada's historical GHG emissions, Figure 7 shows projected emissions under each of the five modelling scenarios. Note that with no change from current policies, Canada's total GHG emissions are projected to rise from their current annual level of roughly 690 Mt to about 730 Mt by 2032, an increase of almost 6%. In contrast, the five carbon pricing scenarios all show significant emissions reductions from current levels, with 2032 emissions ranging between 539 Mt and 583 Mt.

Among the carbon pricing scenarios shown in Figure 7, the differences reflect the qualitative findings from the economic literature discussed in Section 3. The revenue-recycling scenarios that involve income-tax cuts and direct transfers to households have emissions paths that are virtually identical (even though they have different GDP paths), which is to be expected, since they are very similar in terms of the built-in incentives to reduce emissions. The recycling option involving transitional industrial

Figure 7: Projected GHG Emissions With Carbon Pricing Under Alternative Recycling Approaches

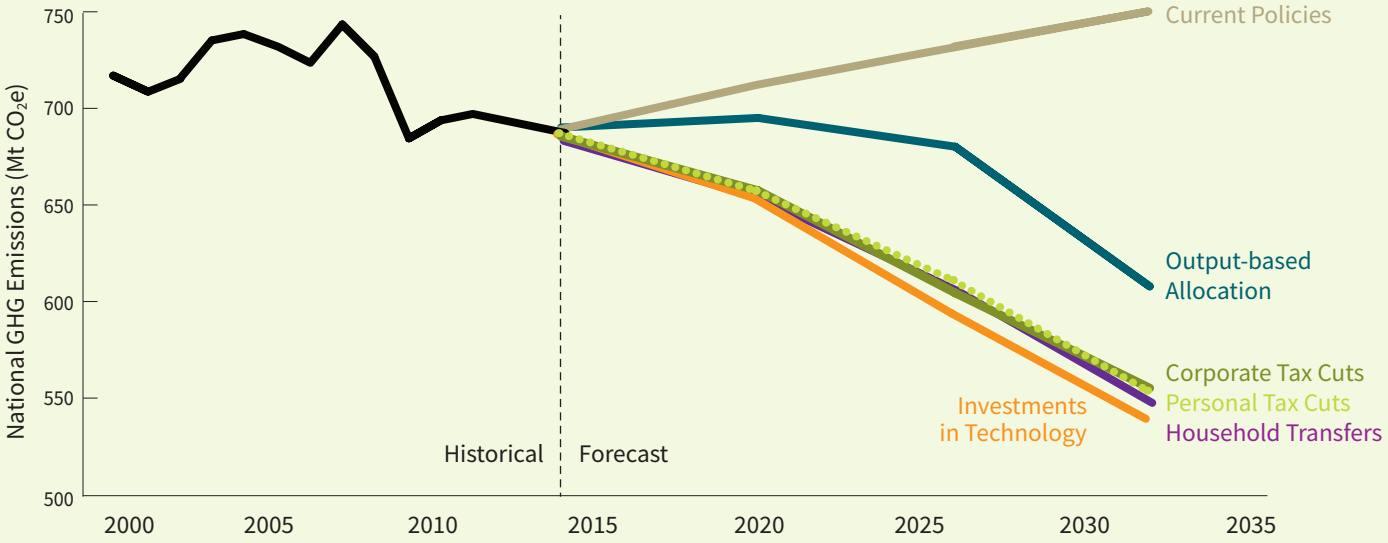


Figure 7 shows projected GHG emissions to 2032 for Canada under six scenarios. Current policy projects GHG emissions without new carbon pricing policies, while the other five scenarios project emissions under a carbon price rising from $30/tonne to $100/tonne by 2027, each with different approaches to revenue recycling. This analysis best highlights *relative* outcomes between scenarios, rather than absolute outcomes for any one scenario.

Source: Economic modelling from Navius Research.

[17] In other models in which firms have foresight regarding future carbon prices and other taxes, there are even greater benefits from reducing corporate income taxes. Jorgensen et al. (2013) and Carbone et al. (2013), for example, find a "strong double dividend"—a net *increase* in GDP—under a carbon tax in the United States with revenue recycled to reductions in corporate tax rates.

support shows lower emissions reductions; this is the flip side of this option's success in addressing the competitiveness challenge in the emissions-intensive sectors by supporting economic activity there. The recycling option with the greatest emissions reductions, not surprisingly, is the one that involves investments in low-emitting technologies, investments that increase the ability of firms and households to respond to the carbon price by substituting toward cleaner products and production methods.

4.4 THE PUBLIC ACCEPTABILITY OF VARIOUS REVENUE-RECYCLING OPTIONS

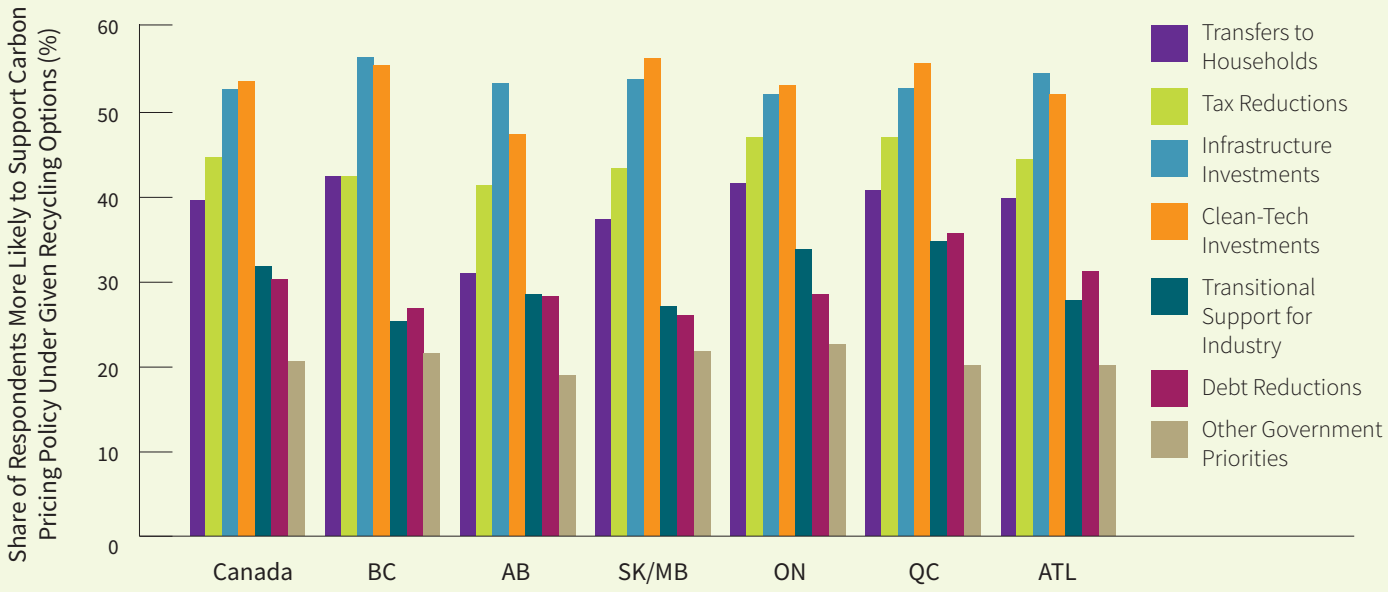
Revenue recycling can affect public attitudes toward carbon pricing policy. To get a sense of how different recycling approaches affect public support, we commissioned opinion-polling research from Abacus Research (2015).

Overall, 76% of survey respondents across Canada believe that it is an "acceptable," "good," or "very good" idea for governments to implement carbon pricing. But how does this support depend on the way revenues are recycled? And are there differences across provinces?

Figure 8 summarizes the share of respondents in each province that would be either "more inclined" or "a lot more inclined" to support carbon pricing policy with each specific approach to revenue recycling. The patterns of support are very similar across provinces.

In all regions of the country, commitments to use carbon pricing revenue to invest in clean technology and public infrastructure provide the most support for the policy, with approximately 60%

Figure 8: The Impact of Various Recycling Options on Public Support for Carbon Pricing



Source: Abacus Research (2015).

of respondents favouring this approach. This strong support may reflect the tangibility of infrastructure (combined with the common perception across Canada of a significant need for new and repaired infrastructure); it may also reflect the perceived coherence of using carbon pricing revenues to invest in technologies that help to further reduce GHG emissions, thus clearly complementing the direct objective of the carbon price.

Reducing existing taxes and making cash transfers to households also provide considerable support for carbon pricing policies, with an average across provinces of roughly 50%. Support for carbon pricing falls below 40% if carbon revenue is used to reduce public debt, provide transitional support to industry, or fund other government priorities. These results highlight that *perceived* costs and benefits of various recycling approaches may be different from those suggested by more formal economic evidence.

4.5 SUMMARY OF TRADE-OFFS ACROSS RECYCLING APPROACHES

As we have seen, genuine trade-offs exist across different approaches to revenue recycling. No single approach examined here can improve household fairness, address business competitiveness, improve broad economic and environmental performance, and also garner strong public support.

For example, some methods of recycling are good for economic growth but have little effect on GHG emissions (e.g., reductions in corporate taxes). Other approaches are good for addressing household fairness but do not help to address the challenge of business competitiveness (e.g., transfers to households). Still other approaches successfully address the competitiveness issue but dampen reductions in GHG emissions (e.g., industrial support involving output-based subsidies). Public investments in emerging technologies garner considerable public support but face the risk of being an uneconomic expenditure of scarce public funds. Achieving more along one dimension invariably means achieving less along another.

Table 5 summarizes these trade-offs. The impacts described in the table are the impacts of the revenue recycling *only*, not the combined impact of the carbon price *and* the revenue recycling. These impacts are thus above and beyond the impacts of the carbon price itself.

Some assumptions are embedded in the assessments shown in the table. For instance, they assume that each approach to revenue recycling is implemented well. This means, for example, that infrastructure investments are chosen carefully with the goal of boosting long-term productivity, rather than being chosen merely to curry political favour. Yet even good implementation does not necessarily lead to the intended outcome. The assessments in the table also include an implicit assessment of the likelihood of success. For example, there are risks inherent to any public investments in clean technology and innovation, for the simple reason that these investments are invariably made in an economic environment with uncertain returns. These investments could lead to positive outcomes if the support leads to successful new innovations with genuine value. Or, they could instead lead to negligible outcomes but incur a considerable fiscal cost. Implementing this approach well improves the likelihood of success but does not ensure it.

These trade-offs clearly indicate that no single revenue-recycling approach is a clear winner across all dimensions. Optimal revenue recycling within any given province will depend on the relative weights placed on the different objectives, and these weights will naturally depend on the provincial context. In the next section, we look at how differences in these contexts might lead to different recycling priorities in five specific provinces.

Table 5: Summary of Trade-Offs for Revenue-Recycling Options

		Environmental Impacts	Economic Impacts	Competitiveness Impacts	Household Fairness	Public Acceptability
Household Transfers		Neutral	Neutral	Neutral	Positive	Somewhat positive
Income-Tax Cuts	Personal	Neutral	Somewhat positive	Neutral	Somewhat negative	Somewhat positive
	Corporate	Neutral	Positive	Somewhat positive	Somewhat negative	Somewhat positive
Infrastructure Investments		Somewhat positive (depending on investment choices)	Somewhat positive	Neutral	Neutral	Positive
Clean-Technology Investments		Positive	Neutral	Somewhat positive	Neutral	Positive
Transitional Support to Industry		Negative	Somewhat positive	Positive	Neutral	Neutral
Debt Reduction		Neutral	Positive (with high debt)	Neutral	Positive (intergenerational)	Neutral

5 APPLYING THE FRAMEWORK: THE IMPORTANCE OF PROVINCIAL CONTEXT

The trade-offs across revenue-recycling options apply quite generally. Yet Canadian provinces have unique circumstances and priorities. This section considers how local context might affect governments' choices for revenue recycling. It considers the case of five provinces, each with different economies, emissions profiles, and policy contexts—British Columbia, Alberta, Ontario, Quebec, and Nova Scotia. As we argued in *The Way Forward*, different provincial circumstances can justify customized approaches to carbon pricing policy, particularly in terms of revenue recycling. These five provinces highlight the diversity in provincial circumstances across Canada.

The section does not make precise policy recommendations for each province, but it does highlight key province-specific considerations. For each revenue-recycling option in each province, it considers how local context might make an option a higher or lower priority.[18]

5.1 BRITISH COLUMBIA

British Columbia has had a carbon tax since 2008. However, it also has a GHG target for 2020 that will be challenging to achieve with its current policy, especially in the context of its substantial population inflow and its emerging natural gas and liquefied natural gas (LNG) industries. The province's fiscal context is strong, with relatively low tax rates and low public indebtedness. What revenue-recycling choices might be best suited for B.C.'s current situation?

Transfers to households may be a lower priority

The biggest advantages of using direct transfers to households are the gains in fairness and public acceptance. For reasons we discuss below, these issues can likely be addressed with relatively small adjustments to existing policy mechanisms, thus making them a lower priority for revenue recycling. The province's Climate Leadership Team (2015), for example, estimates that a carbon price of $60/tonne by 2020 would require an additional $120 million annually to support vulnerable households—a small fraction of additional carbon revenues in that scenario.

B.C.'s carbon tax already enjoys wide acceptance in the province (Clean Energy Canada, 2015a). Indeed, polling described in Section 4 suggests that residents might be more inclined to support more-stringent carbon pricing if revenue was linked to support for

[18] Some interpretations of Canadian constitutional law suggest revenues generated by a cap-and-trade system must be committed to emissions-reducing activities. This remains an open question. We assume in this report that provinces have the flexibility to choose their preferred approach to revenue recycling.

emissions-reducing technology rather than additional transfers to households. And as discussed in Section 3, the one-time $100 Climate Action Dividends provided to B.C. residents in 2008 may not have helped build support for the carbon tax when first implemented.

Fairness concerns may also be quite modest in B.C. Analysis suggests that the existing carbon tax is actually progressive, given the province's low-carbon electricity generation. Further, low-income households receive an ongoing tax credit to offset carbon costs, while northern and rural homeowners receive an annual $200 benefit. These transfers more than compensate vulnerable groups for their carbon costs (Beck et al., 2015). As a result, future increases in the carbon tax will generally be less regressive than in provinces such as Alberta and Nova Scotia (Beck et al., 2015; Canada's Ecofiscal Commission, 2016). Consequently, the scale of revenue required to address concerns of household fairness will tend to be relatively small.

Further reductions in income taxes may be a lower priority

The benefits of using revenue to reduce existing income-tax rates will be smaller in B.C. than in some other provinces. B.C.'s main corporate tax rate is currently the lowest in the country, at 11% (Canada Revenue Agency, 2015). Personal income-tax rates are also relatively low (Milligan & Smart, 2015). These low rates are partly a function of the existing carbon tax, which recycles the associated revenue by reducing income taxes.

Additional reductions in tax rates would lead to reduced distortions in the economy, but the lower the existing tax rates, the smaller the benefits generated by additional rate reductions. Given that B.C.'s income-tax rates are already very competitive in Canada and North America, other approaches to revenue recycling might make more sense.

Its Climate Leadership Team (2015) recommends that revenues from increasing the provincial carbon tax be used to reduce sales taxes. While sales taxes are generally less distortionary than income taxes, they still impose economic costs and are also highly visible. Reducing the provincial sales tax could increase public support for policy while also generating broader economic gains.

Investments in emissions-reducing technology could help B.C. achieve its GHG emissions target

Of all the provinces, B.C. has the most ambitious target for GHG emissions reductions by 2020. In fact, the target is so ambitious that carbon pricing alone might be insufficient to the task, especially over such a short time frame (Canada's Ecofiscal Commission, 2015b). If achieving this target is a genuine government priority, investments in emissions-reducing technology could play a key role.

In particular, the province's emerging natural gas and LNG industries are a source of increasing GHG emissions, and likely pose the greatest challenge for achieving its emissions-reduction target. Technology investments could complement carbon pricing and help to ensure that B.C.'s gas industry meets its goal of becoming the "cleanest in the world" (Glave & Moorhouse, 2013).

Investing in critical infrastructure could be a priority for B.C.'s cities

Increased spending for the 2010 Olympics and the Pacific Gateway resulted in the completion of several major projects throughout the province—including the Canada Line, the Sea-to-Sky Highway, the Port Mann Bridge, and the Prince Rupert port expansion. As a result of increased investment, the average age of B.C.'s infrastructure declined from 16.7 years in 2002 to 14.8 years in 2012 (Infrastructure Canada, 2014).

Despite these significant investments, B.C. faces funding issues for repairing and building new infrastructure. The mayors' council in Metro Vancouver, for example, identifies a list of key infrastructure priorities totalling $7.5 billion, but is unclear as to how it can finance all of these investments (BCBC, 2014). Indeed, the failed referendum in 2015 highlights this tension between the need for new infrastructure and the willingness to pay for it. Within this context, using some of B.C.'s carbon revenues to help finance major infrastructure projects may be desirable.

The Climate Leadership Team (2015) suggests that a portion of new carbon tax revenue be used for community-level infrastructure that could enable additional emissions reductions. Examples include district heating systems, car pooling, transit, walking, and cycling infrastructure.

With a strong fiscal position, debt reduction is likely not a priority

B.C. has low net provincial debt, roughly 17% of GDP, which puts it below all other provinces except Alberta and Saskatchewan (British Columbia Ministry of Finance, 2015). Moreover, the province's current fiscal position is quite stable, with a diverse economy that insulates government revenue from swings in world commodity prices (EDC, 2015). As a result, using carbon pricing revenues for debt reduction may be a relatively low provincial priority.

Targeted, transitional support could address competitiveness pressures

Only around 2% of B.C.'s economy is vulnerable to competitiveness pressures from carbon pricing (Canada's Ecofiscal Commission, 2015a). Electricity prices are among the lowest in the country and would not substantially increase under carbon pricing, owing to the province's extensive reliance on hydroelectric power. Indeed, the low-carbon electricity resources will likely give B.C.'s businesses a competitive advantage as more jurisdictions implement carbon pricing (Sawyer, 2013).

Selected sectors will nonetheless face some competitiveness pressures from carbon pricing—including natural gas, refining, cement and lime manufacturing, and aluminum. And if the emergent LNG industry gains momentum in the province, the natural gas sector (both extraction and LNG) will also be exposed to these pressures. Some carbon pricing revenue could beneficially be used to provide targeted support to these vulnerable industries. Such support would best be provided on a transitional basis, only until equivalent carbon policies are implemented in the relevant, competing jurisdictions. The Climate Leadership Team (2015) similarly highlights the importance of targeted, transitional support for industries exposed to competitiveness pressures.

5.2 ALBERTA

Alberta is a resource-intensive province with high absolute and per capita GHG emissions. These emissions are increasing as a result of expanding oil sands production and the province's current reliance on coal-fired electricity. Alberta's public indebtedness is almost zero and it has relatively low income-tax rates, although it currently has a significant budget deficit. The scale of emissions in Alberta means that modest carbon prices have the potential to generate substantial revenues for the provincial government. What revenue-recycling options are likely to make the most sense in this context?

Transfers to households can offset relatively high carbon costs

Carbon costs for households in Alberta—prior to considering revenue recycling—will be higher than in other provinces. This is largely due to the province's emissions-intensive resource sector and its reliance on coal-fired electricity generation. Carbon pricing will increase electricity costs for all users, a burden that will fall disproportionately on low-income households. Our analysis suggests that transferring between 3% and 9% of carbon revenues to lower-income households could fully offset this burden (Canada's Ecofiscal Commission, 2016).

Income taxes are already relatively low in Alberta

Even including the increases in corporate and personal income taxes announced in 2015, Alberta has low tax rates when compared with other provinces. As a result, tax reductions could be a lower priority than other revenue-recycling alternatives. On the other hand, lowering tax rates could still lead to economic benefits (McKenzie, 2016). Lowering corporate income taxes, for example, would be one way of improving the overall business environment in Alberta. Given the combination of recent changes to royalty regimes, more-stringent carbon pricing, and a low world price of oil, reductions in corporate taxes may generate valuable economic benefits.

Investments in emissions-reducing technology could support long-term prosperity

The oil and gas sector remains a main driver of both GHG emissions and economic activity in Alberta. Even in the presence of a carbon price, however, growth in the oil and gas sector is likely to continue, at least for several years. And while the carbon price will improve emissions performance per barrel of oil produced, overall emissions will likely continue growing in the short term.

Over the longer term, however, Alberta's oil sands will almost certainly face pressure from two global forces—expanding carbon policy and the growth of renewable energy. Both factors will eventually depress the world demand for oil and gas. McGlade and Ekins (2015) and Chan et al. (2012), for example, suggest that reductions in global demand (and thus low oil prices) could have major implications for Alberta's oil sands. Though the world will continue to require petroleum products for several decades, even as it decarbonizes, Alberta's oil sands tend to be high-cost products. As a result, oil from other lower-cost jurisdictions may replace the province's oil as the world market eventually shrinks.

Yet this assessment does not incorporate the potential impact of large-scale innovation. Successful investments in innovation and emissions-reducing technology in Alberta would help improve the performance of the oil sands, by reducing both economic costs and carbon emissions. Such improved performance would help to position it as a longer-term participant in global oil markets.

Alberta may have an infrastructure deficit

Dodge (2015) argues that Alberta has insufficiently invested in public infrastructure. He shows that Alberta has less infrastructure (as a share of GDP) compared with other provinces: $1.6 billion in annual spending from 2016 to 2019 would be required to raise Alberta's stock of infrastructure to the provincial average. This infrastructure gap exists even though the province has, on average, the second-

youngest stock of public infrastructure in Canada (Infrastructure Canada, 2014). In particular, trade-related infrastructure, such as highways and bridges, the Calgary ring road, and intermodal hubs, may be a priority in Alberta (Giovannetti & Jones, 2015).

Public debt is low, but short-term budget deficits are significant

Alberta has the lowest debt-to-GDP ratio of all the provinces. As a result, using carbon pricing revenue to reduce public debt is likely a low priority, particularly in the short term.

Alberta's fiscal structure is closely tied to royalty earnings on natural resources, and the dramatic decline in the world price of oil since 2014 has helped to generate large budget deficits. If oil prices remain low for several years, continued budget deficits are likely and could lead to significant increases in public debt. Given Alberta's history of low debt, avoiding future debt could be a longer-term priority for revenue recycling.

Transitional support is important for Alberta industry

As we discussed in Section 3 and in a separate report (Canada's Ecofiscal Commission, 2015a), Alberta's economy is more vulnerable to competitiveness pressures than those of other provinces. Roughly 18% of Alberta's economy is both emissions intensive and trade exposed, compared with 5% for Canada overall. And these vulnerable industries generate approximately half of Alberta's GHG emissions. In this context, the recent proposal to provide output-based allocations to large industrial emitters makes sense (Leach et al., 2015). This approach to recycling can limit the extent to which emissions in Alberta leak to jurisdictions with weaker carbon policy.

5.3 ONTARIO

Ontario has the second-lowest per capita GHG emissions of all Canadian provinces, owing to its low-carbon electricity system and an economy in which emissions-intensive resources play only a modest role. In 2014, the province eliminated coal as a source of electricity generation. Despite its low per capita emissions, however, Ontario accounts for roughly one-quarter of the country's overall GHG emissions. Its rate of economic growth has trailed the national average over the last 15 years (Statistics Canada, 2015a), and the province has the second-highest level of public indebtedness, at 39% of GDP (RBC, 2015). By Canadian standards, Ontario has relatively low personal and corporate tax rates. Given this context, which recycling methods could make sense?

Ontario's low-carbon electricity system makes carbon pricing relatively fair

Ontario derived more than 85% of its electricity from low-carbon sources in 2014 (IESO, 2015). Although large industrial users pay some of the highest electricity prices in the country, a carbon price is likely to have a negligible impact on residential and commercial electricity rates. Concerns regarding household fairness are thus expected to be less important in Ontario than in provinces with emissions-intensive electricity systems.

Carbon pricing may nonetheless be mildly regressive in Ontario. The carbon cost for low-income households will likely be a larger fraction of their annual income than will be the case for higher-income households. Direct transfers to households, specifically low-income ones, would offset these impacts. Based on our assessment, less than 12% of Ontario's carbon pricing revenue would be required to fully offset the carbon costs on the province's lower-income households, thus making the policy clearly progressive (Canada's Ecofiscal Commission, 2016).

With low provincial tax rates, further reductions may not be a high priority

Given that Ontario's income-tax rates are already relatively competitive, further tax cuts may be a lower priority than other recycling approaches. Corporate tax rates in Ontario are among the lowest in the country, with general and manufacturing rates at 11.5% and 10%, respectively. Personal income-tax rates are also relatively low, with marginal rates ranging from 5% to 13% (excluding current surtaxes). Reductions in tax rates from current levels would lead to some reduced distortions in the economy, but the low existing rates suggest that the benefits of further rate reductions may only be modest (Canada Revenue Agency, 2015; Milligan & Smart, 2015).

Investment in clean innovation could reduce the costs of achieving Ontario's ambitious GHG emissions target

Ontario has a GHG emissions-reduction target of 37% below 1990 levels by 2030 (Government of Ontario, 2015a). This target is ambitious, and achieving it will likely require stringent policy—or significant permit purchases from California or Quebec via linked carbon markets. Investments in low-emissions technology, if successful, could ultimately reduce the cost of emissions reductions in Ontario.

However, interactions between investments in green technologies and the province's planned cap-and-trade system must be carefully considered. These investments, even if successful,

applied to sectors covered by the cap will not lead to additional emissions reductions, since the cap will continue to determine the total level of emissions. But such investments could reduce the costs of achieving any given level of emissions reductions. As a result, Ontario emitters would purchase fewer emissions permits from California or Quebec.

It is also possible—though not certain—that Ontario has the foundation for developing a comparative advantage in clean technology. It has a highly skilled labour force, leading universities, considerable manufacturing expertise, and a strong applied-research hub in Kitchener-Waterloo. In 2014, the province attracted more than half of all Canadian investment in new clean-energy generation, with significant investments in wind and solar power (Clean Energy Canada, 2015c). These investments could potentially form the nucleus of a clean-energy cluster in Ontario's economy.

Ontario has considerable infrastructure needs

Since the 1990s, the Ontario government has prioritized investments in public infrastructure (Statistics Canada, 2009). As a reflection of this investment, the average age of public infrastructure in Ontario was 13.4 years in 2012, compared with the national average of 15.2 years. Moreover, the 2015 provincial budget included $130 billion in infrastructure spending over the next decade (Government of Ontario, 2015b).

Paying for these infrastructure commitments without cutting existing services or increasing taxes will be a significant challenge (Dmitrieva & Gutscher, 2015). Carbon pricing revenues may therefore be an attractive option to help fund Ontario's future infrastructure projects.

Reducing Ontario's high public debt may be prudent

From 2010 to 2015, the Ontario government ran some of the highest provincial budget deficits in the country, averaging more than 2% of GDP each year. These budgets, incurred during a period of slow economic growth, led to a sharp increase in the province's debt-to-GDP ratio, from 28% in 2009 to 39% in 2015. Today, Ontario has the second-highest debt ratio of all the provinces (RBC, 2015). Although low provincial income-tax rates provide some potential for raising taxes in the future to pay down debt, using carbon pricing revenues to reduce its debt obligations could be a prudent long-term strategy.

Ontario's low-carbon electricity system reduces the need for targeted support

Some industries will experience competitiveness pressures from Ontario's carbon pricing policy and may require some transitional support. However, only targeted, short-term support for specific industries is required. Despite a robust manufacturing sector, only a few specific industries (e.g., steel, chemicals, petrochemicals, fertilizer, and refining) would be exposed to significant competitiveness pressures from a carbon price (Canada's Ecofiscal Commission, 2015a). These exposed industries make up less than 2% of Ontario's GDP, yet emit roughly one-quarter of the province's industrial GHG emissions. Other industries, such as vehicle and aerospace manufacturing, are highly traded, but are generally not emissions intensive. In addition, Ontario's low-carbon electricity system reduces indirect GHG emissions for industry, lessening the competitiveness pressures.

5.4 QUEBEC

Quebec has one of Canada's largest supplies of renewable energy and has the lowest per capita GHG emissions of any province (Environment Canada, 2015). The province also has a cap-and-trade system that includes revenue recycling to support emissions-reducing technologies and the provision of free permits as transitional support to industry (Clean Energy Canada, 2015b). As the policy's stringency increases over time, and the carbon price rises, new revenue will be generated. Yet the province is still far from achieving its ambitious GHG emissions-reduction target. It also has the highest public debt level in the country, some of the highest income-tax rates in Canada, and a serious problem with aging public infrastructure. Which recycling options make the most sense in Quebec?

Low-cost, clean energy reduces fairness concerns

Quebec generated 98% of its electricity from renewable sources in 2014, primarily from its vast hydropower network, which provides some of the lowest electricity rates in the country (Clean Energy Canada, 2015c; Hydro Quebec, 2014). Owing to its low-emissions grid, carbon pricing is unlikely to cause price increases for electricity users.

Yet even with a low-carbon electricity grid, carbon pricing may still have small regressive impacts on Quebec households. Road transportation, for example, is the province's biggest source of GHG emissions (Environment Canada, 2015). With an increased carbon price, consumers will have to pay more for fuel, and this will disproportionately affect lower-income households. Transferring carbon pricing revenues to low-income households could therefore help offset such price impacts.

Reducing income taxes in Quebec may be a priority

Although Quebec's corporate tax rates are close to the Canadian average, it has some of the highest personal income-tax rates in the

country (KPMG, 2015; Canada Revenue Agency, 2015). Using carbon pricing revenues to reduce personal income taxes could therefore lead to substantial economic benefits.

Carbon revenues could also be used to reduce corporate income-tax rates. Research suggests that corporate taxes are the most distortionary form of taxation, with negative effects on investment, productivity, and long-run growth (Dahlby & Ferede, 2011). Reducing corporate income taxes in Quebec would help align the provincial rates with those in Ontario, and could generate significant economic benefits, especially over the longer term.

Further clean-tech investments could help Quebec achieve its GHG emissions-reduction target

So far, revenue from permit auctions in Quebec's cap-and-trade system has been dedicated to investments in technologies and further efforts to reduce GHG emissions through the "Fonds vert." The fund has invested in a range of opportunities, including public transit, energy efficiency, and research and development (MDDELCC, 2015). Yet concerns have been raised regarding the administration and transparency of these investments (Lecavalier, 2016).

Quebec had the second-highest level of clean-tech investment in 2014, representing 36% of the Canadian total (Clean Energy Canada, 2015c). Along with Ontario, Quebec has led clean-energy investment in Canada over the past few years, with aggressive policies that promote projects and an array of consumer rebate programs (KPMG, 2013; Clean Energy Canada, 2015c)

Based on Quebec's progress in developing its clean-tech sector, using carbon revenues to finance additional investments may not initially appear to be a high priority. However, given the province's ambitious GHG emissions-reduction target of 37.5% below 1990 levels by 2030, it will need to find new areas for further emissions reductions. As of 2013, Quebec's emissions were only 8% below 1990 levels; expansions of clean technology will likely need to play an important role if this target is to be achieved.

Addressing Quebec's aging infrastructure may be a high priority

Quebec's aging public infrastructure is highly visible and has become a politically charged issue. Much of the provincial infrastructure was built between 1960 and 1980, and was chronically underfunded during the last two decades of the century. The result of this sustained underinvestment is the oldest infrastructure in the country. In 2007, Quebec was the only province in which the average age of public infrastructure was above the national average for all categories—roads, bridges, sewers, wastewater, and water supply systems (Statistics Canada, 2009). In recent years, however, infrastructure spending has increased substantially, from an annual average of $3.6 billion (from 2000 to 2008) to an annual average of $9 billion (from 2009 to 2015) (Government of Quebec, 2015).

Although infrastructure has been a higher priority in Quebec in recent years, paying for new investments will continue to be a challenge. High public debt and taxation levels constrain the government's ability to finance its ambitious infrastructure commitments, and may put pressure on cutting other government services. Carbon pricing revenues dedicated to infrastructure could help ease this pressure.

Reducing Quebec's high public debt deserves serious consideration

Quebec's debt-to-GDP ratio in 2014 was 51%, the highest debt load of any province (RBC, 2015). Such high debt levels can raise the perceived risk of insolvency and increase the province's cost of borrowing, with negative implications for investment and long-run growth. Higher debt-service costs would generate some pressure for government to increase provincial income taxes, which are already quite high. Using carbon pricing revenues to reduce public debt may therefore be a prudent fiscal policy, and one that enhances long-term growth. It could also make sense in terms of intergenerational equity; reducing indebtedness today would reduce obligations on future generations.

Low-carbon electricity will help offset most competitiveness pressures in Quebec

Owing largely to its low-carbon electricity grid, Quebec's businesses are less exposed to competitiveness pressures from carbon pricing than those in other provinces. Only 1% of Quebec's GDP is generated in sectors that are significantly exposed to competitiveness pressures, compared with 2% in Ontario and 18% in Alberta and Saskatchewan (Canada's Ecofiscal Commission, 2015a). However, despite representing only 1% of provincial GDP, these exposed sectors are responsible for 17% of the province's total GHG emissions. Quebec's current cap-and-trade system provides, on a transitional basis, free permits to these emitters to help insulate these exposed sectors from competitiveness pressures.

5.5 NOVA SCOTIA

Nova Scotia faces some significant economic challenges. It has the highest ratio of people over the age of 65, the lowest ratio of youth, and the second-oldest median age (One Nova Scotia, 2014). The province's corporate and personal tax rates are among the highest in the country, it has the third-highest public debt-to-GDP ratio, and it has one of the slowest rates of economic growth (Statistics Canada,

2015a). Nova Scotia is one of the only provinces expected to reach its GHG emissions-reduction target for 2020, but this is partly due to declining economic activity in some sectors. Given this provincial context, what approaches could Nova Scotia take to recycle carbon pricing revenue?

Household transfers could address important fairness concerns

Fairness is likely to be a significant concern for carbon pricing in Nova Scotia. Unlike provinces that derive the bulk of their electricity from low-carbon sources, ratepayers in Nova Scotia—which continues to rely largely on coal-fired electricity—are more likely to see an increase in electricity bills as a result of carbon pricing. Further, overall income levels are lower in Nova Scotia than in many other provinces. As we discuss in a separate report, carbon pricing may therefore be more regressive in Nova Scotia. Direct transfers would help offset regressive impacts from higher energy prices. Based on our research, between 3% and 13% of the province's carbon pricing revenue would be required to fully offset these costs for lower-income households (Canada's Ecofiscal Commission, 2016).

Tax cuts could be a priority to improve economic performance

Nova Scotia has the highest provincial sales tax, two of the highest marginal income-tax rates, and the highest corporate tax rates in the country (Canada Revenue Agency, 2015). Following the approach taken in British Columbia, carbon revenues could be used to help reduce corporate and personal income taxes to provide a greater economic incentive for people to live, work, and invest in the province. Using carbon revenue in this way would allow Nova Scotia to reduce existing income or sales taxes while maintaining its current level of government services. Considering the current high tax rates in the province, and current low levels of private sector investment, tax reductions would likely result in improved investment, productivity, and long-run growth.

Clean-tech investments may be most valuable in the longer term

Nova Scotia is currently projected to meet its GHG emissions-reduction target for 2020 (Environment Canada, 2015). An economy-wide price on carbon would nonetheless create powerful incentives for transitioning to an even less emissions-intensive economy. Investing in clean technology would not only help drive further emissions reductions, it could also help build a local clean-tech industry. Nova Scotia has a comparative advantage in tidal energy, in particular from the Bay of Fundy, which has an estimated 2,500 MW of safely extractable power (ICF International, 2014). Additional investments might help to bring tidal energy closer to commercialization.

Infrastructure investments may make sense, including on a regional scale

Nova Scotia had the third-oldest stock of public infrastructure in 2012, including roads, bridges, sewers, waterways, and wastewater facilities (Statistics Canada, 2009). Though increased investments in the past decade have lowered the average age of public infrastructure, the province still has major infrastructure needs. In particular, the province faces a $4-billion deficit for rehabilitating its aging network of highways and bridges (Government of Nova Scotia, 2015). Carbon revenues could help to finance some of these needed upgrades.

Owing to its small and declining population, key infrastructure gaps—such as updates to the electricity grid and trade corridors—may be better considered in a regional context. The four Atlantic provinces could benefit from coordinated infrastructure investments, rather than from more fragmented province-specific ones. Upgrades to electricity transmission capacity across the Maritimes, for example, would enhance access to hydroelectricity from Quebec or Labrador. The smaller scale of Nova Scotia's potential carbon revenue may limit the province's ability to unilaterally invest in these kinds of major infrastructure projects.

Public debt is relatively high, but reducing it is likely a lower priority

Nova Scotia's public debt-to-GDP ratio is the third-highest among all the provinces, equal to 37% in 2014, and it has been approximately stable over the past decade (RBC, 2015). While reducing public debt might provide some long-term economic benefits for Nova Scotia, including greater fairness to future generations, shorter-term economic concerns are probably a bigger priority. Other choices for recycling carbon pricing revenue are more likely to be successful in reversing the province's slow economic growth and population decline. And in the longer term, such improvements would likely have a positive impact on its fiscal situation.

Temporary and targeted industrial assistance could ease competitiveness pressures

Many goods produced in Nova Scotia—including coal, gold, cement, natural gas, and pulp and paper—are exported in competitive global markets. Any increases in electricity prices would expose firms in these emissions-intensive and trade-exposed sectors to greater competitive pressures. Note that such exposed sectors are often represented by only a small number of facilities. For example, Nova

Scotia has a single cement facility and two pulp and paper plants.

Because the economy is small, competitiveness pressures bring high stakes. Using revenues for targeted and transitional support for vulnerable industries could thus be quite practical for Nova Scotia. Over time this support could be gradually removed as carbon pricing policies are implemented in other jurisdictions.

5.6 SUMMARY

Governments deciding how to recycle their carbon pricing revenue must face difficult trade-offs; not all provincial challenges can be equally addressed with each recycling approach. Not only do provincial priorities need to be established, they need to be matched with recycling approaches best suited to the task

In summary, different economic and environmental contexts within each province will naturally influence each government's priorities regarding the recycling of carbon pricing revenue. Table 6 highlights our assessment of these priorities, based on the foregoing discussion. The table is intended to show how our framework can be applied in different provinces, but it is not meant to provide definitive recommendations. Differing provincial contexts and the trade-offs across options make provincial decision-making complex; ultimately, it is the elected politicians and their electors who must determine their provincial priorities.

Table 6: Summary of Possible Priorities for Provincial Revenue Recycling

	British Columbia	Alberta	Ontario	Quebec	Nova Scotia
Household Transfers	Moderate priority	Higher priority	Lower priority	Lower priority	Higher priority
Personal and Corporate Income-Tax Cuts	Lower priority	Lower priority	Lower priority	Higher priority	Higher priority
Investments in Low-Carbon Technology	Higher priority	Higher priority	Higher priority	Moderate priority	Moderate priority
Investments in Infrastructure	Moderate priority	Moderate priority	Moderate priority	Higher priority	Moderate priority
Reduction of Public Debt	Lower priority	Lower priority	Moderate priority	Moderate priority	Lower priority
Transitional Support to Industry	Moderate priority	Higher priority	Lower priority	Lower priority	Moderate priority

6 CONCLUSIONS AND RECOMMENDATIONS

Carbon pricing policies can generate substantial revenue for the provincial governments involved. The recycling of this revenue back to the economy can influence both economic and environmental performance. The revenue presents provincial governments with many options, but also with the need to choose among them.

This report provides Canada's provincial governments with some guidance regarding the leading options for recycling their carbon pricing revenue, the trade-offs across different recycling options, and how their specific economic context might influence their ultimate choices.

6.1 CONCLUSIONS

Four main conclusions emerge from our research.

Carbon pricing is the way forward for Canada, but it generates two clear challenges

As we argued in *The Way Forward*, carbon pricing makes economic sense for Canadian provinces. It reduces GHG emissions at the lowest possible cost, contributing to global efforts to avoid costly impacts of climate change. Carbon pricing can also help position Canada to better compete in carbon-constrained international markets by sparking low-carbon innovation. Finally, by representing a transparent and credible climate policy, and one known to be effective, carbon pricing may help to secure market access for our abundant and valuable natural resources.

At the same time, however, carbon pricing poses two clear challenges. The first is related to the fact that carbon pricing invariably leads to changes in product prices. In particular, the price of carbon-intensive energy will increase. Since it is usual that lower-income households spend a higher fraction of their income on energy-related products than do households with higher incomes, carbon pricing has the potential to be regressive. While carbon pricing is not necessarily regressive, this possibility is more likely in provinces with electricity-generation systems based on the burning of coal and other fossil fuels (Canada's Ecofiscal Commission, 2016). When designing carbon pricing policies, provincial governments must pay close attention to the different impacts on households of different incomes.

The second challenge follows from the fact that different jurisdictions are not equally far down the road of carbon pricing, and differences between carbon prices across jurisdictions can create problems. Specifically, a more aggressive carbon pricing policy in any one Canadian province can lead to competitiveness pressures for businesses in that province, especially ones that are both emissions intensive and actively competing with firms from jurisdictions with a lower carbon price (Canada's Ecofiscal Commission, 2015a). Provinces must therefore be mindful of carbon policies in other jurisdictions—including other provinces—when designing their own carbon pricing policies. And governments must begin to consider how to coordinate provincial policies into a coherent pan-Canadian system.

Revenue recycling can address fairness and competitiveness challenges

Yet these two challenges need not be obstacles to designing and implementing carbon pricing policies. In particular, well-designed policy—which includes the careful recycling of revenue—can effectively address both challenges.

Providing low-income households with direct transfers—as British Columbia does through rebates delivered in parallel with GST rebates, for example—can address fairness concerns while still providing low-income households with an incentive to reduce emissions. Indeed, analysis of B.C.'s carbon tax suggests that when the tax and associated revenue recycling (including tax cuts and transfers to households) are considered together, the policy is actually progressive, meaning that low-income households face a smaller proportionate burden than higher-income households (Beck et al., 2015).

Similarly, for those industries most exposed to competitiveness pressures, the provision of well-designed transitional support can combine incentives to reduce GHG emissions with incentives to maintain economic activity in the home province. Specifically, support that is linked to firms' current level of economic activity can offset any incentives to move facilities to other jurisdictions with lower carbon prices, without undermining incentives for reducing emissions. In this way, carbon pricing within any one province need not lead to the leakage of economic activity and corresponding emissions.

Revenue recycling can also support economic and environmental objectives

Some approaches to revenue recycling can generate significant economic benefits. Reducing existing income taxes, for example, can improve how efficiently the economy uses labour and capital, and this can lead to greater productivity and stronger economic growth. Well-chosen investments in public infrastructure can also improve productivity, again driving growth and prosperity. For provinces with high levels of public indebtedness, using revenue to reduce public debt could lead to long-term economic benefits, partly by avoiding the need for future increases in growth-retarding income taxes.

Other approaches to revenue recycling can lead to reductions in GHG emissions, beyond those generated by the carbon price. Such reductions could be achieved by using carbon revenue to invest in the development of new technologies and production processes; or the funds could be invested to improve the adoption of superior technologies. These approaches can complement an existing carbon price by targeting specific barriers and easing firms' adjustment to the carbon price.

Provinces can customize revenue recycling to achieve their own distinct priorities

Priorities are different across provinces. And that suggests that the best approach for revenue recycling will not be the same for each province. Some provinces are more exposed to competitiveness pressures created by carbon pricing (e.g., Alberta and Saskatchewan). Fairness concerns are heightened in provinces with carbon-intensive electricity systems (e.g., Alberta and Nova Scotia). Some provinces have much higher provincial debt (e.g., Ontario and Quebec), while others face more immediate fiscal challenges (e.g., Alberta). Still others have economic challenges associated with high income-tax rates (e.g., Quebec and Nova Scotia). Additional investments in emissions-reducing technology can make it possible to achieve ambitious targets (e.g., British Columbia and Ontario); technology investments could also be justified to improve the long-term performance of emissions-intensive sectors (e.g., Alberta and B.C.).

6.2 RECOMMENDATIONS

How should provinces manage these trade-offs? In this report, we do not provide detailed, prescriptive recommendations to provinces: each province is best situated to make its own choices about revenue recycling. Instead, we provide broader guidance on the factors that policy makers should examine when considering trade-offs and making recycling choices. Our recommendations are as follows:

RECOMMENDATION #1: Governments should use revenue recycling to address fairness and competitiveness concerns around carbon pricing.

Carbon pricing is the economically sensible way forward for Canadian provinces. Challenges associated with pricing carbon—disproportionate costs for low-income households and competitiveness pressures for vulnerable industries—should not preclude implementing carbon pricing policies. These issues can be effectively addressed through well-designed revenue recycling. Our earlier recommendations therefore still hold: provinces without broad carbon pricing should implement it; provinces with existing policies should gradually increase the carbon price.

RECOMMENDATION #2:
Governments should clearly define their objectives for revenue recycling.

Achieving multiple objectives usually requires multiple policy instruments. Pricing carbon has the primary objective of reducing GHG emissions, but the associated revenue can be recycled to achieve additional objectives. Different provinces will have different objectives, depending on their unique provincial context and priorities.

Given that only a finite level of revenue will be available for each province, not all objectives can be achieved through the recycling of carbon pricing revenue. Governments must always confront the reality of scarcity; the need to make difficult choices is the nature of their business. Identifying the government's priorities is a crucial first step in defining appropriate province-specific approaches to revenue recycling.

Not only are there multiple objectives, there are multiple approaches to revenue recycling. Yet no single revenue-recycling approach is a clear winner across all dimensions and for all provinces. Optimal revenue recycling within any province will depend on the relative weights placed on the different objectives, and these weights will naturally depend on the provincial context.

RECOMMENDATION #3:
Governments should use a portfolio of approaches to revenue recycling.

Genuine trade-offs exist across the different approaches to revenue recycling. No single approach examined here can improve household fairness, address business competitiveness, and improve broad economic and environmental performance as well. Some methods of recycling are good for economic growth but have little effect on GHG emissions; other approaches are good for addressing household fairness but do not help to protect business competitiveness. Still others successfully address the competitiveness issue but weaken the reductions in GHG emissions. Multiple priorities can justify multiple approaches to revenue recycling.

At the same time, achieving more along one dimension invariably means achieving less along another. Further, the scale of revenue recycling matters, particularly for some approaches. Significant benefits from infrastructure or clean-technology investments, for example, are only likely to be realized through larger investments. Using only a small percentage of carbon revenue to reduce taxes could lead to imperceptible changes in tax rates. As a result, prioritization is critical. Governments cannot expect to achieve all objectives using carbon revenue.

Possible Revenue-Recycling Priorities for Five Canadian Provinces

	British Columbia	Alberta	Ontario	Quebec	Nova Scotia
Household Transfers	Moderate priority	Higher priority	Lower priority	Lower priority	Higher priority
Personal and Corporate Income-Tax Cuts	Lower priority	Lower priority	Lower priority	Higher priority	Higher priority
Investments in Low-Carbon Technology	Higher priority	Higher priority	Higher priority	Moderate priority	Moderate priority
Investments in Infrastructure	Moderate priority	Moderate priority	Moderate priority	Higher priority	Moderate priority
Reduction of Public Debt	Lower priority	Lower priority	Moderate priority	Moderate priority	Lower priority
Transitional Support to Industry	Moderate priority	Higher priority	Lower priority	Lower priority	Moderate priority

Provincial priorities will naturally vary. Choosing priorities is the task of governments, and beyond the mandate of the Ecofiscal Commission. However, our analysis of the various recycling options, when combined with the various provincial contexts, allows us to identify the possible higher, moderate, and lower priorities for each of five Canadian provinces. These assessments are shown in the table on the preceding page.

RECOMMENDATION #4: Revenue-recycling priorities should be adjusted over time.

Provincial priorities generally change over time, and revenue-recycling approaches should similarly evolve. Some changes in circumstances will be predictable, while others will be unexpected. Like other fiscal decisions, revenue-recycling choices can and should be revisited periodically.

Competitiveness pressures, for example, will predictably change over time. In the long term, other jurisdictions will begin to implement comparable carbon policies to achieve their own international obligations. As a result, comparable carbon prices will lead to a level playing field in international markets, thus reducing the need for provinces to provide transitional support to industries.

In the longer term, total revenue from carbon pricing will eventually begin to decline. As emitters respond to the price by finding ways to reduce their GHG emissions, the revenue base for the carbon pricing policy will decline (whereas in the short term, the price of carbon will likely rise by a greater proportion than the decline in total emissions). Revenue-recycling decisions must account for this long-term change in total carbon revenues.

In selecting their approach to revenue recycling, provincial governments should consider carefully the trade-offs of each available option. This report provides a framework with which to do so. We all stand to benefit when our provincial governments choose wisely.

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